

That Which is Claimed is:

1. A base station antenna, comprising:
a passive antenna assembly comprising a housing and a first reflector, wherein the housing comprises a rear wall; and
a separate active antenna module comprising a second reflector coupleable to or coupled to the housing of the passive antenna assembly, wherein, in position, the second reflector resides adjacent or inside the rear wall of the housing.
2. The base station antenna of Claim 1, wherein the housing comprises a front that defines an external radome with an internal chamber between the front and the rear wall, wherein the rear wall comprises or defines a recess, and wherein the second reflector resides adjacent the first reflector inside the recess.
3. The base station antenna of Claim 1, wherein the first reflector comprises an aperture, and wherein at least a portion of the second reflector is positioned in the aperture of the first reflector.
4. The base station antenna of Claim 3, wherein the first reflector has a longitudinal and lateral extent and defines a reflector wall with wall segments that at least partially surrounds the aperture thereof.
5. The base station antenna of Claim 4, wherein the wall segments of the reflector wall of the first reflector entirely surround the aperture.
6. The base station antenna of Claim 1, wherein the first reflector is capacitively coupled to the second reflector.
7. The base station antenna of Claim 1, wherein at least one of the first reflector or the second reflector is provided by a frequency selective surface and/or substrate that is configured to allow RF energy to pass through at one or more defined frequency range and that is configured to reflect RF energy at a different frequency band.
8. The base station antenna of Claim 7, wherein the first reflector comprises

the frequency selective surface and/or substrate and is configured to reflect RF energy at a low band and pass RF energy at a higher band.

9. The base station antenna of Claim 7, wherein the frequency selective surface and/or substrate resides in the housing behind low band dipole radiating antenna elements.

10. The base station antenna of Claim 7, further comprising low band dipole antenna with feed stalks, wherein the feed stalks project forward of the frequency selective substrate.

11. The base station antenna of Claim 7, further comprising a third reflector that is an extension of the first reflector or that is coupled to the first reflector, wherein the third reflector extends in a longitudinal direction and has a lateral extent, wherein the third reflector resides in the housing and extends longitudinally a distance greater than the first reflector.

12. The base station antenna of Claim 11, wherein the frequency selective surface and/or substrate is co-planar with the third reflector.

13. The base station antenna of Claim 11, wherein the frequency selective surface and/or substrate is parallel to the third reflector and resides closer to an external, front radome of the housing than the third reflector.

14. The base station antenna of Claim 1, wherein the first reflector has a longitudinal and lateral extent, wherein the second reflector has a longitudinal and lateral extent, and wherein the longitudinal extent of the second reflector is less than the longitudinal extent of the first reflector.

15. The base station antenna of Claim 3, wherein the aperture of the first reflector and the recess provided by or in the rear wall of the housing are aligned and each has a rectangular perimeter.

16. The base station antenna of Claim 1, wherein the aperture of the first

reflector is bordered on a sub-set of its sides by wall segments of the first reflector.

17. The base station antenna of Claim 1, wherein the aperture of the first reflector is bordered on all sides by wall segments of the first reflector.

18. The base station antenna of Claim 3, further comprising an intermediate radome extending over the aperture of the first reflector.

19. The base station antenna of Claim 1, wherein the active antenna module comprises a radome coupled thereto, and wherein the radome of the active antenna module resides inside a recess provided by or in a rear wall of the housing, facing a front of the housing.

20. The base station antenna of Claim 1, wherein the antenna housing comprises a front surface defining an external radome, wherein the base station antenna comprises an internal radome residing inside the housing adjacent the rear wall of the housing, facing the external radome, and an intermediate radome behind the internal radome sealably coupled to the housing.

21. The base station antenna of Claim 1, further comprising first and second rails that extend in a longitudinal direction inside the housing, wherein the active antenna module is releasably coupled to the first and second rails.

22. The base station antenna of Claim 21, wherein the first and second rails are first and second internal rails, the base station antenna further comprising first and second external rails that extend longitudinally and that are coupled to corresponding first and second internal rails, and wherein the active antenna module comprises an adapter member, and wherein the external adapter member is attached to the first and second external rails.

