

CLAIMS

What is claimed is:

1. A computer-implemented method of dynamically configuring a wireless networking system, comprising:

5 obtaining, for each of a plurality of antennas in the wireless networking system, topology information indicating whether and how the antenna is in reach of one or more other antennas in the plurality of antennas, the wireless networking system including two or more Wi-Fi transceivers coupled to each other in parallel, each of which is operable to be selectively coupled to one or more of the plurality of antennas by respective switches;

10 determining, dependent on the obtained topology information, a desired configuration change for the wireless networking system, the desired configuration change including a change in which and how many of the plurality of antennas are coupled to the two or more Wi-Fi transceivers or a change in which or how many of the two or more Wi-Fi transceivers are active; and

15 initiating the desired configuration change.

2. The method of claim 1, wherein initiating the desired configuration change comprises one or more of:

initiating an activation of a switch to couple one of the plurality of antennas to one of
20 the two or more Wi-Fi transceivers; and

initiating a deactivation of a switch to decouple one of the plurality of antennas from one of the two or more Wi-Fi transceivers.

3. The method of claim 1, wherein initiating the desired configuration change
25 comprises one or more of:

initiating an activation of one of the two or more Wi-Fi transceivers; and

initiating a deactivation of one of the two or more Wi-Fi transceivers.

30 4. The method of claim 1, wherein obtaining the topology information comprises using passive telemetry or active telemetry to obtain, during operation of the wireless

networking system, the topology information or neighbor information from which the topology information is derived.

5 5. The method of claim 1, wherein the obtained topology information applies to a combination of antennas from which a transmission is received or a combination of receiving antennas.

 6. The method of claim 1, wherein obtaining the topology information comprises correlating transmissions of a transmitting wireless client device between two or more
10 receiving wireless client devices.

 7. The method of claim 1, wherein determining the desired configuration change is further dependent on a respective coverage pattern for wireless transmission and reception for one or more of the plurality of antennas.
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 8. The method of claim 1, wherein determining the desired configuration change comprises determining a set of antennas that, when activated, create a coverage pattern over a collective coverage area that includes at least a desired coverage area.

20 9. The method of claim 1, wherein determining the desired configuration change is further dependent on at least one of: optimality, network needs, operator requests, wireless conditions, and client demand.

 10. The method of claim 1, wherein:
25 the antennas coupled to each Wi-Fi transmitter represent a repeated collection of antenna elements each of which contributes to a default coverage pattern for the collection of antenna elements; and
 determining the desired configuration change comprises determining a configuration change that results in a change to the coverage pattern for the antennas coupled to the one of
30 the two or more Wi-Fi transceivers.

 11. The method of claim 1, wherein:
 the wireless networking system comprises at least one of:

a single networking line and a single power line; and
a combined power and networking distribution; and
the single networking line and the single power line or the combined power and
networking distribution are arranged along a linear row and are coupled to each of the two or
5 more Wi-Fi transceivers.

12. The method of claim 1, wherein determining the desired configuration change
comprises using a machine learning model that has been trained to produce a discriminator for
evaluating proposed configurations for the wireless networking system.
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13. The method of claim 12, further comprising:
generating, by the machine learning model, one or more proposed configurations for
the wireless networking system;
predicting a respective result of each of the proposed configurations; and
15 selecting, based on the predicting, one of the proposed configurations, the selected
proposed configuration including the desired configuration change.

14. The method of claim 12, further comprising determining, by the machine
learning model, a learned response indicating a significance of each of the plurality of antennas.
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15. The method of claim 12, wherein the machine learning model is trained using
weighted configuration propositions produced by a telemetry process and a respective quality
measure associated with a region of the wireless networking system affected by each weighted
configuration proposition.
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16. The method of claim 1, wherein:
the method further comprises determining that a wireless client device should be
handed off from one or more currently active antennas over which signals are transmitted or
received on behalf of the wireless client device in a first coverage area;
30 determining the desired configuration change and initiating the desired configuration
change are performed in response to determining that the wireless client device should be
handed off from the one or more currently active antennas; and

initiating the desired configuration change comprises deactivating at least one of the one or more currently active antennas and activating at least one alternate antenna having a second coverage area.

