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(54) **Title:** WIRELESS MESH NETWORK WITH PINCH POINT AND LOW BATTERY ALERTS

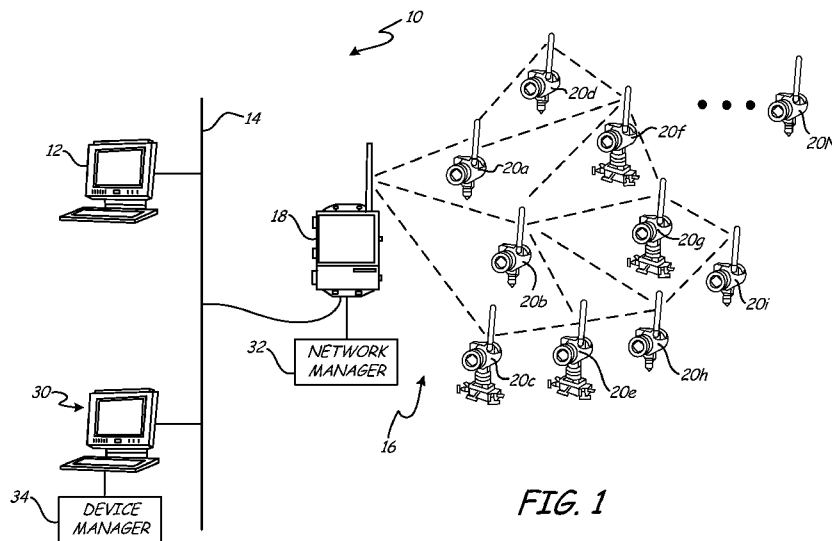


FIG. 1

(57) **Abstract:** A wireless mesh network includes a plurality of wireless devices and a gateway organized in a multi hop mesh topology. Each wireless device maintains and reports radio statistics to the gateway, and also reports battery conditions of its power source. The device manager communicates with the gateway and provides an alert indicating existence of a pinch point within the mesh network based upon the radio statistics. When a low battery condition is reported by a device, the device manager determines whether loss of that device is a pinch point or will cause a pinch point, and provides a low battery alert prioritized based upon the pinch point analysis.

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AMENDED CLAIMS

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CLAIMS:

1. A wireless mesh network comprising:
 - a gateway;
 - a plurality of wireless devices, each wireless device providing radio statistics and battery condition to the gateway;
 - a network manager for scheduling communication among the wireless devices and gateway and defining communication paths between the gateway and the wireless devices based upon radio statistics provided by the wireless devices;
 - and
 - a device manager for providing a pinch point alert indicating existence of a pinch point within the mesh network based upon radio statistics.
2. The wireless mesh network of claim 1, wherein the device manager provides a prioritized low battery alert based upon battery condition data and an actual or potential pinch point associated with a source of the battery condition data.
3. The wireless mesh network of claim 1, wherein the radio statistics include at least one of identification of neighbors, received signal strength from neighbors, percentage of successful communications with neighbors, number of parents to each wireless device, number of children to each wireless device, a parent-to-children ratio, a parent-to-neighbor ratio, and a children-to-neighbor ratio.
4. The wireless mesh network of claim 1, wherein the device manager performs a pinch point analysis based upon a number of wireless devices within radio range of the gateway.
5. The wireless mesh network of claim 1, wherein the device manager performs a pinch point analysis based upon a percentage of all wireless devices in the network that are within radio range of the gateway.
6. The wireless mesh network of claim 1, wherein the device manager performs a pinch point analysis based upon neighbors of each wireless device.
7. The wireless mesh network of claim 6, wherein the pinch point analysis includes an evaluation of standard deviation of the number of neighbors and one wireless device to a mean value of neighbors per wireless device in the network.
8. The wireless mesh network of claim 1, wherein the device manager performs a pinch point analysis based upon a parent-to-children ratio.

9. The wireless mesh network of claim 8, wherein the pinch point analysis includes an evaluation of statistical deviation of the parent-to-children ratio of one wireless device to a mean value of the parent-to-children ratio for the network.
10. The wireless mesh network of claim 1, wherein the device manager provides a visual display that includes a visual representation of a particular wireless device that is a pinch point.
11. A method comprising:
 - collecting radio statistics from a wireless devices of a wireless mesh network;
 - determining communication paths, parent-child relationships and communication time slots for the wireless devices based upon the radio statistics;
 - identifying a pinch point within the wireless mesh networks based upon the radio statistics; and
 - producing an alert that indicates existence of the pinch point.
12. The method of claim 11 and further comprising:
 - receiving battery condition data from the wireless devices; and
 - producing a prioritized low battery alert if a wireless device with a low battery is a pinch point.
13. The method of claim 11 and further comprising:
 - receiving battery condition data from the wireless devices; and
 - producing a prioritized low battery alert if failure of a wireless device with a low battery will cause a pinch point to occur.
14. The method of claim 11, wherein the radio statistics include at least one of identification of neighbors, received signal strength from neighbors, percentage of successful communications with neighbors, number of parents to each wireless device, number of children to each wireless device, a parent-to-children ratio, a parent-to-neighbor ratio, and a children-to-neighbor ratio.
15. The method of claim 11, wherein identifying a pinch point includes performing a pinch point analysis based upon a number of wireless devices within radio range of the gateway.
16. The method of claim 11, wherein identifying a pinch point includes performing a pinch point analysis based upon neighbors of each wireless device.

17. The method of claim 11, wherein identifying a pinch point includes performing a pinch point analysis based upon at least one of a parent-to-children ratio, a parent-to-neighbor ratio, and a children-to-neighbor ratio.
18. The method of claim 11 and further comprising:
 - providing a visual display that includes a visual representation of a particular wireless device that is a pinch point.
19. A method comprising:
 - collecting radio statistics from wireless devices of a wireless mesh network;
 - determining communication paths, parent-child relationships, and communication time slots for the wireless devices based upon the radio statistics;
 - receiving battery condition data from the wireless devices; and
 - producing a low battery alert based upon the battery condition data and the radio statistics.
20. The method of claim 19, wherein the prioritized low battery alert is produced if a wireless device with a low battery condition is a pinch point, or failure of the wireless device will cause another wireless device in the wireless mesh network to become a pinch point.