CLAIMS

What is claimed is:

1. A node, comprising:

a processor;

a wireless transceiver communicatively coupled to the processor and configured to receive communications based on a channel hopping timing interval and a channel hopping sequence; and

a memory communicatively coupled to the processor and comprising instructions that are executable by the processor to cause the processor to:

store a broadcast channel hopping timing interval and a broadcast channel hopping sequence;

store a channel hopping timing and a channel hopping sequence for each of a plurality of tracked neighbor nodes;

determine whether a destination node for a unicast message corresponds to any of the plurality of tracked neighbor nodes;

based on a determination that the destination node does not correspond to any of the plurality of tracked neighbor nodes, determine (i) a next broadcast dwell interval based on the broadcast channel hopping timing interval and (ii) a next broadcast channel based on the broadcast channel hopping sequence;

transmit the unicast message to the destination node during the next broadcast dwell interval; and

based on a determination that the unicast message cannot be sent during the remaining time in the next broadcast dwell interval, back off sending the unicast message to the destination node.

2. The node of claim 1, wherein the memory further comprises instructions that are executable by the processor to cause the processor to:
transmit the unicast message to the destination node during the next broadcast dwell interval via the next broadcast channel.

3. The node of claim 1, wherein the memory further comprises instructions that are executable by the processor to cause the processor to:

prior to sending the unicast message to the destination node:

detect broadcast traffic during the next broadcast dwell interval; and

in response to detecting the broadcast traffic, delay the sending of the unicast message until later in the next broadcast dwell interval.

4. The node of claim 1, wherein the memory further comprises instructions that are executable by the processor to cause the processor to:

prior to sending the unicast message to the destination node:

detect broadcast traffic during the next broadcast dwell interval; and

in response to detecting the broadcast traffic, back off the sending of the unicast message until after the next broadcast dwell interval.

5. The node of claim 1, wherein the memory further comprises instructions that are executable by the processor to cause the processor to:

receive a NACK message from the destination node for the unicast message; and

in response to receiving the NACK message, re-send the unicast message.

6. The node of claim 1, wherein the memory further comprises instructions that are executable by the processor to cause the processor to:

determine a failure to receive an ACK message from the destination node for the unicast message; and

in response to determining the failure to receive the ACK message, re-send the unicast message.

7. The node of claim 1, wherein the memory further comprises instructions that are executable by the processor to cause the processor to:

receive a NACK message from the destination node; and

in response to receiving the NACK message, re-send the unicast message during a later broadcast dwell interval.

8. The node of claim 1, wherein the memory further comprises instructions that are executable by the processor to cause the processor to:

determine a failure to receive an ACK message from the destination node; and

in response to determining the failure to receive the ACK message, re-send the unicast message during a later broadcast dwell interval.

9. The node of claim 1, wherein the memory further comprises instructions that are executable by the processor to cause the processor to:

based on a determination that the destination node corresponds to one of the plurality of tracked neighbor nodes, determine a unicast dwell interval based on a channel hopping timing and a channel hopping sequence for a tracked neighbor node from among the plurality of tracked neighbor nodes; and

transmit the unicast message to the destination node during the unicast dwell interval.

10. The node of claim 1, wherein the memory further comprises instructions that are executable by the processor to cause the processor to:

based on the determination that the destination node does not correspond to a neighbor node of the plurality of tracked neighbor nodes, request the channel hopping timing and the channel hopping sequence for the destination node;

receive the channel hopping timing and the channel hopping sequence for the destination node; and

update a list of the plurality of tracked neighbor nodes by adding the channel hopping timing and the channel hopping sequence for the destination node, wherein the list of the plurality of tracked neighbor nodes comprises the channel hopping timing and the channel hopping sequence for each of the plurality of tracked neighbor nodes.

11. A method for transmitting unicast messages in an unsynchronized channel hopping wireless network, the method comprising:

storing, by a node, a first channel hopping timing interval and a first channel hopping sequence for the node, wherein the node comprises a wireless transceiver and a processor, and wherein the wireless transceiver of the node is configured to receive communications based on the first channel hopping timing interval and the first channel hopping sequence;

storing, by the node, a broadcast channel hopping timing interval and a broadcast channel hopping sequence;

storing, by the node, a plurality of channel hopping timings and channel hopping sequences for each of a plurality of tracked neighbor nodes;

determining, by the node, whether a destination node for a unicast message that is pending at the node corresponds to any of the plurality of tracked neighbor nodes;

based on a determination that the destination node for the unicast message does not correspond to any of the tracked neighbor nodes, determining, by the node, (i) a next

broadcast dwell interval based on the broadcast channel hopping timing interval and (ii) a next broadcast channel based on the broadcast channel hopping sequence;

determining, by the node, to transmit the unicast message to the destination node during the next broadcast dwell interval; and

based on a determination that the unicast message cannot be sent during the remaining time in the next broadcast dwell interval, back off sending, by the node, the unicast message to the destination node.