23. The base station antenna of Claim 22, wherein the first and second external rails are configured to couple to different configurations of the adapter member whereby different configurations and/or sizes of adapter members and/or active antenna modules are interchangeably, serially attachable to the first and second rails.

24. The base station antenna of Claim 1, wherein the active antenna module comprises a first sub-module comprising radio circuitry and a second sub-module comprising a massive MIMO antenna element array, and wherein the first and second sub-modules are stackable and attached to each other.

25. The base station antenna of Claim 1, wherein the active antenna module comprises an integrated module of radio circuitry and a massive MIMO antenna element array residing in front of the second reflector.

26. The base station antenna of Claim 1, wherein the passive antenna assembly comprises feed boards on right and left sides of the base station antenna that are perpendicular to the second reflector of the active antenna module.

27. The base station antenna of Claim 1, further comprising first and second rails that extend in a longitudinal direction, wherein the first and second rail frames each provide a flat rail surface with a stop block coupled thereto at a location corresponding to a lower portion of the recess in the housing, wherein the active antenna module comprises an external adapter member with a lower edge portion that releasably engages the stop block.

28. A base station antenna, comprising:
a base station antenna housing comprising a top, a bottom, a front, a rear and right and left side walls extending between the top and the bottom and joining the front and rear, wherein the rear comprises a recessed segment that extends longitudinally and laterally across the rear of the base station housing;
a passive antenna assembly in the base station antenna housing; and
an active antenna module that includes radio circuitry and a plurality of radiating elements that resides over the recessed segment of the rear of the base station antenna housing.

29. The base station antenna of Claim 28, wherein the front and the right and left side walls comprise at least part of a radome, and wherein the active antenna module is sealably coupled to the rear of the base station antenna housing.

30. The base station antenna of Claim 28, further comprising a back plate in the base station antenna housing with an open aperture, wherein the open aperture extends longitudinally and laterally across the rear of the base station antenna housing, and wherein the active antenna module covers the open aperture of the back plate.

31. The base station antenna of Claim 28, wherein the active antenna module and/or a back plate and/or first and second longitudinally extending rails in the base station antenna housing comprise a seal configured to sealably couple the active antenna module to the base station antenna housing.

32. The base station antenna of Claim 28, wherein the right and left side walls have a first height along the recessed segment, wherein the right and left side walls have a second height that is greater than the first height at a second segment longitudinally spaced apart from the recessed segment, and wherein a difference between the first and second heights is in a range of about 0.25 inches and about 6 inches.

33. The base station antenna of Claim 28, wherein the recessed segment extends a length that is in a range of about 20%-60% of a length of the rear of the base station antenna housing and extends in a width direction, perpendicular to the length direction, that is in a range of about 30-110% of a width of the rear of the base station antenna housing.

34. The base station antenna of Claim 29, further comprising a seal cap sealably coupled to the left and right side walls and the rear of the base station antenna housing.

35. The base station antenna of Claim 28, further comprising a reflector in the base station antenna housing, wherein at least a portion of the reflector resides forwardly of a back plate in the base station antenna housing.

36. The base station antenna of Claim 35, wherein the reflector comprises an open aperture that, with the base station antenna in operative position, resides forward of the open aperture of the back plate.

37. The base station antenna of Claim 28, wherein the recessed segment resides adjacent the top of the base station antenna housing and terminates above a medial segment of the rear of the base station antenna housing.

38. The base station antenna of Claim 29, wherein the back plate is rectangular and has a rectangular perimeter that surrounds the open aperture and that is sealably coupled to the active antenna module.

39. The base station antenna of Claim 28, further comprising first and second rails that are laterally spaced and that longitudinally extend inside the base station antenna, wherein the first and second rails are coupled to the base station antenna housing,

optionally the base station antenna further comprises first and second cross-members coupled to the first and second rails that together surround a window configured to receive the active antenna module.

40. The base station antenna of Claim 39, wherein the first and second rails are sealably coupled to the active antenna module.

