Improvement of Handoff Performance in Wireless Mesh Networks

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Acknowledgment

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2.1 Wireless Mesh Network

As various wireless networks evolve into the next generation to provide better services, a key technology, wireless mesh networks (WMNs) has emerged recently. In WMNs, nodes are comprised of mesh routers and mesh clients. Each node operates not only as a host but also as a router, forwarding packets on behalf of other nodes that may not be within direct wireless transmission range of their destinations. A WMN is dynamically self-organized and self-configured, with the nodes in the network automatically establishing and maintaining mesh connectivity among themselves.

Conventional nodes, e.g., desktops, laptops, PDAs, PocketPCs, phones, equipped with wireless network interface cards (NICs) can be connected directly to wireless mesh routers. Customers without wireless NICs can access WMNs by connecting to wireless mesh routers through, for example, Ethernet. Thus, WMNs will greatly help users to be always- on-line anywhere anytime. Moreover, the gateway/bridge functionalities in mesh routers enable the integration of WMNs with various existing wireless networks such as cellular systems, wireless sensor networks, wireless-fidelity (Wi-Fi) systems and worldwide inter-operability for microwave access (WiMAX)networks.

2.1.1 Network Architecture

WMNs consist of two types of nodes: mesh routers and mesh clients. Other than the routing capability for gateway/repeater functions as in a conventional wireless router, a wireless mesh router contains additional routing functions to support mesh networking. To further improve the flexibility of mesh networking, a mesh router is usually equipped with multiple wireless interfaces built on either the same or different wireless access technologies.

Mesh clients also have the necessary functions for mesh networking, and thus can also work as a router in WMN. However, gateway or bridge functions do not exist in these nodes. In addition, mesh clients usually have only one wireless interface. As a consequence, the hardware platform and the software for mesh clients can be much simpler than those for mesh routers. Mesh clients have a greater variety of devices compared to mesh routers. They can be a laptop/desktop PC, pocket PC, PDA, IP phone, RFID reader, BACnet (Building Automation and Control network) controller, and many other devices

The architecture of WMNs can be classified into three main groups based on the functionality of the nodes.

Infrastructure/Backbone WMNs

Infrastructure/Backbone WMN includes mesh routers that form an infrastructure for clients that connect to them. The WMN infrastructure/backbone can be built using various types of radio technology, in addition to the heavily used IEEE 802.11 technology. The mesh routers form a mesh of self-configuring, self- healing links among themselves. With gateway functionality, mesh routers can be connected to the Internet. This approach, also referred to as infrastructure meshing, provides backbone for conventional clients and enables the integration of WMNs with existing wireless networks, through gateway/bridge functionalities in mesh routers.

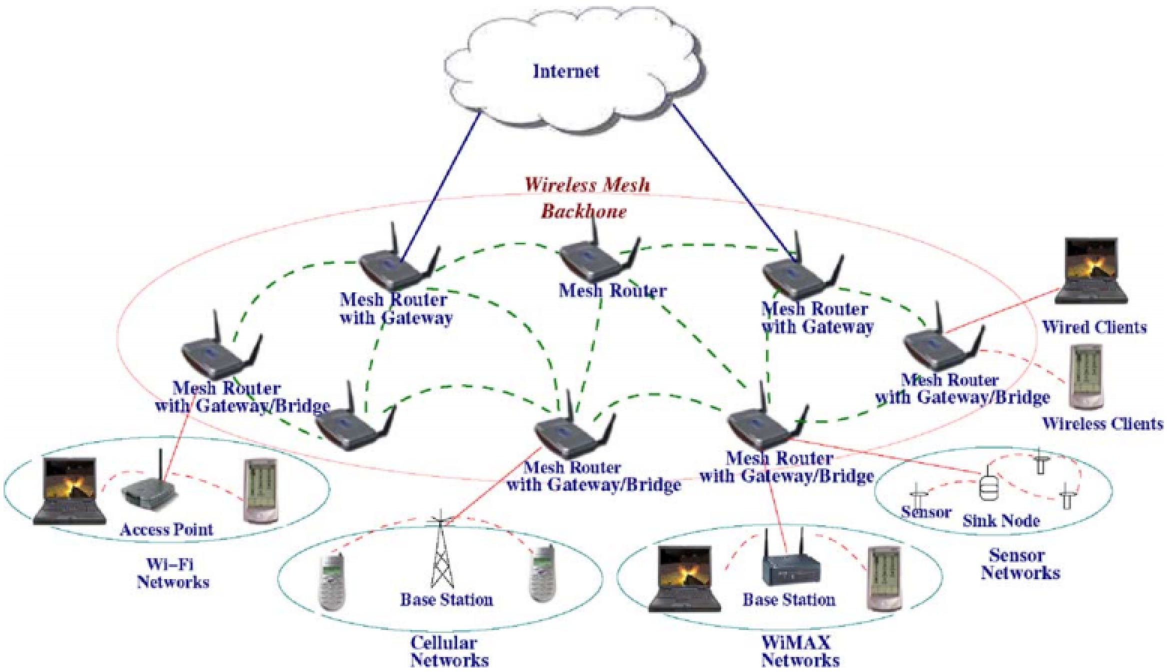

Figure 2.1: Infrastructure/Backbone WMN

Infrastructure/Backbone WMNs are the most commonly used type. For example, community and neighborhood networks can be built using infrastructure meshing. The mesh routers are placed on the roofs of houses in a neighborhood, and these can serve as access points for users in homes and along the roads. Typically, two types of radio are used in the routers, i.e., for backbone communication and for user communication. The mesh backbone communication can be established using long- range communication techniques including, for example, directional antennas.