12. The method of claim 11, further comprising:

sending, by the node, the unicast message to the destination node during the next broadcast dwell interval via the next broadcast channel.

13. The method of claim 11, further comprising:

at a start of the next broadcast dwell interval:

listening, by the node, for broadcast traffic;

detecting, by the node, broadcast traffic during the next broadcast dwell interval; and

in response to detecting the broadcast traffic, delaying, by the node, the sending of the unicast message until after the next broadcast dwell interval.

14. The method of claim 11, further comprising:

prior to sending the unicast message to the destination node:

detecting, by the node, broadcast traffic during the next broadcast dwell interval; and

in response to detecting the broadcast traffic, back off , by the node, the sending of the unicast message.

15. The method of claim 11, further comprising:

receiving, by the node, a NACK message from the destination node; and

in response to receiving the NACK message, re-sending, by the node, the unicast message.

16. The method of claim 11, further comprising:

determining, by the node, a failure to receive an ACK message from the destination node; and

in response to determining the failure to receive the ACK message, re-sending, by the node, the unicast message.

17. The method of claim 11, wherein the destination node is a first destination node, and further comprising:

sending, by the node, a broadcast message to the first destination node and a second destination node during a later broadcast dwell interval.

18. The method of claim 11, further comprising:

sending, by the node, a second unicast message to a first tracked neighbor node of the tracked neighbor nodes by sending the second unicast message during the next channel hopping timing interval for the first tracked neighbor node on a channel defined by the channel hopping sequence for the first tracked neighbor node.

19. The method of claim 11, further comprising:

based on a determination that the destination node does not correspond to a neighbor node of the plurality of tracked neighbor nodes, requesting, by the node, the channel hopping timing and the channel hopping sequence for the destination node;

receiving, by the node, the channel hopping timing and the channel hopping sequence for the destination node; and

updating, by the node, a list of the plurality of tracked neighbor nodes by adding the channel hopping timing and the channel hopping sequence for the destination node, wherein the list of the plurality of tracked neighbor nodes comprises the channel hopping timing and the channel hopping sequence for each of the plurality of tracked neighbor nodes.

20. A system, comprising:

a first node, comprising:

a first processor;

a first wireless transceiver communicatively coupled to the first processor and configured to receive communications based on a channel hopping timing interval and a channel hopping sequence; and

a first memory that is communicatively coupled to the first processor and is configured to provide instructions that are executable by the first processor which cause the first processor to:

store a first broadcast channel hopping timing interval and a first broadcast channel hopping sequence;

store a plurality channel hopping timings and channel hopping sequences for each of a plurality of tracked neighbor nodes;

determine whether a second node for a unicast message is among the plurality of tracked neighbor nodes;

based on a determination that the second node is not among the plurality of tracked neighbor nodes, determine (i) a broadcast dwell interval based on the first broadcast channel hopping timing interval and (ii) a next broadcast channel based on the first broadcast channel hopping sequence; transmit the unicast message to the second node during the broadcast dwell interval; and

based on a determination that the unicast message cannot be sent during the remaining time in the next broadcast dwell interval, back off sending the unicast message to the destination node.

the second node, comprising:

a second processor;

a second wireless transceiver communicatively coupled to the second processor and configured to receive communications based on a second broadcast channel hopping timing interval and a second broadcast channel hopping sequence; and

a second memory communicatively coupled to the second processor and comprising instructions that are executable by the second processor to cause the second processor to:

store the second broadcast channel hopping timing interval and the second broadcast channel hopping sequence;

determine (i) the broadcast dwell interval based on the second broadcast channel hopping timing interval and (ii) the next broadcast channel based on the second broadcast channel hopping sequence;

detect the unicast message during the broadcast dwell interval; and

in response to detecting the unicast message during the broadcast dwell interval, back off sending a broadcast message during the broadcast dwell interval.

21. The system of claim 20, wherein the second memory further comprises instructions that are executable by the second processor to cause the second processor to:

receive the unicast message during the next broadcast dwell interval; and

delay the sending of the broadcast message until a later broadcast dwell interval.

22. The system of claim 20, further comprising:

a third node, comprising:

a third processor;

a third wireless transceiver communicatively coupled to the third processor and configured to receive communications based on a third broadcast channel hopping timing interval and a third broadcast channel hopping sequence; and

a third memory communicatively coupled to the third processor and comprising instructions that are executable by the third processor to cause the third processor to:

detect broadcast traffic during the next broadcast dwell interval; and

back off sending of a second unicast message to the first node or second node during the next broadcast dwell interval.

23. The system of claim 20, further comprising:

a third node, comprising:

a third processor;

a third wireless transceiver communicatively coupled to the third processor and configured to receive communications based on a third broadcast channel hopping timing interval and a third broadcast channel hopping sequence; and

a third memory communicatively coupled to the third processor and comprising instructions that are executable by the third processor to cause the third processor to:

detect broadcast traffic during the next broadcast dwell interval; and

send a broadcast message to the plurality of tracked neighbor nodes during a later broadcast dwell interval.