41. The base station antenna of Claim 39, wherein the first and second rails are coupled to a reflector in the base station antenna housing, optionally wherein the reflector is positioned a distance in a range of about 0.5 inches to about 4 inches from a back plate in a front to back direction between the front and rear of the base station antenna housing, and/or optionally wherein the passive antenna assembly comprises feed boards on right and left sides of the base station antenna that are perpendicular to the reflector of the active antenna module.

42. A base station antenna, comprising:
a base station antenna housing comprising a top, a bottom, a front, a rear and right and left sides joining the front and rear, wherein the rear comprises a longitudinally and laterally extending recessed segment;
a passive antenna assembly in the base station antenna housing; and
an active antenna module sealably coupled to the rear of the base station housing over the recessed segment.

43. The base station antenna of Claim 42, wherein the active antenna module comprises radio circuitry and a plurality of radiating elements.
44. The base station antenna of Claim 42, further comprising a back plate with an open aperture, wherein the open aperture extends longitudinally and laterally over the open chamber.
45. The base station antenna of Claim 44, wherein the active antenna module and/or the back plate comprises a seal extending about a perimeter portion thereof.
46. The base station antenna of Claim 42, wherein the right and left side walls have a first height along the recessed segment of the rear, wherein the right and left side walls have a second height that is greater than the first height at a second segment of the rear that is longitudinally spaced apart from the recessed segment, and wherein a difference between the first and second heights is in a range of about 0.25 inches and about 6 inches.
47. The base station antenna of Claim 46, wherein the recessed segment extends a length that is in a range of about 20%-60% of a length of the rear of the base station antenna housing and extends in a width direction, perpendicular to the length direction, that is in a range of about 30-110% of a width of the rear of the base station antenna housing.
48. The base station antenna of Claim 42, further comprising a seal cap sealably coupled to the left and right side walls and the rear of the base station antenna housing.
49. The base station antenna of Claim 44, further comprising a reflector in the base station antenna housing, wherein at least a portion of the reflector resides forwardly of the back plate.
50. The base station antenna of Claim 42, wherein the recessed segment resides adjacent the top of the base station antenna housing and terminates above a medial segment of the rear of the base station antenna housing.

51. The base station antenna of Claim 44, wherein the back plate is rectangular and has a rectangular perimeter that surrounds the open aperture and is sealably coupled to the active antenna module.

52. The base station antenna of Claim 42, further comprising first and second rails that are laterally spaced and that longitudinally extend inside the base station antenna, wherein the first and second rails are coupled to the base station antenna housing and/or are sealably coupled to the active antenna module.

53. The base station antenna of Claim 42, further comprising:
first and second rails that are laterally spaced and that longitudinally extend inside the base station antenna; and
first and second cross members that attach to the first and second rails,
wherein the first and second cross members and the first and second rails cooperate to form a window that receives an inner facing portion of the active antenna module, optionally wherein the first and second rails and the first and second cross members are sealably coupled to the active antenna module.

54. The base station antenna of Claim 53, wherein the first and second rails are coupled to a reflector via respective U-shaped connectors, wherein the reflector is positioned a distance in a range of about 0.5 to about 4 inches from a back plate in a front to back direction between the front and rear of the base station antenna housing, and wherein the back plate is sealably coupled to the active antenna module.

55. An active antenna module comprising:
a remote radio unit;
an integrated filter and calibration board assembly coupled to the remote radio unit;
an antenna assembly coupled to the remote radio unit; and
a radome coupled to the antenna assembly with the antenna assembly sandwiched between the radome and the integrated filter and calibration board assembly.

56. The active antenna module of Claim 55, wherein the radome is a first radome, the active antenna module further comprising a second radome that is coupled to and extends across and along at least part of the first radome.

57. A method of assembling a base station antenna, comprising:
mounting a base station antenna housing to a mounting structure;
aligning an active antenna module with a recessed rear segment and/or open chamber along a rear of the base station antenna housing before or after mounting the base station antenna housing; then
attaching the active antenna module against the base station antenna housing to couple the active antenna module to the base station antenna housing.

58. A base station antenna, comprising:
a base station antenna housing comprising a top, a bottom, a front, a rear and right and left sides joining the front and rear;
a passive antenna assembly in the base station antenna housing; and
an active antenna module slidably mountable to the base station antenna housing through the top of the base station antenna housing.

