CLAIMS

1. A system for cancelling spatial interference associated with an original multi-carrier signal carrying at least one data transmission sent by a transmitter to an antenna array comprising a plurality of antennae and having a receiver operatively associated therewith, the system receiving a plurality of received signals respectively including the interference and the original signal as received by a respective individual antenna from among the plurality of antennae, the system comprising:

a spatial nulling device for generating a cleaner signal by reducing at least one spatial component of said interference; and

a signal manipulator operative to manipulate a derivative of said received signal so as to cause said at least one data transmission to be more concentrated in a subset of frequency bands in which the spatial nulling device is more effective and to be less concentrated in frequency bands which do not belong to said subset of frequency bands.

2. A system according to claim 1 and also comprising an antenna array.

3. A system according to claim 1 wherein said signal manipulator comprises a programmable band pass filter device which filters a signal to be filtered derived from a signal received by at least one of the antennae so as to pass at least one frequency band inside the subset and to block at least one frequency band outside the subset.

4. A system according to claim 1 wherein said spatial nulling device includes a dynamic weighted antenna summation functionality operative to dynamically compute a weighted sum of signals received by said plurality of antennae wherein said weighting is performed in accordance with a plurality of weighting coefficients corresponding in number to said plurality of antennae and selected to reduce at least one spatial component of the received signal which includes interference.

5. A system according to claim 3 wherein each said band pass filter has dynamically computed filter coefficients and wherein said signal manipulator also comprises a filter coefficient computer operative to dynamically compute said filter coefficients.

6. A system according to claim 5 wherein said spatial nulling device includes a weighted antenna summation functionality operative to compute a weighted sum of signals received by said plurality of antennae wherein said weighting is performed in accordance with a plurality of weighting coefficients corresponding in number to said plurality of antennae, and wherein said filter coefficient computer is operative to use said plurality of weighting coefficients to dynamically compute said filter coefficients.

7. A system according to claim 1 wherein said signal manipulator comprises an array of programmable band limited noise injectors including a plurality of programmable band limited noise injectors corresponding in number to said plurality of antennae, wherein each noise injector adds noise to the signal received from the antenna corresponding to the noise injector, such that noise is added only to frequency bands outside the subset and not to frequency bands inside the subset.

8. A system according to claim 7 wherein said noise comprises white Gaussian noise.

9. A system according to claim 1 wherein said signal manipulator comprises an array of programmable band pass filters including a plurality of band pass filters corresponding in number to said plurality of antennae and wherein each individual band pass filter filters the signal received from the antenna corresponding to the individual band pass filter so as to pass all frequency bands inside the subset and to block all frequency bands outside the subset.

10. A system according to claim 1 wherein said signal manipulator receives information indicative of said cleaner signal and operates in accordance therewith.

11. A system according to claim 10 wherein said information indicative of said cleaner signal comprises the cleaner signal itself.

12. A system according to claim 10 wherein said information indicative of said cleaner signal comprises a result of spectral analysis performed on said cleaner signal.

13. A system according to claim 10 wherein said signal manipulator determines said subset at least partly based on said information indicative of said cleaner signal.

14. A system according to claim 4 wherein said signal manipulator determines said subset at least partly based on at least a portion of said plurality of weighting coefficients.

15. A system according to claim 3 wherein said signal manipulator receives signals from said antenna array and feeds signal to said spatial nulling device and wherein said programmable band pass filter device comprises a plurality of band pass filters corresponding in number to said plurality of antennae and wherein said programmable band pass filter device comprises an array of programmable band pass filters including a plurality of band pass filters corresponding in number to said plurality of antennae and wherein each individual band pass filter filters the signal received from the antenna corresponding to the individual band pass filter so as to pass at least one frequency band inside the subset and to block at least one frequency band outside the subset.

16. A system according to claim 3 wherein said spatial nulling device receives signals from said antenna array and feeds signal to said signal manipulator and wherein said signal to be filtered comprises an output signal generated by said spatial nulling device.

17. A system according to claim 1 wherein said signal manipulator performs at least one frequency-dependent operation on said signal.

18. A system according to claim 1 wherein said signal comprises a communication signal.

19. A system according to claim 1 wherein said signal comprises a wideband signal.

20. – 28. (Cancelled)

29. A method for cancelling spatial interference associated with an original multi-carrier signal carrying at least one data transmission sent by a transmitter to an antenna array comprising a plurality of antennae and having a receiver operatively associated therewith, the system receiving a plurality of received signals respectively including said interference and said original signal as received by a respective individual antenna from among the plurality of antennae, the system comprising:

using a spatial nulling device for generating a cleaner signal by reducing at least one spatial component of said interference; and

manipulating a derivative of said received signal so as to cause said at least one data transmission to be more concentrated in a subset of frequency bands in which the spatial nulling device is more effective and to be less concentrated in frequency bands which do not belong to said subset of frequency bands.

30. A method according to claim 29 and also comprising:

providing a scheduler which is operative, for each individual time frame along a temporal axis, to allocate to said at least one data transmission, at least one respective portion of a time-frequency region defined over said individual time frame; and

adapting said spatial nulling device to said interference, the adapting comprising:

using the scheduler to reserve at least one empty sub-region within said time-frequency region by allocating only at least one portion external to said sub-region to said at least one data transmission, rather than allocating any portion disposed internally of said sub-region to said at least one data transmission; and

configuring the spatial nulling device by deriving, from signal content in the empty sub-region, at least one interference-dependent parameter of the spatial nulling device's operation.

31. A method according to claim 29 wherein said manipulating includes manipulating the received signal to cause the transmitter-receiver communications to be allocated only to a subset of frequency bands in which the spatial nulling device answers to a predetermined effectiveness criterion.

32. A method according to claim 30 wherein said manipulating includes manipulating the received signal to cause the transmitter-receiver communications to be allocated only to a subset of frequency bands in which the spatial nulling device answers to a predetermined effectiveness criterion.

