a second portion of the user coverage area does not overlap with the AN coverage area.

53. The method of claim 52, wherein the AN coverage area is a subset of the user coverage area, and the AN coverage area is less than one fifth the user cover area in physical area.

54. The method of any of claims 32 – 53, wherein the transmitting comprises:

first transmitting a first plurality of forward downlink signals by a first plurality of user-link constituent transmit feeds elements to a first plurality of user terminals geographically distributed over a first user coverage area (3460a); and

second transmitting a second plurality of forward downlink signals by a second plurality of user-link constituent transmit feeds elements to a second plurality of user terminals geographically distributed over a second user coverage area (3460b).

55. The method of claim 54, wherein the first transmitting and the second transmitting are performed at different times.

56. The method of claim 54 or 55, wherein:

the first transmitting comprises illuminating the first user coverage area with a first plurality of user beams; and

the second transmitting comprises illuminating the second user coverage area with a second plurality of user beams,

such that, during a first time, the first plurality of user beams is active, and the second plurality of user beams is inactive, and

such that, during a second time, the second plurality of user beams is active, and the first plurality of user beams is inactive.

57. The method of any of claims 54 – 56, wherein a first portion of the first user coverage area overlaps the second user coverage area, and a second portion of the first user coverage area does not overlap the second user coverage area.

58. The method of claim 57, wherein the second user coverage area is a subset of the first user coverage area.

59. The method of any of claim 54 – 56, wherein the first user coverage area is non-overlapping with the second user coverage area.

60. A satellite (503, 1202, 1502, 3403) comprising:

a plurality of receive antenna elements (406, 3416, 3426) each having a receive component beam antenna pattern, such that at least one of the receive component beam antenna patterns overlaps with at least one other of the receive component beam antenna patterns, the receive antenna elements operable at a same receive frequency and a same receive polarization;

a plurality of transmit antenna elements (409, 3419, 3429), each having a transmit component beam antenna pattern, such that at least one of the transmit component beam antenna patterns overlaps with at least one other of the transmit component beam antenna patterns, the transmit antenna elements operable at a same transmit frequency and a same transmit polarization; and

a plurality of transponders (410, 3430, 3440), each having an input coupled to an associated receive antenna element, and each having an output coupled to an associated transmit antenna element, such that there is a one-to-one relationship between each transponder, the associated receive antenna element, and the associated transmit antenna element.

61. The satellite of claim 60, wherein each of at least 25% of the component beam antenna patterns overlaps with at least five other of the receive component beam antenna patterns.

62. The satellite of claim 60 or 61, wherein each of the at least 25% of the transmit component beam antenna patterns overlap with at least five other of the transmit component beam antenna patterns.

63. The satellite of any of claims 60 – 62, having an uplink satellite coverage area defined by a set of points, the receive component beam antenna pattern of each receive antenna element establishing a corresponding receive antenna element coverage area, wherein at least 25% of the set of points of the uplink satellite coverage area span at least four of the receive antenna element coverage areas.

64. The satellite of claim 63, wherein at least 25% of the points of the uplink satellite coverage area span at least six of the receive antenna element coverage areas.

65. The satellite of any of claims 60 – 64, wherein each receive antenna element coverage area is defined by a set of points for which receive component beam antenna gain is within 10 dB of a peak receive component beam antenna gain for the receive antenna element associated with the receive antenna element coverage area.

66. The satellite of any of claims 60 – 64, wherein each receive antenna element coverage area is defined by a set of points for which receive component beam antenna gain is within 6 dB of a peak receive component beam antenna gain for the receive antenna element associated with the receive antenna element coverage area.

67. The satellite of any of claims 60 – 64, wherein each receive antenna element coverage area is defined by a set of points for which receive component beam antenna gain is within 3 dB of a peak receive component beam antenna gain for the receive antenna element associated with the receive antenna element coverage area.

68. The satellite of any of claims 60 – 67, having a downlink satellite coverage area defined by a set of points, the transmit component beam antenna pattern of each transmit antenna element establishing a corresponding transmit antenna element coverage area for the transmit antenna element, wherein at least 25% of the set of points of the downlink satellite coverage area span at least four of the transmit antenna element coverage areas.

69. The satellite of claim 68, wherein at least 25% of the set of points of the downlink satellite coverage area span at least six of the transmit antenna element coverage areas.