59. The base station antenna of Claim 58, wherein, in position, the active antenna module is sealably coupled to a top portion of the rear of the base station housing.

60. The base station antenna housing of Claim 58, wherein, in position, the active antenna module resides over and closes an open chamber or resides in a recessed segment provided by the base station antenna housing.

61. The base station antenna of Claim 60, wherein the active antenna module comprises a radome that resides in the open chamber or the recessed segment and that faces an external radome of the front of the base station antenna housing.

62. The base station antenna of Claim 58, wherein the rear of the base station antenna housing comprises a longitudinally and laterally extending recessed segment or open chamber that receives a radome of the active antenna module.

63. The base station antenna of Claim 58, wherein the active antenna module comprises an inwardly projecting top member that extends inwardly further than the radome of the active antenna module.

64. The base station antenna of Claim 58, wherein the active antenna module comprises rail couplers that slidably couple to rails of the base station antenna housing.

65. The base station antenna of Claim 58, wherein the base station antenna housing comprises outwardly projecting side members that extend for a sub-length of the base station antenna housing at a top portion of the base station antenna housing and that couple to mounting hardware configured to mount the base station antenna to a mounting structure.

66. The base station antenna of Claim 65, wherein the active antenna module is coupled to the base station antenna housing and is devoid of mounting hardware that mounts to the mounting structure.

67. The base station antenna housing of Claim 58, wherein the active antenna module comprises mounting hardware on a rear surface thereof that is configured to attach to a mounting structure.

68. A base station antenna, comprising:
at least one radome comprising segments thereof interposed between first and second capacitively coupled reflectors.

69. The base station antenna of Claim 68, wherein the at least one radome comprises first and second radomes with segments thereof positioned between coupling surfaces of the first and second reflectors, optionally wherein one or both of the first and second reflectors comprise a frequency selective surface and/or substrate.

70. A base station antenna comprising:
a base station antenna housing comprising a fixed reflector; and
a removable reflector that is configured to couple with the fixed reflector to thereby provide a common electrical ground.

71. The base station antenna of Claim 70, wherein the fixed reflector comprises a frequency selective surface and/or substrate aligned with the removable reflector, optionally wherein the removable reflector is capacitively coupled to the fixed reflector.

72. The base station antenna of Claim 70, wherein the removable reflector is provided in an active antenna module that is removably attached to the base station antenna housing.

73. A base station antenna that extends along a longitudinal direction comprising:
a plurality of columns of first radiating elements configured for operating in a first operational frequency band, each column of first radiating elements comprising a plurality of first radiating elements arranged in the longitudinal direction; and
a reflector positioned behind the plurality of columns of first radiating elements and extending in the longitudinal direction, wherein the reflector comprises a frequency selective surface(s) configured such that electromagnetic waves within the first operational frequency band are substantially blocked by the reflector.

74. The base station antenna of Claim 73, wherein the frequency selective surface is configured to reflect the electromagnetic waves within the first operational frequency band.

75. The base station antenna of Claim 73, further comprising a plurality of columns of second radiating elements configured for operating in a second operational frequency band that is different from and does not overlap with the first operational frequency band, each column of second radiating elements comprising a plurality of second radiating elements arranged in the longitudinal direction, wherein the frequency selective surface is further configured such that electromagnetic waves within the second operational frequency band can propagate through the reflector.

76. The base station antenna of Claim 75, wherein the second operational frequency band is higher than the first operational frequency band.

77. The base station antenna of Claim 73, wherein the reflector provides the frequency selective surface on a printed circuit board.

78. The base station antenna of Claim 73, wherein the reflector comprises a dielectric board having opposite first and second sides, the first and second sides facing respective columns of the first radiating elements, each formed with a periodic conductive structure, the periodic conductive structures forming the frequency selective surface.

79. The base station antenna of Claim 78, wherein the periodic conductive structure on the first side of the dielectric board comprises a first array structure and the periodic conductive structure on the second side of the dielectric board comprises a second array structure that has a different pattern than the first array structure.