33. – 35. (cancelled)

36. A system according to claim 7 wherein each said noise injector has dynamically configurable noise parameters and wherein said signal manipulator also comprises a noise parameter computer operative to dynamically compute said noise parameters.

37. A system according to claim 36 wherein said configurable noise parameters define frequency bands of the noise.

38. A system according to claim 36 wherein said spatial nulling device includes a weighted antenna summation functionality operative to compute a weighted sum of signals received by said plurality of antennae wherein said weighting is performed in accordance with a plurality of weighting coefficients corresponding in number to said plurality of antennae, and wherein said noise parameters computer is operative to use said plurality of weighting coefficients to dynamically compute said noise parameters.

39. A method according to claim 32 wherein said using the scheduler includes using the signal manipulator to manipulate the received signal so as to prevent the scheduler from allocating said empty sub-region to any of the data transmissions.

40. (cancelled)

41. A system according to claim 18 wherein said communication signal comprises a multi-user communication signal.

42. A system according to claim 1 wherein said subset of frequency bands in which the spatial nulling device is more effective comprises frequencies satisfying a predefined criterion based on at least the estimated reduction of said at least one spatial component of the received signal at said frequencies.

43. A system according to claim 1 wherein said subset of frequency bands in which the spatial nulling device is more effective comprises frequencies satisfying a predefined criterion based on at least the estimated signal to interference ratio of said cleaner signal at said frequencies.

44. A method according to claim 30 wherein said using the scheduler comprises configuring the scheduler to reserve said at least one empty sub-region by allocating only said portions external to said sub-region to each of the data transmissions.

45. A method according to claim 30 wherein said using the scheduler comprises:

generating a request to the scheduler for allocation of a sub-region within said time-frequency region to an auxiliary transmitter;

employing the scheduler to accede to said request by allocating at least one individual sub-region to the auxiliary transmitter; and

refraining from transmitting within the individual sub-region.

46. A method according to claim 45 wherein generating a request to the scheduler comprises generating said request by said auxiliary transmitter.

47. A system according to claim 1 wherein said cleaner signal is cleaner than each of said plurality of received signals.

48. A system according to claim 1 and also comprising a scheduler which is operative, for each individual time frame from among at least one time frame defined along a temporal axis, to allocate to said at least one data transmission, respective portions of a time-frequency region defined over said individual time frame; and to cause said at least one data transmission to be more concentrated in a subset of frequency bands by manipulating a derivative of said received signals so as to cause said scheduler to allocate said at least one data transmission such that said data transmission is more concentrated in a subset of frequency bands in which the spatial nulling device is more effective and is less concentrated in frequency bands which do not belong to said subset of frequency bands.

49. A system according to claim 1 wherein said signal manipulator comprises a programmable band limited noise injector device which adds noise to a signal derived from a signal received by at least one of the antennae such that noise is added only to frequency bands outside the subset and not to frequency bands inside the subset.

50. A system according to claim 49 wherein said spatial nulling device receives signals from said antenna array and feeds a signal to said signal manipulator,

and wherein said signal derived from said signal received by said at least one of the antennae comprises an output signal generated by said spatial nulling device.

51. A system for cancelling spatial interference associated with an original multi-carrier signal carrying at least one data transmission sent by a transmitter to an antenna array comprising a plurality of antennae and having a receiver operatively associated therewith, the system receiving a plurality of received signals respectively including the interference and the original signal as received by a respective individual antenna from among the plurality of antennae, the system comprising:

a spatial nulling device for generating a cleaner signal by reducing at least one spatial component of said interference; and

a signal manipulator operative to manipulate a derivative of said received signal so as to cause said at least one data transmission to be more concentrated in a subset of frequency bands in which the spatial nulling device is more effective and to be less concentrated in frequency bands which do not belong to said subset of frequency bands,

wherein said signal manipulator comprises an array of programmable band limited noise injectors including a plurality of programmable band limited noise injectors corresponding in number to said plurality of antennae,

wherein each noise injector adds noise to the signal received from the antenna corresponding to the noise injector, such that noise is added only to frequency bands outside the subset and not to frequency bands inside the subset.

52. A system according to claim 51 and also comprising an antenna array.

53. A system according to claim 51 wherein said signal manipulator comprises a programmable band pass filter device which filters a signal to be filtered derived

from a signal received by at least one of the antennae so as to pass at least one frequency band inside the subset and to block at least one frequency band outside the subset.

54. A system according to claim 51 wherein said spatial nulling device includes a dynamic weighted antenna summation functionality operative to dynamically compute a weighted sum of signals received by said plurality of antennae wherein said weighting is performed in accordance with a plurality of weighting coefficients corresponding in number to said plurality of antennae and selected to reduce at least one spatial component of the received signal which includes interference.

55. A system according to claim 53 wherein each said band pass filter has dynamically computed filter coefficients and wherein said signal manipulator also comprises a filter coefficient computer operative to dynamically compute said filter coefficients.

56. A system according to claim 55 wherein said spatial nulling device includes a weighted antenna summation functionality operative to compute a weighted sum of signals received by said plurality of antennae wherein said weighting is performed in accordance with a plurality of weighting coefficients corresponding in number to said plurality of antennae, and wherein said filter coefficient computer is operative to use said plurality of weighting coefficients to dynamically compute said filter coefficients.

57. A system according to claim 51 wherein said signal manipulator comprises an array of programmable band limited noise injectors including a plurality of programmable band limited noise injectors corresponding in number to said plurality of antennae,

wherein each noise injector adds noise to the signal received from the antenna corresponding to the noise injector, such that noise is added only to frequency bands outside the subset and not to frequency bands inside the subset.