Client WMNs

Client meshing provides peer-to-peer networks among client devices. In this type of architecture, client nodes constitute the actual network to perform routing and configuration functionalities as well as providing end-user applications to customers. Hence, a mesh router is not required for this type of network.

Hybrid WMNs

This architecture is the combination of infrastructure and client meshing. Mesh clients can access the network through mesh routers as well as directly meshing with other mesh clients.

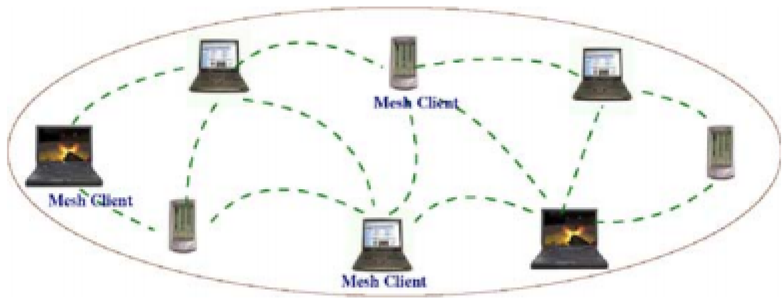

Figure 2.2: Client WMNs

While the infrastructure provides connectivity to other networks such as the Internet, Wi-Fi, WiMAX, cellular, and sensor networks, the routing capabilities of clients provide improved connectivity and coverage inside the WMN.

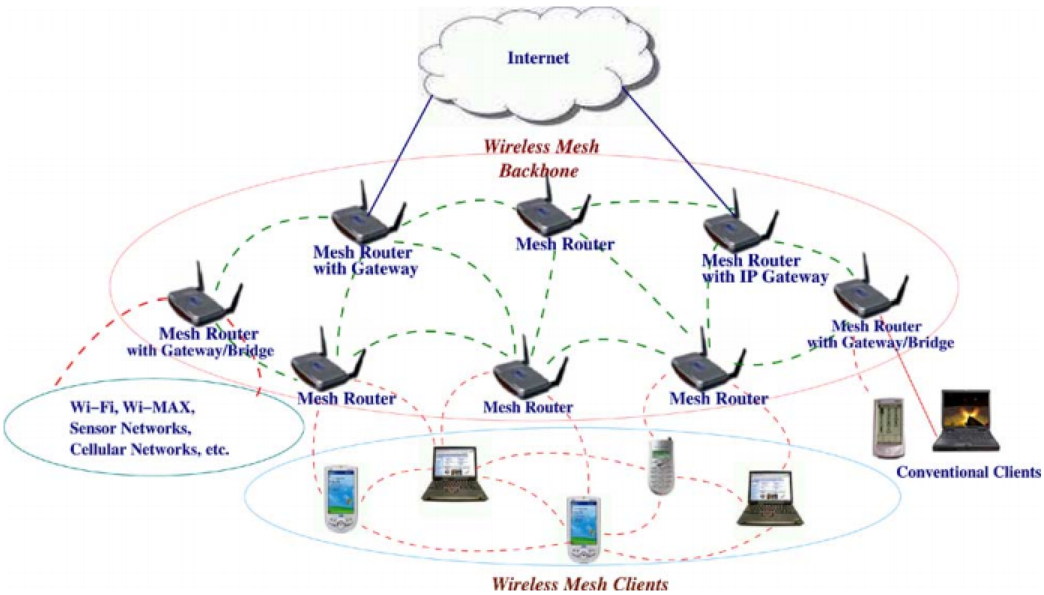

Figure 2.3: Hybrid WMNs

2.1.2 Application

Research and development of WMNs is motivated by several applications which clearly demonstrate the promising market, but, at the same time, these applications cannot be supported directly by other wireless networks such as cellular systems, ad hoc networks, wireless sensor networks, standard IEEE 802.11, etc. In this section, we discuss these applications.

- Broadband home networking
- Community and neighborhood networking
- Enterprise networking
- Metropolitan area networks (MAN)
- Transportation systems

- Building automation
- Health and medical systems
- Security surveillance systems

In addition to the above applications, WMNs can also be applied to spontaneous (emergency/disaster) networking and P2P communications. For example, wireless networks for an emergency response team and firefighters do not have in-advance knowledge of where the network should be deployed. By simply placing wireless mesh routers in desired locations, a WMN can be quickly established. For a group of people holding devices with wireless networking capability, e.g., laptops and PDAs, P2P communication anytime anywhere is an efficient solution for information sharing. WMNs are able to meet this demand. These applications illustrate that WMNs are a superset of ad hoc networks, and thus, can accomplish all functions provided by ad hoc networking.

2.2 Routing Protocols

WMNs will be tightly integrated with the Internet, and IP has been accepted as a network layer protocol for many wireless networks including WMNs. However, routing protocols for WMNs are different from those in wired networks and cellular networks. Therefore, we focus our study on routing protocols in this section. Since WMNs share common features with adhoc networks, the routing protocols developed for ad hoc networks can be applied to WMNs.

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6.1 Conclusion

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