5 17. The method of claim 16, further comprising:

obtaining, using passive telemetry or active telemetry and during operation of the wireless networking system, a measure of a signal quality, error rate, or data rate associated with the wireless client device and the first Wi-Fi transceiver or a measure of a signal quality, error rate, or data rate associated with the wireless client device and a second Wi-Fi transceiver;

10 and

determining that the wireless client device should be handed off from the one or more currently active antennas is dependent on the signal quality, error rate, or data rate associated with the wireless client device and the first Wi-Fi transceiver, or the signal quality, error rate, or data rate associated with the wireless client device and the second Wi-Fi transceiver.

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18. The method of claim 16, wherein:

determining the desired configuration comprises:

modifying a configuration proposition or a configuration proposition weighting;

and

20 initiating production of a new configuration for the wireless networking system dependent on the modified configuration proposition or configuration proposition weighting; and

the method further comprises generating the new configuration for the wireless networking system dependent on the modified configuration proposition or configuration proposition weighting and one or more applicable configuration change constraints.

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19. One or more computer-readable non-transitory storage media storing one or more sequences of instructions which, when executed using one or more processors, cause the one or more processors to:

30 obtain, for each of a plurality of antennas in a wireless networking system, topology information indicating whether and how the antenna is in reach of one or more other antennas in the plurality of antennas, the wireless networking system including two or more Wi-Fi

transceivers coupled to each other in parallel, each of which is operable to be selectively coupled to one or more of the plurality of antennas by respective switches;

determine, dependent on the obtained topology information, a desired configuration change for the wireless networking system, the desired configuration change including a change in which and how many of the plurality of antennas are coupled to the two or more Wi-Fi transceivers or a change in which or how many of the two or more Wi-Fi transceivers are active; and
initiating the desired configuration change.

20. The media of claim 19, wherein to obtain the topology information, the instructions cause the one or more processors to use passive telemetry or active telemetry to obtain, during operation of the wireless networking system, the topology information or neighbor information from which the topology information is derived.

21. The media of claim 19, wherein to obtain the topology information, the instructions cause the one or more processors to correlate transmissions of a transmitting wireless client device between two or more receiving wireless client devices.

22. The media of claim 19, wherein determining the desired configuration change is further dependent on a respective coverage pattern for wireless transmission and reception for one or more of the plurality of antennas.

23. The media of claim 19, wherein to determine the desired configuration change, the instructions cause the one or more processors to determine a set of antennas that, when activated, create a coverage pattern over a collective coverage area that includes at least a desired coverage area.

24. The media of claim 19, wherein:
the antennas coupled to each Wi-Fi transmitter represent a repeated collection of antenna elements each of which contributes to a default coverage pattern for the collection of antenna elements; and

to determine the desired configuration change, the instructions cause the one or more processors to determine a configuration change that results in a change to the coverage pattern for the antennas coupled to the one of the two or more Wi-Fi transceivers.

5 25. The media of claim 19, wherein to determine the desired configuration change, the instructions cause the one or more processors to use a machine learning model that has been trained to produce a discriminator for evaluating proposed configurations for the wireless networking system.

10 26. The media of claim 25, wherein the instructions further cause the one or more processors to:

generate, by the machine learning model, one or more proposed configurations for the wireless networking system;

predict a respective result of each of the proposed configurations; and

15 select, based on the predicting, one of the proposed configurations, the selected proposed configuration including the desired configuration change.

27. The media of claim 25, wherein the machine learning model is trained using weighted configuration propositions produced by a telemetry process and a respective quality
20 measure associated with a region of the wireless networking system affected by each weighted configuration proposition.