58. A system according to claim 57 wherein said noise comprises white Gaussian noise.

59. A system according to claim 51 wherein said signal manipulator comprises an array of programmable band pass filters including a plurality of band pass filters corresponding in number to said plurality of antennae and wherein each individual band pass filter filters the signal received from the antenna corresponding to the individual band pass filter so as to pass all frequency bands inside the subset and to block all frequency bands outside the subset.

60. A system according to claim 51 wherein said signal manipulator receives information indicative of said cleaner signal and operates in accordance therewith.

61. A system according to claim 60 wherein said information indicative of said cleaner signal comprises the cleaner signal itself.

62. A system according to claim 60 wherein said information indicative of said cleaner signal comprises a result of spectral analysis performed on said cleaner signal.

63. A system according to claim 60 wherein said signal manipulator determines said subset at least partly based on said information indicative of said cleaner signal.

64. A system according to claim 54 wherein said signal manipulator determines said subset at least partly based on at least a portion of said plurality of weighting coefficients.

65. A system according to claim 53 wherein said signal manipulator receives signals from said antenna array and feeds signal to said spatial nulling device and wherein said programmable band pass filter device comprises a plurality of band pass filters corresponding in number to said plurality of antennae and wherein said programmable band pass filter device comprises an array of programmable band pass filters including a plurality of band pass filters corresponding in number to said plurality of antennae and wherein each individual band pass filter filters the signal received from the antenna corresponding to the individual band pass filter so as to pass at least one frequency band inside the subset and to block at least one frequency band outside the subset.

66. A system according to claim 53 wherein said spatial nulling device receives signals from said antenna array and feeds signal to said signal manipulator and wherein said signal to be filtered comprises an output signal generated by said spatial nulling device.

67. A system according to claim 51 wherein said signal manipulator performs at least one frequency-dependent operation on said signal.

68. A system according to claim 51 wherein said signal comprises a communication signal.

69. A system according to claim 51 wherein said signal comprises a wideband signal.

70. In a multi-carrier communication system including a receiver, at least one transmitter transmitting a multi-carrier signal defining multiple carriers to the receiver, an interference canceller for cancelling spatial interference and a scheduler which is operative, for each individual time frame along a temporal axis, to allocate to various data transmissions, respective portions of a time-frequency region defined over said individual time frame, the multi-carrier signal defining a multiplicity of carriers together spanning a frequency band,

a method for adapting said interference canceller to said interference, the method comprising:

using the scheduler to reserve at least one empty sub-region within said time-frequency region by allocating said multiple carriers, taking into account channel quality over various frequencies, such that only portions external to said sub-region are allocated to each of the data transmissions; and

configuring the interference canceller by deriving, from signal content in the empty sub-region, at least one interference-dependent parameter of the interference canceller's operation.

71. A method according to claim 20 wherein said empty sub-region includes the entire said frequency band and only a portion of said time frame.

72. A method according to claim 20 wherein said empty sub-region includes only a portion of said frequency band and only a portion of said time frame.

73. A method according to claim 20 wherein said empty sub-region includes only a portion of said frequency band and the entire said time frame.

74. A method according to claim 20 wherein said using the scheduler to reserve at least one empty sub-region within said time-frequency region by allocating only portions external to said sub-region to each of the data transmissions comprises configuring the scheduler to reserve said at least one empty sub-region by allocating only said portions external to said sub-region to each of the data transmissions.

75. A method according to claim 20 and wherein said using the scheduler comprises:

generating a request to the scheduler for allocation of a sub-region within said time-frequency region to an auxiliary transmitter;

employing the scheduler to accede to said request by allocating at least one individual sub-region to the auxiliary transmitter; and

refraining from transmitting within the individual sub-region.

76. A method according to claim 25 wherein no auxiliary transmitter is provided and the request to the scheduler for allocation to an auxiliary transmitter comprises a simulated request.

77. A method according to claim 25 wherein the receiver is located at a first location and wherein said method also comprises providing said auxiliary transmitter at a second location which differs from said first location.

78. A method according to claim 25 wherein said method also comprises providing said auxiliary transmitter co-located with said receiver.

79. A method for cancelling spatial interference associated with an original multi-carrier signal carrying at least one data transmission sent by a transmitter to an

antenna array comprising a plurality of antennae and having a receiver operatively associated therewith, the system receiving a plurality of received signals respectively including said interference and said original signal as received by a respective individual antenna from among the plurality of antennae, the system comprising:

using a spatial nulling device for generating a cleaner signal by reducing at least one spatial component of said interference; and

manipulating a derivative of said received signal so as to cause said at least one data transmission to be more concentrated in a subset of frequency bands in which the spatial nulling device is more effective and to be less concentrated in frequency bands which do not belong to said subset of frequency bands.

wherein said manipulating comprises providing an array of programmable band limited noise injectors including a plurality of programmable band limited noise injectors corresponding in number to said plurality of antennae, wherein each noise injector adds noise to the signal received from the antenna corresponding to the noise injector, such that noise is added only to frequency bands outside the subset and not to frequency bands inside the subset.

80. A method according to claim 79 and also comprising:

providing a scheduler which is operative, for each individual time frame along a temporal axis, to allocate to said at least one data transmission, at least one respective portion of a time-frequency region defined over said individual time frame; and

adapting said spatial nulling device to said interference, the adapting comprising:

using the scheduler to reserve at least one empty sub-region within said time-frequency region by allocating only at least one portion external to said sub-region to said at least one data transmission, rather than allocating any portion disposed internally of said sub-region to said at least one data transmission; and

configuring the spatial nulling device by deriving, from signal content in the empty sub-region, at least one interference-dependent parameter of the spatial nulling device's operation.

81. A method according to claim 79 wherein said manipulating includes manipulating the received signal to cause the transmitter-receiver communications to be allocated only to a subset of frequency bands in which the spatial nulling device answers to a predetermined effectiveness criterion.

82. A method according to claim 80 wherein said manipulating includes manipulating the received signal to cause the transmitter-receiver communications to be allocated only to a subset of frequency bands in which the spatial nulling device answers to a predetermined effectiveness criterion.

