Claims

1. A method of managing node transmissions in a computer network using a time-slotted channel hopping protocol ("TSCH network"), the method including operations executed by a processor of a first node included in the TSCH network, the operations comprising:

receiving, by the first node, a message-initiation packet from a second node;

determining, by the first node and based on the message-initiation packet, a transmission time of a message content packet associated with the message-initiation packet;

modifying, by the first node, a node-specific transmission delay associated with the second node, the node-specific transmission delay indicating a quantity of backoff time slots during which the first node delays initiating a transmission to the second node;

determining, by the first node, an additional message content packet having a destination for the second node;

queuing, by the first node and based on the node-specific transmission delay, the additional message content packet for transmission to the second node subsequent to the node-specific transmission delay;

determining that the message-initiation packet is a header packet from the second node;

determining a size of the message content packet associated with the header packet;

determining a communication mode indicated by the header packet; and

calculating the quantity of backoff time slots based on the size of the message content packet and the communication mode indicated by the header packet.

2. The method of claim 1, further comprising:

determining, by the first node and based on the message-initiation packet, a recipient node for the message content packet associated with the message-initiation packet, the recipient node being a node other than the first node,

wherein modifying the node-specific transmission delay associated with the second node is responsive to determining that the recipient node is other than the first node.

3. The method of claim 1, further comprising:

determining that an additional packet is a mode-switch packet from the second node, the mode-switch packet indicating a communication mode applied by the second node to the message content packet;

determining a reception sensitivity of the first node; and

determining a transmission output power of the second node,

wherein calculating the quantity of backoff time slots is further based on the reception sensitivity and the transmission power output.

4. The method of claim 3, wherein one or more of the reception sensitivity or the transmission output power are determined based on a history of transmissions between the first node and the second node.

5. The method of claim 3, further comprising:

calculating, based on a history of transmissions between the first node and the second node, multiple default backoff values, each of the multiple default backoff values being associated with a particular communication mode in a set of communication modes;

responsive to receiving the mode-switch packet, identifying a particular default backoff value associated with the communication mode indicated by the mode-switch packet; and

responsive to determining that the mode-switch packet is associated with a prior transmission from the first node to the second node, modifying the particular default backoff value based on (i) a size of the prior transmission and (ii) the communication mode indicated by the mode-switch packet,

wherein calculating the quantity of backoff time slots comprises calculating the quantity of backoff time slots based on the modified backoff value.

6. The method of claim 1, wherein determining the additional message content packet includes one or more of:

receiving the additional message content packet from a third node, or

generating the additional message content packet by the first node.

7. The method of claim 1, further comprising:

updating a node status table to include a communication status associated with the second node, the updated communication status indicating the second node is unavailable to receive transmissions during the quantity of backoff time slots.

8. The method of claim 1, further comprising:

identifying, by the first node, a queued message packet having a destination for a third node, the queued message packet having a queue position subsequent to the additional message content packet; and

responsive to determining that the third node is available to receive transmissions during the quantity of backoff time slots, modifying the queue position of the queued message packet to be prior to the additional message content packet.

9. The method of claim 1, wherein modifying the node-specific transmission delay includes adjusting the quantity of backoff time slots to include a conflict-avoidance delay.

10. A computer network node configured for managing node transmissions in a computer network using a time-slotted channel hopping protocol ("TSCH network"), the computer network node including a processor that is configured to perform operations comprising:
receiving a message-initiation packet from an additional node in the computer network;
determining, based on the message-initiation packet, a quantity of backoff time slots during which the additional node transmits a message content packet associated with the message-initiation packet;

modifying a node-specific transmission delay associated with the additional node, the node-specific transmission delay indicating the additional node is unavailable to receive transmissions during the quantity of backoff time slots;

receiving an additional message content packet having a destination for the additional node; and

queuing, based on the node-specific transmission delay, the additional message content packet for transmission subsequent to the quantity of backoff time slots,
wherein determining the quantity of backoff time slots comprises:

determining that the message-initiation packet is a header packet from the additional node;

determining a size of the message content packet associated with the header packet;

determining a communication mode indicated by the header packet; and

calculating the quantity of backoff time slots based on the size of the message content packet and the communication mode.

11. The computer network node of claim 10, the processor further configured for:

determining, by the computer network node and based on the message-initiation packet, a recipient node for the message content packet associated with the message-initiation packet, the recipient node being a node other than the computer network node,

wherein modifying the node-specific transmission delay associated with the additional node is responsive to determining that the recipient node is other than the computer network node.

12. The computer network node of claim 10, wherein determining the quantity of backoff time slots comprises:

determining that the an additional packet is a mode-switch packet from the additional node, the mode-switch packet indicating a communication mode used by the additional node;

determining a reception sensitivity of the computer network node; and

determining a transmission output power of the additional node,

wherein calculating the quantity of backoff slots is further based on the reception sensitivity and the transmission power output.

13. The computer network node of claim 12, wherein one or more of the reception sensitivity or the transmission output power are determined based on a history of transmissions between the computer network node and the additional node.

14. The computer network node of claim 12, the processor further configured for:

calculating, based on a history of transmissions between the computer network node and the additional node, multiple default backoff values, each of the multiple default backoff values being associated with a particular communication mode in a set of communication modes;

responsive to receiving the mode-switch packet, identifying a particular default backoff value associated with the communication mode indicated by the mode-switch packet; and

responsive to determining that the mode-switch packet is associated with a prior transmission from the computer network node to the additional node, modifying the particular default backoff value based on (i) a size of the prior transmission and (ii) the communication mode indicated by the mode-switch packet,

wherein calculating the quantity of backoff time slots comprises calculating the quantity of backoff time slots based on the modified backoff value.

15. The computer network node of claim 10, wherein receiving the additional message content packet includes one or more of:

receiving the additional message content packet from a further node in the computer network, or

generating the additional message content packet by the computer network node.

16. The computer network node of claim 10, the processor further configured for:
updating a node status table to include a communication status associated with the additional node, the updated communication status indicating the additional node is unavailable to receive transmissions during the quantity of backoff time slots.

17. The computer network node of claim 10, the processor further configured for:
identifying, by the computer network node, a queued message packet having a destination for a further node in the computer network, the queued message packet having a queue position subsequent to the additional message content packet; and
responsive to determining that the further node is available to receive transmissions during the quantity of backoff time slots, modifying the queue position of the queued message packet to be prior to the additional message content packet.

18. The computer network node of claim 10, wherein modifying the node-specific transmission delay includes adjusting the quantity of backoff time slots to include a conflict-avoidance delay.