

WHAT IS CLAIMED IS:

1. A phased array antenna comprising:
 - an array of antenna elements having a beam with a boresight direction;
 - a plurality of phase shifters responsive to commands to adjust phases of a plurality of signals communicated with the array of antenna elements;
 - a controller to provide the commands to the plurality of phase shifters, wherein the provided commands are used by the plurality of phase shifters to direct the beam within a range of scan angles relative to the boresight direction; and
 - a plurality of amplifiers to amplify the plurality of signals, wherein each of the plurality of amplifiers is coupled to an antenna port of the array of antenna elements and has a performance characteristic that depends on antenna port impedance at the antenna port, wherein the antenna impedance varies with a scan angle of the beam within the range of scan angles, and a maximum of the performance characteristic is achieved at a value of the antenna port impedance that corresponds to a particular scan angle within the range of scan angles that differs from the boresight direction.
2. The phased array antenna of claim 1, each of the plurality of antenna elements having a corresponding impedance matching network to adjust the impedance at the antenna port such that the maximum value for the performance characteristic is achieved when the antenna port impedance corresponds to the selected scan angle.
3. The phased array antenna of any one of claims 1 through 2, wherein the particular scan angle within the range of scan angles is selected to maximize a performance metric of the phased array antenna.
4. The phased array antenna of claim 3, wherein the plurality of amplifiers comprise a first plurality of amplifiers, each configured to amplify a signal of the plurality of signals received at an associated antenna element, the performance metric comprising a gain-to-noise temperature ratio for the phased array antenna.
5. The phased array antenna of claim 4, wherein the performance metric is a first performance characteristic and the particular scan angle is a first particular scan angle, the plurality of amplifiers comprising a second plurality of amplifiers, each configured to amplify a signal of the plurality of signals for transmission at an associated antenna element such that a maximum value for a second performance metric of the phased array antenna is achieved when the antenna port impedance corresponds to a second particular scan angle that is different from the boresight direction and the first

particular scan angle, the second performance metric comprising one of an effective radiated power for the phased array antenna and an effective isotropic radiated power for the phased array antenna.

6. The phased array antenna of claim 3, wherein the plurality of amplifiers are each configured to amplify a signal of the plurality of signals for transmission at an associated antenna element, the performance metric comprising one of an effective radiated power for the phased array antenna and an effective isotropic radiated power for the phased array antenna.

7. The phased array antenna of claim 3, wherein the particular scan angle is selected such that a minimum value for the performance metric across all scan angles within the range of scan angles is maximized.

8. The phased array antenna of claim 3, wherein the particular scan angle is selected such that a total sum of the performance metric across all scan angles within the range of scan angles is maximized.

9. The phased array antenna of claim 3, wherein the range of scan angles defines a maximum scan angle, and the particular scan angle is selected to be halfway between the boresight direction and the maximum scan angle.

10. The phased array antenna of claim 3, the particular scan angle is selected to maximize a function of the performance metric across all scan angles within a proper subset of the defined range of scan angles.

11. The phased array antenna of claim 10, wherein the proper subset of the defined range of scan angles does not include the boresight direction.

12. A method for implementing a phased array antenna having a boresight direction, the method comprising:

selecting a scan angle within a defined range of scan angles for the phased array antenna such that the selected scan angle is different from a scan angle associated with the boresight direction, an antenna port impedance associated with each of a plurality of antenna elements comprising the phased array antenna varying with the scan angle of the phased array antenna; and

configuring a plurality of amplifiers, each coupled to an antenna port of one of the plurality of antenna elements, such that a maximum value for a performance characteristic of the plurality of amplifiers is achieved when an impedance at the antenna port corresponds to the selected scan angle.

13. The method of claim 12, wherein selecting a scan angle within a defined range of scan angles for the phased array antenna comprises selecting the scan angle to provide an extrema for a function of a performance metric for the phased array antenna across all scan angles within a subset of the defined range.

14. The method of claim 13, wherein the performance metric is one of a gain-to-noise temperature ratio for the phased array antenna, an effective radiated power for the phased array antenna, and an effective isotropic radiated power for the phased array antenna.