83. A method according to claim 25, wherein said request to the scheduler is generated by said auxiliary transmitter.

84. A method according to claim 20, wherein said multi-carrier communication system comprises a multi-user communication system.

85. A method according to claim 20, wherein said configuring the interference canceller also comprises providing an empty region detector which triggers the interference canceller upon detection of said sub-region.

86. A system according to claim 57 wherein each said noise injector has dynamically configurable noise parameters and wherein said signal manipulator also comprises a noise parameter computer operative to dynamically compute said noise parameters.

87. A system according to claim 86 wherein said configurable noise parameters define frequency bands of the noise.

88. A system according to claim 86 wherein said spatial nulling device includes a weighted antenna summation functionality operative to compute a weighted sum of signals received by said plurality of antennae wherein said weighting is performed in accordance with a plurality of weighting coefficients corresponding in number to said plurality of antennae, and wherein said noise parameters computer is operative to use said plurality of weighting coefficients to dynamically compute said noise parameters.

89. A method according to claim 82 wherein said using the scheduler includes using the signal manipulator to manipulate the received signal so as to prevent the scheduler from allocating said empty sub-region to any of the data transmissions.

90. In a multi-carrier communication system including a receiver, at least one transmitter transmitting a multi-carrier signal to the receiver, an interference canceller for cancelling spatial interference and a scheduler which is operative, for each individual time frame along a temporal axis, to allocate to various data transmissions, respective portions of a time-frequency region defined over said individual time frame, the multi-carrier signal defining a multiplicity of carriers together spanning a frequency band;

apparatus for adapting said interference canceller to said interference, including:

apparatus for activating the scheduler to reserve at least one empty sub-region within said time-frequency region by allocating only portions external to said sub-region to each of the data transmissions; and

apparatus for configuring the interference canceller by deriving, from signal content in the empty sub-region, at least one interference-dependent parameter of the interference canceller's operation.

91. A system according to claim 68 wherein said communication signal comprises a multi-user communication signal.

92. A system according to claim 51 wherein said subset of frequency bands in which the spatial nulling device is more effective comprises frequencies satisfying a predefined criterion based on at least the estimated reduction of said at least one spatial component of the received signal at said frequencies.

93. A system according to claim 51 wherein said subset of frequency bands in which the spatial nulling device is more effective comprises frequencies satisfying a predefined criterion based on at least the estimated signal to interference ratio of said cleaner signal at said frequencies.

94. A method according to claim 80 wherein said using the scheduler comprises configuring the scheduler to reserve said at least one empty sub-region by allocating only said portions external to said sub-region to each of the data transmissions.

95. A method according to claim 80 wherein said using the scheduler comprises:

generating a request to the scheduler for allocation of a sub-region within said time-frequency region to an auxiliary transmitter;

employing the scheduler to accede to said request by allocating at least one individual sub-region to the auxiliary transmitter; and

refraining from transmitting within the individual sub-region.

96. A method according to claim 95 wherein generating a request to the scheduler comprises generating said request by said auxiliary transmitter.

97. A system according to claim 51 wherein said cleaner signal is cleaner than each of said plurality of received signals.

98. A system according to claim 51 and also comprising a scheduler which is operative, for each individual time frame from among at least one time frame defined along a temporal axis, to allocate to said at least one data transmission, respective portions of a time-frequency region defined over said individual time frame; and to cause said at least one data transmission to be more concentrated in a subset of frequency bands by manipulating a derivative of said received signals so as to cause said scheduler to allocate said at least one data transmission such that said data transmission is more concentrated in a subset of frequency bands in which the spatial nulling device is more effective and is less concentrated in frequency bands which do not belong to said subset of frequency bands.

99. A system according to claim 51 wherein said signal manipulator comprises a programmable band limited noise injector device which adds noise to a signal derived from a signal received by at least one of the antennae such that noise is added only to frequency bands outside the subset and not to frequency bands inside the subset.

100. A system according to claim 99 wherein said spatial nulling device receives signals from said antenna array and feeds a signal to said signal manipulator,

and wherein said signal derived from said signal received by said at least one of the antennae comprises an output signal generated by said spatial nulling device.

101. A system for cancelling spatial interference associated with an original multi-carrier signal carrying at least one data transmission sent by a transmitter to an antenna array comprising a plurality of antennae and having a receiver operatively associated therewith, the system receiving a plurality of received signals respectively including the interference and the original signal as received by a respective individual antenna from among the plurality of antennae, the system comprising:

a spatial nulling device for generating a cleaner signal by reducing at least one spatial component of said interference; and

a signal manipulator operative to manipulate a derivative of said received signal so as to cause said at least one data transmission to be more concentrated in a subset of frequency bands in which the spatial nulling device is more effective and to be less concentrated in frequency bands which do not belong to said subset of frequency bands,

wherein said signal manipulator comprises a programmable band limited noise injector device which adds noise to a signal derived from a signal received by at least one of the antennae such that noise is added only to frequency bands outside the subset and not to frequency bands inside the subset.

102. A system according to claim 101 and also comprising an antenna array.

103. A system according to claim 101 wherein said signal manipulator comprises a programmable band pass filter device which filters a signal to be filtered derived from a signal received by at least one of the antennae so as to pass at least one frequency band inside the subset and to block at least one frequency band outside the subset.

104. A system according to claim 1 wherein said spatial nulling device includes a dynamic weighted antenna summation functionality operative to dynamically compute a weighted sum of signals received by said plurality of antennae wherein

said weighting is performed in accordance with a plurality of weighting coefficients corresponding in number to said plurality of antennae and selected to reduce at least one spatial component of the received signal which includes interference.

105. A system according to claim 103 wherein each said band pass filter has dynamically computed filter coefficients and wherein said signal manipulator also comprises a filter coefficient computer operative to dynamically compute said filter coefficients.