28. The media of claim 19, wherein:

25 the instructions further cause the one or more processors to determine that a wireless client device should be handed off from one or more currently active antennas over which signals are transmitted or received on behalf of the wireless client device in a first coverage area;

determining the desired configuration change and the initiating the desired configuration change are performed in response to determining that the wireless client device
30 should be handed off from the one or more currently active antennas; and

to perform initiating the desired configuration change, the instructions cause the one or more processors to deactivate at least one of the one or more currently active antennas and activate at least one alternate antenna having a second coverage area.

29. The media of claim 28, wherein:

the instructions further cause the one or more processors to obtain, using passive telemetry or active telemetry and during operation of the wireless networking system, a
5 measure of a signal quality, error rate, or data rate associated with the wireless client device and the first Wi-Fi transceiver or a measure of a signal quality, error rate, or data rate associated with the wireless client device and a second Wi-Fi transceiver; and

determining that the wireless client device should be handed off from the one or more currently active antennas is dependent on the signal quality, error rate, or data rate associated
10 with the wireless client device and the first Wi-Fi transceiver, or the signal quality, error rate, or data rate associated with the wireless client device and the second Wi-Fi transceiver.

30. The media of claim 28, wherein:

to determine the desired configuration, the instructions cause the one or more
15 processors to:

modify a configuration proposition or a configuration proposition weighting;
and

initiate production of a new configuration for the wireless networking system
dependent on the modified configuration proposition or configuration proposition
20 weighting; and

the instructions further cause the one or more processors to generate the new configuration for the wireless networking system dependent on the modified configuration proposition or configuration proposition weighting and one or more applicable configuration change constraints.
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31. A computer-implemented method of dynamically configuring a wireless networking system, comprising:

obtaining, for each of a plurality of antennas in the wireless networking system, topology information indicating whether and how the antenna is in reach of one or more other
30 antennas in the plurality of antennas, the wireless networking system including two or more Wi-Fi transceivers coupled to each other in parallel, each of which is operable to be selectively coupled to one or more of the plurality of antennas by respective switches, and the obtained

topology information representing one or more configuration propositions for the wireless networking system;

determining, using a machine learning model that has been trained to produce a discriminator for evaluating proposed configurations for the wireless networking system and
5 dependent on the obtained topology information, a respective predicted result of each of the one or more configuration propositions; and

determining, dependent on the predicted results, a set of antennas selected from among the plurality of antennas to be activated in the wireless networking system following a configuration change to the wireless networking system, the configuration change including a
10 change in which and how many of the plurality of antennas are coupled to the two or more Wi-Fi transceivers or a change in which or how many of the two or more Wi-Fi transceivers are active.

32. The method of claim 31, further comprising determining, by the machine
15 learning model, a learned response indicating a significance of each of the plurality of antennas.

33. The method of claim 31, wherein the machine learning model is trained using the one or more configuration propositions as weighted by a telemetry process and a respective quality measure associated with a region of the wireless networking system affected by each
20 weighted configuration proposition.

34. The method of claim 31, wherein obtaining the topology information comprises using passive telemetry or active telemetry to obtain, during operation of the wireless networking system, the topology information or neighbor information from which the topology
25 information is derived.

35. The method of claim 31, wherein the obtained topology information applies to a combination of antennas from which a transmission is received or a combination of receiving antennas.
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36. The method of claim 31, wherein determining the set of antennas is further dependent on a respective coverage pattern for wireless transmission and reception for one or more of the plurality of antennas.

37. The method of claim 31, wherein determining the set of antennas comprises determining a set of antennas that, when activated, create a coverage pattern over a collective coverage area that includes at least a desired coverage area.

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38. The method of claim 31, wherein determining the set of antennas is further dependent on at least one of: optimality, network needs, operator requests, wireless conditions, and client demand.

10 39. The method of claim 38, further comprising:

determining that a wireless client device should be handed off from one or more currently active antennas over which signals are transmitted or received on behalf of the wireless client device in a first coverage area;

15 determining the respective predicted results and determining the set of antennas are performed in response to determining that the wireless client device should be handed off from the one or more currently active antennas; and

initiating the configuration change comprises deactivating at least one of the one or more currently active antennas and activating at least one alternate antenna having a second coverage area.