15. The method of any one of claims 13 through 14, wherein selecting the scan angle to provide the extrema for the function of the performance metric across all scan angles within the subset of the defined range comprises selecting the scan angle to maximize a total sum of the performance metric across all scan angles within the subset of the defined range.

16. The method of any one of claims 13 through 15, wherein selecting the scan angle to provide the extrema for the function of the performance metric across all scan angles within the subset of the defined range comprises selecting the scan angle to maximize a minimum value for the performance metric across all scan angles within the subset of the defined range.

17. The method of any one of claims 13 through 16, wherein the subset of the defined range is a proper subset of the defined range.

18. The method of any one of claims 13 through 17, wherein selecting a scan angle within the defined range of scan angles for the phased array antenna comprises selecting a first scan angle that is different from the scan angle associated with the boresight direction and a second scan angle that is different from each of the scan angle associated with the boresight direction and the first scan angle, and configuring the plurality of amplifiers comprises:

configuring a first set of amplifiers that amplify receive signals such that a maximum value for a first performance characteristic associated with the phased array antenna is achieved when the impedance at the antenna port corresponds to the first scan angle; and

configuring a second set of amplifiers that amplify transmit signals such that a maximum value for a second performance characteristic associated with the phased array antenna is achieved when the impedance at the antenna port corresponds to the second scan angle.

19. The method of any one of claims 12 through 18, wherein configuring the plurality of amplifiers comprises providing an impedance matching network for each of the plurality of amplifiers to adjust the impedance at the antenna port to which the amplifier is connected.

20. A phased array antenna comprising:
- an array of antenna elements having a beam with a boresight direction;
 - a first set of phase shifters responsive to commands to adjust phases of receive signals received by the array of antenna elements;
 - a second set of phase shifters responsive to commands to adjust phases of transmit signals for transmission by the array of antenna elements;
 - a controller to provide the commands to the first set of phase shifters and the second set of phase shifters, wherein the provided commands are used to direct the beam within a range of scan angles relative to the boresight direction; and
 - a first set of amplifiers to amplify the receive signals and a second set of amplifiers to amplify the transmit signals, each of the first set of amplifiers and each of the second set of amplifiers being coupled to an antenna port of the array of antenna elements, wherein:
 - each of the first set of amplifiers has a first performance characteristic that depends on antenna port impedance at the antenna port, the antenna impedance varying with a scan angle of the beam within the range of scan angles, with a maximum of the first performance characteristic achieved at a first value of the antenna port impedance that corresponds to a first scan angle that differs from the boresight direction; and
 - each of the second set of amplifiers has a second performance characteristic that depends on the antenna port impedance at the antenna port with a maximum of the second performance characteristic achieved at a second value of the antenna port impedance that corresponds to a second scan angle that differs from each of the boresight direction and the first scan angle.
21. The phased array antenna of any one of claim 20, wherein the first scan angle is selected to maximize a first performance metric of the phased array antenna, and the second scan angle is selected to maximize a second performance metric of the phased array antenna.
22. The phased array antenna of claim 21, wherein the first performance metric comprises a gain-to-noise temperature ratio for the phased array antenna, and the second performance metric comprises one of an effective radiated power for the phased array antenna and an effective isotropic radiated power for the phased array antenna.
23. The phased array antenna of any one of claims 20 through 22, wherein the first scan angle is selected such that a minimum value for the first performance metric across all scan angles within the range of scan angles is maximized, and the second scan angle is selected such that a minimum value of the second performance metric across all scan angles within the range of scan angles is maximized.

24. The phased array antenna of any one of claims 20 through 22, wherein the first scan angle is selected such that a total sum of the first performance metric across all scan angles within the range of scan angles is maximized.
25. The phased array antenna of any one of claims 20 through 22, wherein the range of scan angles defines a maximum scan angle, and the first scan angle is selected to be halfway between the boresight direction and the maximum scan angle.
26. The phased array antenna of any one of claims 20 through 22, wherein the first scan angle is selected to maximize a function of the first performance metric across all scan angles within a proper subset of the defined range of scan angles.
27. The phased array antenna of claim 26, wherein the proper subset of the defined range of scan angles does not include the boresight direction.