106. A system according to claim 105 wherein said spatial nulling device includes a weighted antenna summation functionality operative to compute a weighted sum of signals received by said plurality of antennae wherein said weighting is performed in accordance with a plurality of weighting coefficients corresponding in number to said plurality of antennae, and wherein said filter coefficient computer is operative to use said plurality of weighting coefficients to dynamically compute said filter coefficients.

107. A system according to claim 101 wherein said signal manipulator comprises an array of programmable band limited noise injectors including a plurality of programmable band limited noise injectors corresponding in number to said plurality of antennae,

wherein each noise injector adds noise to the signal received from the antenna corresponding to the noise injector, such that noise is added only to frequency bands outside the subset and not to frequency bands inside the subset.

108. A system according to claim 107 wherein said noise comprises white Gaussian noise.

109. A system according to claim 101 wherein said signal manipulator comprises an array of programmable band pass filters including a plurality of band pass filters corresponding in number to said plurality of antennae and wherein each individual band pass filter filters the signal received from the antenna corresponding to the individual band pass filter so as to pass all frequency bands inside the subset and to block all frequency bands outside the subset.

110. A system according to claim 101 wherein said signal manipulator receives information indicative of said cleaner signal and operates in accordance therewith.

111. A system according to claim 110 wherein said information indicative of said cleaner signal comprises the cleaner signal itself.

112. A system according to claim 110 wherein said information indicative of said cleaner signal comprises a result of spectral analysis performed on said cleaner signal.

113. A system according to claim 110 wherein said signal manipulator determines said subset at least partly based on said information indicative of said cleaner signal.

114. A system according to claim 104 wherein said signal manipulator determines said subset at least partly based on at least a portion of said plurality of weighting coefficients.

115. A system according to claim 103 wherein said signal manipulator receives signals from said antenna array and feeds signal to said spatial nulling device and wherein said programmable band pass filter device comprises a plurality of band pass filters corresponding in number to said plurality of antennae and wherein said programmable band pass filter device comprises an array of programmable band pass filters including a plurality of band pass filters corresponding in number to said plurality of antennae and wherein each individual band pass filter filters the signal received from the antenna corresponding to the individual band pass filter so as to pass at least one frequency band inside the subset and to block at least one frequency band outside the subset.

116. A system according to claim 103 wherein said spatial nulling device receives signals from said antenna array and feeds signal to said signal manipulator and wherein said signal to be filtered comprises an output signal generated by said spatial nulling device.

117. A system according to claim 101 wherein said signal manipulator performs at least one frequency-dependent operation on said signal.

118. A system according to claim 101 wherein said signal comprises a communication signal.

119. A system according to claim 101 wherein said signal comprises a wideband signal.

120. A method according to claim 30 wherein said manipulating includes manipulating a derivative of said received signal so as to cause said scheduler to allocate said at least one data transmission such that said data transmission is more concentrated in a subset of frequency bands in which the spatial nulling device is more effective and is less concentrated in frequency bands which do not belong to said subset of frequency bands.

121. A method according to claim 29 and also comprising:

providing a scheduler which is operative, for each individual time frame from among at least one time frames defined along a temporal axis, to allocate to said at least one data transmission, respective portions of a time-frequency region defined over said individual time frame,

and wherein said manipulating includes manipulating a derivative of said received signal so as to cause said scheduler to allocate said at least one data transmission such that said data transmission is more concentrated in a subset of frequency bands in which the spatial nulling device is more effective and is less concentrated in frequency bands which do not belong to said subset of frequency bands.

122. A method according to claim 29 and also comprising:

providing a scheduler which is operative, for each individual time frame along a temporal axis, to allocate to said at least one data transmission, at least one respective portion of a time-frequency region defined over said individual time frame; and

adapting said spatial nulling device to said interference, the adapting comprising:

using the scheduler to reserve at least one empty sub-region within said time-frequency region by allocating only portions external to said sub-region to each of the data transmissions; and

configuring the spatial nulling device by deriving, from signal content in the empty sub-region, at least one interference-dependent parameter of the spatial nulling device's operation.

123. A method according to claim 80 wherein said manipulating includes manipulating a derivative of said received signal so as to cause said scheduler to allocate said at least one data transmission such that said data transmission is more concentrated in a subset of frequency bands in which the spatial nulling device is more effective and is less concentrated in frequency bands which do not belong to said subset of frequency bands.

124. A method according to claim 79 and also comprising:

providing a scheduler which is operative, for each individual time frame from among at least one time frames defined along a temporal axis, to allocate to said at least one data transmission, respective portions of a time-frequency region defined over said individual time frame,

and wherein said manipulating includes manipulating a derivative of said received signal so as to cause said scheduler to allocate said at least one data transmission such that said data transmission is more concentrated in a subset of frequency bands in which the spatial nulling device is more effective and is less concentrated in frequency bands which do not belong to said subset of frequency bands.

125. A method according to claim 79 and also comprising:

providing a scheduler which is operative, for each individual time frame along a temporal axis, to allocate to said at least one data transmission, at least one respective portion of a time-frequency region defined over said individual time frame; and

adapting said spatial nulling device to said interference, the adapting comprising:

using the scheduler to reserve at least one empty sub-region within said time-frequency region by allocating only portions external to said sub-region to each of the data transmissions; and

configuring the spatial nulling device by deriving, from signal content in the empty sub-region, at least one interference-dependent parameter of the spatial nulling device's operation.

126. A method for cancelling spatial interference associated with an original multi-carrier signal carrying at least one data transmission sent by a transmitter to an antenna array comprising a plurality of antennae and having a receiver operatively associated therewith, the system receiving a plurality of received signals respectively including said interference and said original signal as received by a respective individual antenna from among the plurality of antennae, the system comprising:

using a spatial nulling device for generating a cleaner signal by reducing at least one spatial component of said interference; and

manipulating a derivative of said received signal so as to cause said at least one data transmission to be more concentrated in a subset of frequency bands in which the spatial nulling device is more effective and to be less concentrated in frequency bands which do not belong to said subset of frequency bands,

wherein said manipulating comprises using a programmable band limited noise injector device which adds noise to a signal derived from a signal received by at least one of the antennae such that noise is added only to frequency bands outside the subset and not to frequency bands inside the subset.