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40. The method of claim 39, further comprising:

obtaining, using passive telemetry or active telemetry and during operation of the wireless networking system, a measure of a signal quality, error rate, or data rate associated with the wireless client device and the first Wi-Fi transceiver or a measure of a signal quality, error rate, or data rate associated with the wireless client device and a second Wi-Fi transceiver; and

25 determining that the wireless client should be handed off from the one or more currently active antennas is dependent on the signal quality, error rate, or data rate associated with the wireless client device and the first Wi-Fi transceiver, or the signal quality, error rate, or data rate associated with the wireless client device and the second Wi-Fi transceiver.

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41. The method of claim 39, wherein:

determining the set of antennas comprises:

modifying a configuration proposition or a configuration proposition weighting;
and

initiating production of a new configuration for the wireless networking system
dependent on the modified configuration proposition or configuration proposition
weighting; and

the method further comprises generating the new configuration for the wireless
networking system dependent on the modified configuration proposition or configuration
proposition weighting and one or more applicable configuration change constraints.

42. One or more computer-readable non-transitory storage media storing one or
more sequences of instructions which, when executed using one or more processors, cause the
one or more processors to:

obtain, for each of a plurality of antennas in a wireless networking system, topology
information indicating whether and how the antenna is in reach of one or more other antennas
in the plurality of antennas, the wireless networking system including two or more Wi-Fi
transceivers coupled to each other in parallel, each of which is operable to be selectively
coupled to one or more of the plurality of antennas by respective switches, and the obtained
topology information representing one or more configuration propositions for the wireless
networking system;

determine, using a machine learning model that has been trained to produce a
discriminator for evaluating proposed configurations for the wireless networking system and
dependent on the obtained topology information, a respective predicted result of each of the
one or more configuration propositions; and

determine, dependent on the predicted results, a set of antennas selected from among
the plurality of antennas to be activated in the wireless networking system following a
configuration change to the wireless networking system, the configuration change including a
change in which and how many of the plurality of antennas are coupled to the two or more Wi-
Fi transceivers or a change in which or how many of the two or more Wi-Fi transceivers are
active.

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43. The media of claim 42, wherein the machine learning model is trained using the
one or more configuration propositions as weighted by a telemetry process and a respective

quality measure associated with a region of the wireless networking system affected by each weighted configuration proposition.

44. The media of claim 42, wherein to obtain the topology information, the
5 instructions cause the one or more processors to use passive telemetry or active telemetry to obtain, during operation of the wireless networking system, the topology information or neighbor information from which the topology information is derived.

45. The media of claim 42, wherein determining the set of antennas is further
10 dependent on a respective coverage pattern for wireless transmission and reception for one or more of the plurality of antennas.

46. The media of claim 42, wherein to determine the set of antennas, the instructions
15 cause the one or more processors to determine a set of antennas that, when activated, create a coverage pattern over a collective coverage area that includes at least a desired coverage area.

47. The media of claim 42, wherein the instructions further cause the one or more processors to initiate the configuration change.

20 48. The media of claim 42, wherein:
the instructions further cause the one or more processors to determine that a wireless client device should be handed off from one or more currently active antennas over which signals are transmitted or received on behalf of the wireless client device in a first coverage area;

25 determining the respective predicted results and determining the set of antennas are performed in response to determining that the wireless client device should be handed off from the one or more currently active antennas; and

to initiate the configuration change, the instructions cause the one or more processors to deactivate at least one of the one or more currently active antennas and to activate at least
30 one alternate antenna having a second coverage area.

49. The media of claim 48, wherein:

the instructions further cause the one or more processors to obtain, using passive telemetry or active telemetry and during operation of the wireless networking system, a measure of a signal quality, error rate, or data rate associated with the wireless client device and the first Wi-Fi transceiver or a measure of a signal quality, error rate, or data rate associated with the wireless client device and a second Wi-Fi transceiver; and

determining that the wireless client device should be handed off from the one or more currently active antennas is dependent on the signal quality, error rate, or data rate associated with the wireless client device and the first Wi-Fi transceiver, or the signal quality, error rate, or data rate associated with the wireless client device and the second Wi-Fi transceiver.