80. The base station antenna of Claim 73, wherein the frequency selective surface comprises a periodic conductive structure a repeating pattern of polygonal shapes of metal elements.

81. The base station antenna of Claim 77, wherein the periodic conductive structures on the first and second sides of the dielectric board are formed of metal.

82. The base station antenna of Claim 73, wherein the frequency selective surface of the reflector is provided by a multi-layer printed circuit board.

83. The base station antenna of Claim 73, wherein the reflector is implemented as a multi-layer printed circuit board, one or more layers of which formed with a frequency selective surface configured such that electromagnetic waves within a predetermined frequency range can propagate through the reflector, and wherein a combination of predetermined frequency ranges associated with the one or more layers of the multi-layer printed circuit board reflects electromagnetic waves in the first operational frequency band.

84. The base station antenna of Claim 73, wherein the reflector is a first reflector that is provided by a passive antenna housing, wherein the first radiating elements are low band radiating elements, and wherein the base station antenna further comprises a second reflector that resides behind the first reflector.

85. The base station antenna of Claim 84, further comprising at least one radome that resides between the first and second reflectors.

86. The base station antenna of Claim 85, wherein the at least one radome that resides between the first and second reflectors includes first and second radomes stacked and spaced apart in a front to back direction behind a front surface of a housing of the base station antenna, and wherein the front surface of the housing defines an external radome.

87. The base station antenna of Claim 83, wherein the second reflector is provided by an active antenna module that detachably couples to the base station antenna.

88. The base station antenna of Claim 84, wherein the second reflector resides behind a plurality of columns of second radiating elements, each column of second radiating elements comprising a plurality of second radiating elements arranged in the longitudinal direction that operate in a second operational frequency band that is higher than the first operational frequency band, and wherein electromagnetic waves within the second operational frequency band pass through the first reflector.

89. The base station antenna of Claim 73, wherein the reflector has a vertically extending primary surface and resides between an internal radome and an external radome defined by a front of the base station antenna.

90. The base station antenna of Claim 73, further comprising feed boards on right and left sides of the base station antenna that are perpendicular to a primary surface of the reflector.

91. The base station antenna of Claim 89, wherein the reflector is attached to the internal radome.

92. The base station antenna of Claim 91, wherein the reflector is provided by a flexible substrate.

93. A base station antenna comprising:
a first reflector; and
a second reflector, wherein the first and second reflectors are capacitively coupled with at least one radome therebetween.

94. The base station antenna of Claim 93, wherein the at least one radome defines a dielectric.

95. The base station antenna of Claim 93, wherein the at least one radome has a forwardmost surface that merges into side portions that extend rearwardly, wherein the side portions comprise laterally extending outer edge portions, and wherein the laterally extending outer edge portions reside between the first and second reflectors.

96. The base station antenna of Claim 93, wherein the second reflector has a forward primary surface that is forward of a primary surface of the first reflector.

97. The base station antenna of Claim 93, wherein the at least one radome comprises a radome provided by a detachable active antenna module that comprises the second reflector.

98. The base station antenna of Claim 93, wherein the first reflector is a passive antenna assembly reflector, and wherein a plurality of linear arrays of radiating antenna elements reside forward of the second reflector.

99. The base station antenna of Claim 93, further comprising at least one feed board that is orthogonal to a primary surface of the first and/or second reflector and positioned adjacent a right and/or left side of the base station antenna.

100. The base station antenna of Claim 99, further comprising at least one radiating element that is coupled to the at least one feed board, wherein the at least one radiating element extends forward of the first and/or second reflector.

101. A base station antenna comprising:
a reflector having an opening extending longitudinally and laterally between spaced apart left and right side portions of the reflector; and
a removable reflector portion having a length and width that are +/- 20 % of a length and width of the opening and extends across and along the opening.

102. The base station antenna of Claim 101, wherein the reflector and/or the removable reflector portion comprises a frequency selective surface.

103. The base station antenna of Claim 101, further comprising a pair of longitudinally extending rails, wherein the removable reflector portion is coupled to the rails.