127. A method according to claim 126 and also comprising:

providing a scheduler which is operative, for each individual time frame along a temporal axis, to allocate to said at least one data transmission, at least one respective portion of a time-frequency region defined over said individual time frame; and

adapting said spatial nulling device to said interference, the adapting comprising:

using the scheduler to reserve at least one empty sub-region within said time-frequency region by allocating only at least one portion external to said sub-region to said at least one data transmission, rather than allocating any

portion disposed internally of said sub-region to said at least one data transmission; and

configuring the spatial nulling device by deriving, from signal content in the empty sub-region, at least one interference-dependent parameter of the spatial nulling device's operation.

128. A system according to claim 101 wherein said cleaner signal is cleaner than each of said plurality of received signals.

129. A system according to claim 101 and also comprising a scheduler which is operative, for each individual time frame from among at least one time frame defined along a temporal axis, to allocate to said at least one data transmission, respective portions of a time-frequency region defined over said individual time frame; and to cause said at least one data transmission to be more concentrated in a subset of frequency bands by manipulating a derivative of said received signals so as to cause said scheduler to allocate said at least one data transmission such that said data transmission is more concentrated in a subset of frequency bands in which the spatial nulling device is more effective and is less concentrated in frequency bands which do not belong to said subset of frequency bands.

130. A system according to claim 101 wherein said signal manipulator comprises a programmable band limited noise injector device which adds noise to a signal derived from a signal received by at least one of the antennae such that noise is added only to frequency bands outside the subset and not to frequency bands inside the subset.

131. A method according to claim 129 wherein said manipulating includes manipulating the received signal to cause the transmitter-receiver communications to be allocated only to a subset of frequency bands in which the spatial nulling device answers to a predetermined effectiveness criterion.

132. A method according to claim 127 wherein said manipulating includes manipulating the received signal to cause the transmitter-receiver communications to be allocated only to a subset of frequency bands in which the spatial nulling device answers to a predetermined effectiveness criterion.

133. A system according to claim 130 wherein said spatial nulling device receives signals from said antenna array and feeds a signal to said signal manipulator,

and wherein said signal derived from said signal received by said at least one of the antennae comprises an output signal generated by said spatial nulling device.

134. A method according to claim 127 wherein said manipulating includes manipulating a derivative of said received signal so as to cause said scheduler to allocate said at least one data transmission such that said data transmission is more concentrated in a subset of frequency bands in which the spatial nulling device is more effective and is less concentrated in frequency bands which do not belong to said subset of frequency bands.

135. A method according to claim 126 and also comprising:

providing a scheduler which is operative, for each individual time frame from among at least one time frames defined along a temporal axis, to allocate to said at least one data transmission, respective portions of a time-frequency region defined over said individual time frame,

and wherein said manipulating includes manipulating a derivative of said received signal so as to cause said scheduler to allocate said at least one data transmission such that said data transmission is more concentrated in a subset of frequency bands in which the spatial nulling device is more effective and is less concentrated in frequency bands which do not belong to said subset of frequency bands.

136. A system according to claim 107 wherein each said noise injector has dynamically configurable noise parameters and wherein said signal manipulator also comprises a noise parameter computer operative to dynamically compute said noise parameters.

137. A system according to claim 136 wherein said configurable noise parameters define frequency bands of the noise.

138. A system according to claim 136 wherein said spatial nulling device includes a weighted antenna summation functionality operative to compute a weighted sum of signals received by said plurality of antennae wherein said weighting is performed in accordance with a plurality of weighting coefficients corresponding in number to said plurality of antennae, and wherein said noise parameters computer is operative to use said plurality of weighting coefficients to dynamically compute said noise parameters.

139. A method according to claim 132 wherein said using the scheduler includes using the signal manipulator to manipulate the received signal so as to prevent the scheduler from allocating said empty sub-region to any of the data transmissions.

140. A method according to claim 126 and also comprising:

providing a scheduler which is operative, for each individual time frame along a temporal axis, to allocate to said at least one data transmission, at least one respective portion of a time-frequency region defined over said individual time frame; and

adapting said spatial nulling device to said interference, the adapting comprising:

using the scheduler to reserve at least one empty sub-region within said time-frequency region by allocating only portions external to said sub-region to each of the data transmissions; and

configuring the spatial nulling device by deriving, from signal content in the empty sub-region, at least one interference-dependent parameter of the spatial nulling device's operation.

141. A system according to claim 118 wherein said communication signal comprises a multi-user communication signal.

142. A system according to claim 101 wherein said subset of frequency bands in which the spatial nulling device is more effective comprises frequencies satisfying a predefined criterion based on at least the estimated reduction of said at least one spatial component of the received signal at said frequencies.

143. A system according to claim 101 wherein said subset of frequency bands in which the spatial nulling device is more effective comprises frequencies satisfying a predefined criterion based on at least the estimated signal to interference ratio of said cleaner signal at said frequencies.

144. A method according to claim 127 wherein said using the scheduler comprises configuring the scheduler to reserve said at least one empty sub-region by allocating only said portions external to said sub-region to each of the data transmissions.

145. A method according to claim 127 wherein said using the scheduler comprises:

generating a request to the scheduler for allocation of a sub-region within said time-frequency region to an auxiliary transmitter;

employing the scheduler to accede to said request by allocating at least one individual sub-region to the auxiliary transmitter; and

refraining from transmitting within the individual sub-region.

146. A method according to claim 145 wherein generating a request to the scheduler comprises generating said request by said auxiliary transmitter.