70. The satellite of claim 68 or 69, wherein each transmit antenna element coverage area is defined by a set of points for which the transmit component beam antenna gain is within 10 dB of a peak transmit component beam antenna gain for the transmit antenna element associated with the transmit antenna element coverage area.

71. The satellite of claim 68 or 69, wherein each transmit antenna element coverage area is defined by a set of points for which the transmit component beam antenna gain is within 6 dB of a peak transmit component beam antenna gain for the transmit antenna element associated with the transmit antenna element coverage area.

72. The satellite of claim 68 or 69, wherein each transmit antenna element coverage area is defined by a set of points for which the transmit component beam antenna gain is within 3 dB of a peak transmit component beam antenna gain for the transmit antenna element associated with the transmit antenna element coverage area.

73. The satellite of any of claims 60 – 72, further comprising a receive reflector (1521, 1621), wherein the plurality of receive antenna elements is arranged to receive signals reflected by the receive reflector.

74. The satellite of claim 73, wherein the receive reflector (1621) has a focal plane (1625), and the plurality of receive antenna elements is located outside the focal plane of the receive reflector.

75. The satellite of any of claims 60 – 72, wherein the plurality of receive antenna elements is arranged as a direct radiating array.

76. The satellite of any of claims 60 – 75, wherein each of the plurality of transponders is coupled between an associated one and only one of the receive antenna elements and an associated one and only one of the transmit antenna elements.

77. The satellite of any of claims 60 – 76, further comprising a transmit reflector (1521, 1561) wherein the plurality of transmit antenna elements is arranged to illuminate the transmit reflector.

78. The satellite of claim 77, wherein the transmit reflector (1621) has a focal plane (1625), and the plurality of transmit antenna elements is located outside the focal plane of the transmit reflector.

79. The satellite of any of claims 60 – 76, wherein the plurality of transmit antenna elements is arranged as a direct radiating array.

80. The satellite of any of claims 60 – 79, each transponder comprising:

a low noise amplifier (412, 3705) (LNA) having an LNA input and an LNA output, the LNA input coupled to an associated one of the receive antenna elements; and

a power amplifier (420, 3725) (PA) having a PA input coupled with the LNA output and a PA output coupled with an associated one of the transmit antenna elements.

81. The satellite of claim 80, at least one of the plurality of transponders further comprising a frequency converter (414, 3710) coupled between the LNA and the PA.

82. The satellite of any of claims 60 - 81, wherein at least one of the plurality of transponders is a forward-link transponder (3430) and at least one of the plurality of transponders is a return-link transponder (3440).

83. The satellite of any of claims 60 – 82, wherein the plurality of transponders comprises ten transponders.

84. The satellite of any of claims 60 – 83, wherein the plurality of transponders comprises one hundred transponders.

85. The satellite of any of claims 60 – 84, wherein at least one of the transponders operates in a frequency band selected from the group consisting of: C, L, S, X, V, Ka, and Ku.

86. The satellite of any of claims 60 – 85, wherein at least one of the transponders operates with a frequency bandwidth selected from the group consisting of: 500 MHz, 1 GHz, 1.5 GHz, 2 GHz 2.5 GHz, 3 GHz, and 3.5 GHz.

87. The satellite of any of claims 60 – 86, further comprising a beacon generator (426).

88. The satellite of claim 87, wherein the beacon generator is coupled with at least one of the plurality of transmit antenna elements.

89. The satellite of claim 87 or 88, wherein the satellite beacon generator generates a satellite beacon comprising a pseudo random sequence.

90. The satellite of any of claims 60 – 89, wherein the satellite is a geostationary satellite.

91. The satellite of any of claims 60 – 90, wherein the plurality of receive antenna elements receives signals from an Earth transmitter at a plurality of received signal levels, at least a subset of the plurality of receive antenna elements receiving the signals from the Earth transmitter at received signal levels that are all within 10 dB of a maximum of the plurality of received signal levels.

92. The satellite of claim 91, wherein the subset comprises 10% of the plurality of receive antenna elements.

93. The satellite of claim 91 or 92, wherein the subset comprises 10 of the plurality of receive antenna elements.

94. The satellite of any of claims 60 – 93, wherein the plurality of transmit antenna elements transmits signals to an Earth receiver at a plurality of transmit signal levels, at least a subset of the plurality of transmit antenna

elements transmitting the signals to the Earth receiver with transmit signal levels that are all within 10 dB of a maximum of the plurality of transmit signal levels.