104. The base station antenna of Claim 101, wherein the right and left side portions have a width that is less than 50% of the width of the opening in a width direction of the base station antenna.

105. The base station antenna of Claim 101, wherein at least one row of radiating antenna elements extends along the right side portion and/or the left side portion of the reflector.

106. The base station antenna of Claim 105, wherein one or more radiating elements of the at least one row of radiating elements extends laterally across at least a portion of the right or left side of the reflector and an adjacent portion of the removable reflector.

107. A base station antenna comprising:
a first housing member defining a front half of a housing of the base station antenna; and
a second housing member defining a back half of the housing of the base station antenna,
wherein the first and second housing members extend laterally and longitudinally and are sealed together.

108. The base station antenna of Claim 107, wherein the first housing member comprises a front surface that merges into right and left side portions that extend rearward,
wherein the second housing member comprises a rear surface that merges into right and left side portions that extend forward, and wherein the right and left side portions of the first housing member are coupled to the right and left side portions of the second housing member along a joint interface that extends longitudinally a length of the housing.

109. The base station antenna of Claim 107, wherein the second housing member provides at least one laterally and longitudinally extending recess adjacent a lower or upper

end of the housing, wherein the recess extends along a sub-length of the housing, and wherein the recess has a lateral extent that is 60-99% of a lateral extent of the housing.

110. The base station antenna of Claim 109, wherein the second housing member comprises at least one external stepped region that rises above the recess and extends laterally and longitudinally about another sub-length of the housing.

111. The base station antenna of Claim 107, further comprising a support member that resides between the first and second housing members about a top and/or bottom end portion of the housing.

112. The base station antenna of Claim 111, wherein the support member has a front that faces the first housing member and a back that an inner surface of the second housing member, wherein the back has a laterally extending medial segment that is recessed relative to right and left sides of the support member, and wherein the right and left sides of the support member extend between the right and left sides of the first and second housing members.

113. A base station antenna comprising:
a housing;
at least one internal rail coupled to the housing that extends longitudinally and has a first length; and
at least one external rail that extends longitudinally and that has a second length that is optionally less than the first length, wherein one or more of the at least one internal rail is coupled to one or more of the at least one external rail.

114. The base station antenna of Claim 113, wherein the at least one internal rail comprises a right side internal rail and a left side internal rail that are laterally spaced apart, wherein the at least one external rail comprises a right side second external rail and a left side external rail that are laterally spaced apart across a recessed portion of a rear of the housing.

115. The base station antenna of Claim 113, wherein a first one of the at least one internal rail is sealably attached to a first one of the at least one external rail to thereby inhibit water flow into the housing.

116. The base station antenna of Claim 113, further comprising a bolt that extends through a first one of the at least one internal rail, a rear wall of the housing and a first one of the at least one external rail.

117. The base station antenna of Claim 116, further comprising a spacer with a first portion comprising a bolt hole surrounded by a second portion of a different material, wherein the first portion of the spacer resides in a hole in a rear wall of the housing that has an opening with a shape that corresponds to the first portion of the spacer, and wherein the bolt extends through the external rail, through the bolt hole of the spacer and into the internal rail.

118. The base station antenna of Claim 117, wherein the first portion of the spacer has increased rigidity relative to the second portion, and wherein the second portion comprises a resilient, compressible seal material.

119. The base station antenna of Claim 117, wherein the spacer has an elongate shape such that it has a length that is greater than a width thereof.

120. The base station antenna of Claim 117, wherein the second portion resides against an outer surface of the rear wall of the housing, abutting an inner facing wall of the external rail, while the first portion of the spacer resides in the hole in the rear wall of the housing.

121. The base station antenna of Claim 116, wherein the external rail comprises a groove surrounding a bolt channel and a resilient seal member in the groove, and wherein the bolt extends through the bolt channel with a head of the bolt and/or a collar extending forward of the head of the bolt configured to compress the resilient seal member thereby sealing the external rail against the rear wall of the housing.

122. The base station antenna of Claim 116, wherein the bolt comprises a resilient member extending in front of a bolt head, wherein the resilient member resides against a surface of the external rail about a bolt opening in the external rail.