147. A method according to any of the preceding method claims 29 – 32, 39, 44 – 46, 70 – 85, 89, 94 – 96, 120 – 127, 131 – 132, 134 – 135, 139 – 140, 144 – 146 and wherein said noise comprises white Gaussian noise.

148. A system according to any of the preceding system claims 1 – 19, 36 – 38, 41 – 43, 47, 86 – 88, 90 – 93, 97 – 119, 128 – 130, 133, 136 – 138, 141 – 143 and wherein said noise comprises white Gaussian noise.

149. A method according to any of the preceding method claims 29 – 32, 39, 44 – 46, 70 – 85, 89, 94 – 96, 120 – 127, 131 – 132, 134 – 135, 139 – 140, 144 – 146 and wherein said noise comprises LTE signal noise.

150. A system according to any of the preceding system claims 1 – 19, 36 – 38, 41 – 43, 47, 86 – 88, 90 – 93, 97 – 119, 128 – 130, 133, 136 – 138, 141 – 143 and wherein said noise comprises LTE signal noise.

151. A method according to any of the preceding method claims 29 – 32, 39, 44 – 46, 70 – 85, 89, 94 – 96, 120 – 127, 131 – 132, 134 – 135, 139 – 140, 144 – 146 and wherein said noise comprises WiFi signal noise.

152. A system according to any of the preceding system claims 1 – 19, 36 – 38, 41 – 43, 47, 86 – 88, 90 – 93, 97 – 119, 128 – 130, 133, 136 – 138, 141 – 143 and wherein said noise comprises WiFi signal noise.

153. A method according to any of the preceding method claims 29 – 32, 39, 44 – 46, 70 – 85, 89, 94 – 96, 120 – 127, 131 – 132, 134 – 135, 139 – 140, 144 – 146 and wherein said noise comprises WiMax signal noise.

154. A system according to any of the preceding system claims 1 – 19, 36 – 38, 41 – 43, 47, 86 – 88, 90 – 93, 97 – 119, 128 – 130, 133, 136 – 138, 141 – 143 and wherein said noise comprises WiMax signal noise.

155. A method according to claim 29 wherein no modifications are made to the receiver, and no special interfaces are provided to or from the receiver, thus allowing the method to be applied to a standard receiver.

156. A system according to claim 1 wherein the signal manipulator is operative to concentrate the transmitted data information onto multiple carriers within the desired bandwidth portion, corresponding to frequencies where the spatial nulling device performs better because null depth is deep enough.

157. A method according to claim 70 wherein said using the scheduler comprises allocating said multiple carriers, taking into account channel quality over various frequencies, such that only portions external to said sub-region are allocated to each of the data transmissions.

158. A system according to claim 1 and also comprising a local scheduler and wherein, when the receiver detects useless frequencies and reports them to the local scheduler, the local scheduler does not allocate data transmissions over these

frequencies, and sends an allocation table to the transmitter using an opposite communication link.

159. A system according to claim_1 and also comprising a remote scheduler and wherein, when the receiver detects useless frequencies and reports them to the remote scheduler using an opposite communication link, the remote scheduler does not allocate data transmissions over these useless frequencies."

160. A system according to claim_1 wherein the signal manipulator applies to signals, a frequency selective process for rendering undesired frequencies useless for the receiver, and wherein measures are passed from the spatial nulling means to the signal manipulator, to enable the signal manipulator to determine the frequency dependent process.

CLAIMS

1. A system for cancelling spatial interference associated with an original multi-carrier signal carrying at least one data transmission sent by a transmitter to an antenna array comprising a plurality of antennae and having a receiver operatively associated therewith, the system receiving a plurality of received signals respectively including the interference and the original signal as received by a respective individual antenna from among the plurality of antennae, the system comprising:

a spatial nulling device for generating a cleaner signal by reducing at least one spatial component of said interference; and

a signal manipulator operative to manipulate a derivative of said received signals so as to cause said at least one data transmission to be more concentrated in a subset of frequency bands in which the spatial nulling device is more effective and to be less concentrated in frequency bands which do not belong to said subset of frequency bands,

wherein said signal manipulator comprises an array of programmable band limited noise injectors including a plurality of programmable band limited noise injectors corresponding in number to said plurality of antennae,

wherein each noise injector adds noise to the signal received from the antenna corresponding to the noise injector, such that noise is added only to frequency bands outside the subset and not to frequency bands inside the subset.

2. A system according to claim 1 wherein said signal manipulator comprises a programmable band pass filter device which filters a signal to be filtered derived from a signal received by at least one of the antennae so as to pass at least one frequency band inside the subset and to block at least one frequency band outside the subset.

3. A system according to claim 1 wherein said spatial nulling device includes a dynamic weighted antenna summation functionality operative to dynamically compute a weighted sum of signals received by said plurality of antennae wherein said weighting is performed in accordance with a plurality of weighting coefficients corresponding in number to said plurality of antennae and selected to reduce at least one spatial component of the received signals which includes interference.

4. A system according to claim 2 wherein said band pass filter has dynamically computed filter coefficients and wherein said signal manipulator also comprises a filter

coefficient computer operative to dynamically compute said filter coefficients.

5. A system according to claim 4 wherein said spatial nulling device includes a weighted antenna summation functionality operative to compute a weighted sum of signals received by said plurality of antennae wherein said weighting is performed in accordance with a plurality of weighting coefficients corresponding in number to said plurality of antennae, and wherein said filter coefficient computer is operative to use said plurality of weighting coefficients to dynamically compute said filter coefficients.

6. A system according to claim 1 wherein said noise comprises white Gaussian noise.

7. A system according to claim 1 wherein said signal manipulator comprises an array of programmable band pass filters including a plurality of band pass filters corresponding in number to said plurality of antennae and wherein each individual band pass filter filters the signal received from the antenna corresponding to the individual band pass filter so as to pass all frequency bands inside the subset and to block all frequency bands outside the subset.