95. The satellite of claim 94, wherein the subset comprises 10% of the plurality of transmit antenna elements.

96. The satellite of claim 94 or 95, wherein the subset comprises 10 of the plurality of transmit antenna elements.

97. The satellite as in one of claims 60 – 96, wherein signal path time delays among the plurality of transponders are matched.

98. A method for communicating through an end-to-end relay (503, 1202, 1502, 3403), the method comprising:

receiving a communication signal (521, 525) at each of a plurality of receive antenna elements of the end-to-end relay, the communication signal originating from an Earth transmitter (515, 517), such that each of a subset of the receive antenna elements receives the communication signal at a signal level not substantially less than a signal level corresponding to a peak gain of the receive antenna element;

outputting from each of the plurality of receive antenna elements, a corresponding received signal resulting from the receiving antenna element's reception of the communication signal;

independently amplifying each received signal to form a plurality of amplified received signals; and

transmitting, from each of at least some of a plurality of transmit antenna elements, a different one of the amplified received signals as a downlink signal (522,527), such that at least a subset of the downlink signals illuminates an Earth receiver (515, 517) at a signal level not substantially less than a signal level corresponding to a peak gain of the transmit antenna elements participating in the transmitting.

99. The method of claim 98, wherein the Earth transmitter is a user terminal (517).

100. The method of claim 98, wherein the Earth transmitter is an access node (515).

101. The method of claim 98 or 99, wherein the Earth receiver is an access node (515).

102. The method of claim 98 or 100, wherein the Earth receiver is a user terminal (517).

103. The method of claim 101, wherein transmitting the amplified received signals further comprises transmitting to each of a plurality of additional access nodes.

104. The method of any of claims 98 – 103, wherein the satellite has an uplink satellite coverage area defined by a set of points, at least 25% of the set of points of the uplink satellite coverage area spanning overlapping coverage areas of at least six receive antenna elements.

105. The method of any of claims 98 – 103, wherein the satellite has an uplink satellite coverage area defined by a set of points, at least 25% of the set of points of the uplink satellite coverage area spanning overlapping coverage areas of at least four receive antenna elements.

106. The method of any of claims 98 – 105, wherein each receive antenna element coverage area is defined by a set of points for which a receive component beam antenna gain is within 10 dB of a peak receive component beam antenna gain for the receive antenna element associated with the receive antenna element coverage area.

107. The method of any of claims 98 – 105, wherein each receive antenna element coverage area is defined by a set of points for which a receive component beam antenna gain is within 6 dB of a peak receive component beam antenna gain for the receive antenna element associated with the receive antenna element coverage area.

108. The method of any of claims 98 – 105, wherein each receive antenna element coverage area is defined by a set of points for which a receive component beam antenna gain is within 3 dB of a peak receive component beam antenna gain for the receive antenna element associated with the receive antenna element coverage area.

109. The method of one of claim 98 – 108, wherein the satellite has a downlink satellite coverage area defined by a set of points, at least 25% of the set of points of the downlink satellite coverage area spanning overlapping coverage areas of at least six transmit antenna elements.

110. The method of one of claim 98 – 108, wherein the satellite has a downlink satellite coverage area defined by a set of points, at least 25% of the set of points of the downlink satellite coverage area spanning overlapping coverage areas of at least four transmit antenna elements.

111. The method of claims 109 or 110, wherein each transmit antenna element coverage area is defined by a set of points for which a transmit component beam antenna gain is within 10 dB of a peak transmit component beam antenna gain for the transmit antenna element associated with the transmit antenna element coverage area.

112. The method of claims 109 or 110, wherein each transmit antenna element coverage area is defined by a set of points for which a transmit component beam antenna gain is within 6 dB of a peak transmit component beam antenna gain for the transmit antenna element associated with the transmit antenna element coverage area.

113. The method of claims 109 or 110, wherein each transmit antenna element coverage area is defined by a set of points for which a transmit component beam antenna gain is within 3 dB of a peak transmit component beam antenna gain for the transmit antenna element associated with the transmit antenna element coverage area.

114. The method of any of claims 98 – 113, wherein receiving the communication signal comprises reflecting the communication signal to create a signal that focuses at a point in a focal plane, wherein receiving the communication signal occurs away from the focal plane.