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50. The media of claim 48, wherein:

to determine the set of antennas, the instructions cause the one or more processors to:

modify a configuration proposition or a configuration proposition weighting;

and

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initiate production of a new configuration for the wireless networking system dependent on the modified configuration proposition or configuration proposition weighting; and

the instructions further cause the one or more processors to generate the new configuration for the wireless networking system dependent on the modified configuration proposition or configuration proposition weighting and one or more applicable configuration change constraints.

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51. A computer-implemented method of performing an antenna handoff in a wireless networking system, comprising:

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determining that a wireless client device should be handed off from one or more currently active antennas over which signals are transmitted or received on behalf of the wireless client device in a first coverage area, the wireless networking system including two or more Wi-Fi transceivers coupled to each other in parallel, each of which is operable to be selectively coupled to one or more of a plurality of antennas by respective switches, and the one or more currently active antennas being coupled to a first one of the two or more Wi-Fi transceivers; and

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initiating a configuration change in the wireless networking system, the configuration change including deactivating at least one of the one or more currently active antennas and activating at least one alternate antenna having a second coverage area.

5 52. The method of claim 51, wherein the at least one alternate antenna is coupled to the first one of the two or more Wi-Fi transceivers.

 53. The method of claim 51, wherein determining that the wireless client device should be handed off from the one or more currently active antennas is dependent on a signal
10 quality, error rate, or data rate associated with the wireless client device and the first Wi-Fi transceiver or a signal quality error rate, or data rate associated with the wireless client device and a second Wi-Fi transceiver.

 54. The method of claim 53, further comprising obtaining, using passive telemetry
15 or active telemetry and during operation of the wireless networking system, a measure of the signal quality, error rate, or data rate associated with the wireless client device and the first or second Wi-Fi transceiver.

 55. The method of claim 51, wherein initiating the configuration change comprises
20 controlling one or more of the respective switches to deactivate the one or more antennas and to activate the at least one alternate antenna.

 56. The method of claim 51, wherein initiating the configuration change comprises:
 selecting a first preconfigured set of antennas including the at least one alternate
25 antenna from among a plurality of preconfigured sets of antennas; and
 controlling one or more of the respective switches to effect a move of signals transmitted or received on behalf of the wireless client device from a second preconfigured set of antennas including the one or more currently active antennas to the first preconfigured set of antennas.

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 57. The method of claim 51, wherein initiating the configuration change comprises:
 modifying a configuration proposition or a configuration proposition weighting; and

initiating production of a new configuration for the wireless networking system dependent on the modified configuration proposition or configuration proposition weighting.

58. The method of claim 57, further comprising generating the new configuration
5 for the wireless networking system dependent on the modified configuration proposition or configuration proposition weighting and one or more applicable configuration change constraints.

59. The method of claim 58, wherein:
10 the plurality of antennas includes a repeated collection of antenna elements each of which contributes to a default coverage pattern for the collection of antenna elements;
the currently active antennas represent a subset of the elements in a first instance of the repeated collection of antenna elements; and
the one or more applicable configuration change constraints include a requirement that
15 the at least one alternate antenna represents the same subset of elements in a second instance of the repeated collection of antenna elements.

60. The method of claim 51, further comprising:
obtaining, for each of the plurality of antennas, topology information indicating
20 whether and how the antenna is in reach of one or more other antennas in the plurality of antennas; and
determining, dependent on the obtained topology information, the configuration change.

25 61. The method of claim 60, wherein obtaining the topology information comprises using passive telemetry or active telemetry to obtain, during operation of the wireless networking system, the topology information or neighbor information from which the topology information is derived.

30 62. The method of claim 60, wherein determining the configuration change comprises determining a set of antennas that, when activated, create a coverage pattern over a collective coverage area that includes at least the second coverage area.

63. The method of claim 60, wherein determining the configuration change comprises using a machine learning model that has been trained to produce a discriminator for evaluating proposed configurations for the wireless networking system.