8. A system according to claim 1 wherein said signal manipulator receives information indicative of said cleaner signal and operates in accordance therewith.

9. A system according to claim 8 wherein said signal manipulator determines said subset at least partly based on said information indicative of said cleaner signal.

10. A system according to claim 2 wherein said signal manipulator receives signals from said antenna array and feeds signal to said spatial nulling device and wherein said programmable band pass filter device comprises an array of programmable band pass filters including a plurality of band pass filters corresponding in number to said plurality of antennae and wherein each individual band pass filter filters the signal received from the antenna corresponding to the individual band pass filter so as to pass at least one frequency band inside the subset and to block at least one frequency band outside the subset.

11. A system according to claim 2 wherein said spatial nulling device receives signals from said antenna array and feeds signal to said signal manipulator and wherein said signal to be filtered comprises an output signal generated by said spatial nulling device.

12. A system according to claim 1 wherein said signal manipulator performs at least one frequency-dependent operation on said received signals.

13. A method for cancelling spatial interference associated with an original multi-carrier signal carrying at least one data transmission sent by a transmitter to an antenna array comprising a plurality of antennae and having a receiver operatively associated therewith, the method receiving a plurality of received signals respectively including said interference and said original signal as received by a respective individual antenna from among the plurality of antennae, the method comprising:

using a spatial nulling device for generating a cleaner signal by reducing at least one spatial component of said interference; and

manipulating a derivative of said received signals so as to cause said at least one data transmission to be more concentrated in a subset of frequency bands in which the spatial nulling device is more effective and to be less concentrated in frequency bands which do not belong to said subset of frequency bands,

wherein said manipulating comprises using a programmable band limited noise injector device which adds noise to a signal derived from a signal received by at least one of the antennae such that noise is added only to frequency bands outside the subset and not to frequency bands inside the subset.

14. A method according to claim 13 further comprising:

providing a scheduler which is operative, for each individual time frame along a temporal axis, to allocate to said at least one data transmission, at least one respective portion of a time-frequency region defined over said individual time frame; and

adapting said spatial nulling device to said interference, the adapting comprising:

using the scheduler to reserve at least one empty sub-region within said time-frequency region by allocating only at least one portion external to said sub-region to said at least one data transmission, rather than allocating any portion disposed internally of said sub-region to said at least one data transmission; and

configuring the spatial nulling device by deriving, from signal content in the empty sub-region, at least one interference-dependent parameter of the spatial nulling device's operation.

15. A method according to claim 13, wherein said manipulating includes manipulating the received signals to cause the transmitter-receiver communications to be allocated only to the subset of frequency bands in which the spatial nulling device satisfies a predetermined effectiveness criterion.

16. A method according to claim 14 wherein said manipulating includes manipulating the received signals to cause the transmitter-receiver communications to be allocated only to the subset of frequency bands in which the spatial nulling device satisfies a predetermined effectiveness criterion.

17. A system according to claim 1 wherein each said noise injector has dynamically configurable noise parameters and wherein said signal manipulator also comprises a noise parameter computer operative to dynamically compute said noise parameters.

18. A system according to claim 17 wherein said configurable noise parameters define frequency bands of the noise.

19. A system according to claim 17 wherein said spatial nulling device includes a weighted antenna summation functionality operative to compute a weighted sum of signals received by said plurality of antennae wherein said weighting is performed in accordance with a plurality of weighting coefficients corresponding in number to said plurality of antennae, and wherein said noise parameters computer is operative to use said plurality of weighting coefficients to dynamically compute said noise parameters.

20. A method according to claim 16 wherein said using the scheduler includes using the signal manipulator to manipulate the received signals so as to prevent the scheduler from allocating said empty sub-region to any of the data transmissions.

21. A system according to claim 1 wherein said subset of frequency bands in which the spatial nulling device is more effective comprises frequencies satisfying a predefined criterion based on at least the estimated reduction of said at least one spatial component of the received signal at said frequencies.

22. A system according to claim 1 wherein said subset of frequency bands in which the

spatial nulling device is more effective comprises frequencies satisfying a predefined criterion based on at least a estimated signal to interference ratio of said cleaner signal at said frequencies.

23. A method according to claim 14 wherein said using the scheduler comprises configuring the scheduler to reserve said at least one empty sub-region by allocating only said portions external to said sub-region to each of the data transmissions.

24. A method according to claim 14 wherein said using the scheduler comprises:

generating a request to the scheduler for allocation of a sub-region within said time-frequency region to an auxiliary transmitter;

employing the scheduler to accede to said request by allocating at least one individual sub-region to the auxiliary transmitter; and

refraining from transmitting within the individual sub-region.

25. A method according to claim 24 wherein generating a request to the scheduler comprises generating said request by said auxiliary transmitter.

26. A system according to claim 1 further comprising a scheduler which is operative, for each individual time frame from among at least one time frame defined along a temporal axis, to allocate to said at least one data transmission, respective portions of a time-frequency region defined over said individual time frame; and to cause said at least one data transmission to be more concentrated in the subset of frequency bands by manipulating a derivative of said received signals so as to cause said scheduler to allocate said at least one data transmission such that said data transmission is more concentrated in the subset of frequency bands in which the spatial nulling device is more effective and is less concentrated in frequency bands which do not belong to said subset of frequency bands.

27. A system according to claim 1 wherein said spatial nulling device receives signals from said antenna array and feeds a signal to said signal manipulator,

and wherein said signal derived from said signals received by said at least one of the antennae comprises an output signal generated by said spatial nulling device.

28. A system according to claim 1 wherein said signal manipulator is operative to cause said at least one data transmission to be more concentrated in the subset of frequency bands in which the spatial nulling device is more effective relative to the spatial nulling device's lower effectivity in frequency bands which do not belong to said subset of frequency bands and to be less concentrated in said frequency bands which do not belong to said subset of frequency bands.