115. The method of any of claims 98 – 114, wherein transmitting the amplified received signals comprises transmitting from the receive antenna elements to a transmit reflector having a focal plane, wherein transmitting the signals occurs away from the focal plane.

116. The method of any of claims 98 – 115, wherein the communication signal is received on an uplink frequency, and further comprising:

frequency converting at least one of the amplified received signals from the uplink frequency to a downlink frequency to form a frequency converted amplified received signal, and wherein transmitting the amplified received signals includes transmitting the frequency converted amplified received signals.

117. The method of any of claims 98 – 116, wherein the received signals are in a frequency band selected from the group consisting of: C, L, S, X, V, Ka and Ku.

118. The method of any of claims 98 – 117, further comprising transmitting a relay beacon signal.

119. The method of claim 118, wherein the relay beacon signal comprises a pseudo random (PN) sequence.

120. The method of any of claims 98 – 119, each receive antenna element having a receive antenna element coverage area, such that the plurality of receive antenna element coverage areas overlap.

121. The method of any of claims 98 – 120, further including receiving, with the plurality of receive antenna elements, additional signals from a plurality of additional Earth transmitters that are geographically dispersed.

122. The method of claim 98 – 121, further including transmitting from the plurality of receive antenna elements to a plurality of additional Earth receivers that are geographically dispersed.

123. The method of any of claims 98 – 122, wherein each of the subset of the receive antenna elements receives the communication signal originating from the Earth transmitter at a signal level within 10 dB of a maximum signal level received by any of the subset of receive antenna elements.

124. The method of any of claims 98 – 123, wherein the subset comprises at least 10% of the plurality of receive antenna elements.

125. The method of any of claims 98 – 124, wherein the subset comprises at least ten of the plurality of receive antenna elements.

126. The method of any of claims 98 – 125, wherein a subset of the plurality of receive antenna elements transmit signals to the Earth transmitter resulting in a received signal level within 10 dB of a maximum signal level received from any of the transmit antenna elements.

127. The method of any of claims 98 – 126, wherein the subset of the transmitted signals is transmitted by at least 10% of the plurality of transmit antenna elements.

128. The method of any of claims 98 – 126, wherein the subset of the transmitted signals is transmitted by at least ten of the plurality of transmit antenna elements.

129. The method of any of claims 98 – 128, wherein the receiving a communications signal comprises:

receiving from a user terminal during a first receive time interval; and

receiving from an access node during a second receive time interval that does not overlap the first receive time interval.

130. The method of any of claims 98 – 129, wherein the receiving a communications signal comprises:

receiving from a user terminal on a first frequency band; and

receiving from an access node on the first frequency band.

131. The method of any of claims 98 – 130, wherein the transmitting a different one of the amplified received comprises:

transmitting to a user terminal on a second frequency band; and

transmitting to an access node on the second frequency band.

132. The method of any of claims 98 – 131, wherein the transmitting a different one of the amplified received signals comprises:

transmitting to a user terminal during a first transmit time interval; and

transmitting to an access node during a second transmit time interval that does not overlap the first transmit time interval.

133. An end-to-end relay system comprising:

means for inducing multipath (1502, 3403) by generating a plurality of received signals from multiple concurrent observations of an uplink signal received wirelessly from a transmit location; and

means for relaying (1502, 3403) the plurality of received signals wirelessly to a receive location by independently amplifying the received signals to form a beam by superposition to illuminate the receive location.

134. The end-to-end relay system of claim 133, further comprising means for forming (502) an uplink signal comprising a superposition of a plurality of transmitted signals originating from a plurality of geographically dispersed locations, wherein the receive location comprises a user terminal (517).

135. The end-to-end relay system of claim 133, further comprising means for recovering (502) a user data signal from a plurality of received signals, wherein the means for relaying illuminates a plurality of receive locations within an access node coverage area (3450).

136. The end-to-end relay system of claim 135, wherein the user terminal is in a user coverage area (3460), and the access node coverage area is at less than one fifth the user terminal coverage area in physical area.

137. The end-to-end relay system of claim 133, wherein the transmit location comprises a user terminal (517).

138. The end-to-end relay system of claim 133, wherein the transmit location comprises an access node (515).

139. The end-to-end relay system of claim 133, wherein the receive location comprises an access node (515).

140. The end-to-end relay system of claim 133, wherein the receive location comprises a user terminal (517).