5 64. The method of claim 63, further comprising:
generating, by the machine learning model, one or more proposed configurations for the wireless networking system;
predicting a respective result of each of the proposed configurations; and
selecting, based on the predicting, one of the proposed configurations, the selected
10 proposed configuration including the configuration change.

65. The method of claim 63, wherein the machine learning model is trained using weighted configuration propositions produced by a telemetry process and a respective quality measure associated with a region of the wireless networking system affected by each weighted
15 configuration proposition.

66. One or more computer-readable non-transitory storage media storing one or more sequences of instructions which, when executed using one or more processors, cause the one or more processors to:
20 determine, for a wireless networking system, that a wireless client device should be handed off from one or more currently active antennas over which signals are transmitted or received on behalf of the wireless client device in a first coverage area, the wireless networking system including two or more Wi-Fi transceivers coupled to each other in parallel, each of which is operable to be selectively coupled to one or more of a plurality of antennas by
25 respective switches, and the one or more currently active antennas being coupled to a first one of the two or more Wi-Fi transceivers;

initiate a configuration change in the wireless networking system, the configuration change including deactivating at least one of the one or more currently active antennas and activating at least one alternate antenna having a second coverage area.

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67. The media of claim 66, wherein:
the instructions further cause the one or more processors to obtain, using passive telemetry or active telemetry and during operation of the wireless networking system, a

measure of a signal quality, error rate, or data rate associated with the wireless client device and the first Wi-Fi transceiver or a measure of a signal quality, error rate, or data rate associated with the wireless client device and a second Wi-Fi transceiver; and

5 determining that the wireless client device should be handed off from one or more currently active antennas is dependent on the signal quality, error rate, or data rate associated with the wireless client device and the first Wi-Fi transceiver, or the signal quality, error rate, or data rate associated with the wireless client device and the second Wi-Fi transceiver.

68. The media of claim 66, wherein to initiate the configuration change, the
10 instructions cause the one or more processors to:

select a first preconfigured set of antennas including the at least one alternate antenna from among a plurality of preconfigured sets of antennas; and

control one or more of the respective switches to effect a move of signals transmitted or received on behalf of the wireless client device from a second preconfigured set of antennas
15 including the one or more currently active antennas to the first preconfigured set of antennas.

69. The media of claim 66, wherein to initiate the configuration change, the instructions cause the one or more processors to:

modify a configuration proposition or a configuration proposition weighting;
20 initiate production of a new configuration for the wireless networking system dependent on the modified configuration proposition or configuration proposition weighting; and

generate the new configuration for the wireless networking system dependent on the modified configuration proposition or configuration proposition weighting and one or more
25 applicable configuration change constraints.

70. The media of claim 66, wherein the instructions further cause the one or more processors to:

obtain, for each of the plurality of antennas, topology information indicating whether
30 and how the antenna is in reach of one or more other antennas in the plurality of antennas; and determine, dependent on the obtained topology information, the configuration change.

71. The media of claim 70, wherein to obtain the topology information, the instructions cause the one or more processors to use passive telemetry or active telemetry to obtain, during operation of the wireless networking system, the topology information or neighbor information from which the topology information is derived.

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72. The media of claim 70, wherein to determine the configuration change, the instructions cause the one or more processors to determine a set of antennas that, when activated, create a coverage pattern over a collective coverage area that includes at least the second coverage area.

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73. The media of claim 70, wherein to determine the configuration change, the instructions cause the one or more processors to use a machine learning model that has been trained to produce a discriminator for evaluating proposed configurations for the wireless networking system.

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74. The media of claim 73, wherein the instructions further cause the one or more processors to:

generate, by the machine learning model, one or more proposed configurations for the wireless networking system;

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predict a respective result of each of the proposed configurations; and

select, based on the predicting, one of the proposed configurations, the selected proposed configuration including the configuration change.

75. The media of claim 73, wherein the machine learning model is trained using weighted configuration propositions produced by a telemetry process and a respective quality measure associated with a region of the wireless networking system affected by each weighted configuration proposition.

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