WIRELESS MESH NETWORK BASED ON DESIGN AND IMPLEMENTATION

[1]Md Rashid Hussain , [2]Prof. (Dr.) Pankaj Kumar

[1]Research Scholar, B.R.Ambedkar Bihar University, Bihar (India)
[2]HOD Electronics Department, L.S. College Muzaffarpur(India)

ABSTRACT

In spite of the massive efforts in researching and developing mobile ad hoc networks in the last decade, this type of network has not yet witnessed mass-market deployment. The low commercial penetration of products based on ad hoc networking technology could be explained by noting that the ongoing research is mainly focused on implementing military or specialized civilian applications. To turn mobile ad hoc networks into a commodity, we should move to more pragmatic" opportunistic ad hoc networking" in which multihop ad hoc networks are not isolated self-configured networks, but rather emerge as a flexible and low-cost extension of wired infrastructure networks coexisting with them. Indeed, a new class of networks is emerging from this view: mesh networks. We provide a survey of the current state of the art in off-the-shelf and proprietary solutions to build wireless mesh networks. Finally, we address the challenges of designing a high performance, scalable, and cost-effective wireless mesh networks.

I INTRODUCTION

Mobile (multi hop) ad hoc networks (MANETs) are collections of mobile nodes connected together over a wireless medium. These nodes can freely and dynamically self-organize into arbitrary and temporary ad hoc network topologies, allowing people and devices to seamlessly inter network in areas with no preexisting communication infrastructure (e.g., disaster recovery and battlefield environments).

After almost a decade of research into ad hoc networking, MANET technology has not yet affected our way of using wireless networks. A common answer is emerging: most of the ongoing research on mobile ad hoc networks is driven by either Department of Defense (DoD) requirements (large-scale military applications with thousands of ad hoc nodes) or specialized civilian applications (disaster recovery, planetary exploration, etc).

To turn MANETs into a commodity, we move to a more pragmatic "opportunistic ad hoc networking" in which multi hop ad hoc networks are not isolate self-configured networks, but networks coexisting with them. Indeed, a new class of networks is emerging from this view: Mesh networks.

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 (creating, in effect, an ad hoc network).

II MESH NETWORKS

Mesh networks are built on a mix of fixed and mobile nodes interconnected via wireless links to form a multihop ad hoc network. As in MANETs, users' devices are an active part of the mesh. They dynamically join the network, acting as both user terminals and routers for other devices, consequently further extending network coverage. Mesh networks thus inherit many results from MANET research but have civilian applications as the main target. Furthermore, while the MANET development approach was mainly simulation-based, from the beginning mesh networks have been associated with real test beds. Even though mesh networks are quite recent, they have already shown great potential in the wireless market. Indeed, we can subdivide mesh networks into two main classes: off-the-shelf and proprietary solutions.

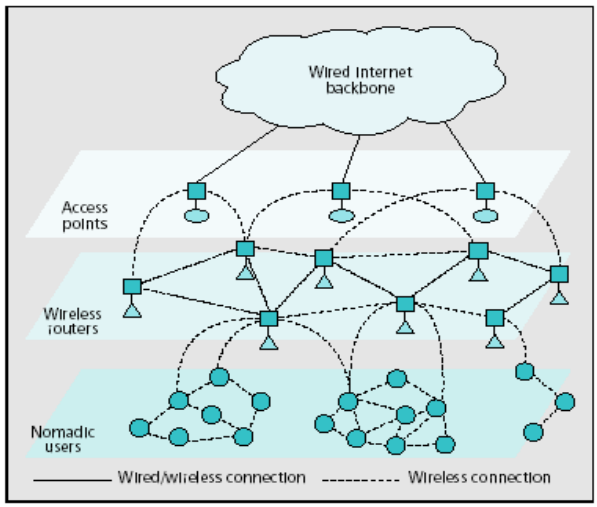
III SYSTEM AND NETWORK ARCHITECTURES FOR WIRELESS MESH NETWORKS

A wireless mesh network is a fully wireless network that employs multihop communications to forward traffic en route to and from wired Internet entry points. Different from flat ad hoc networks, a mesh network introduces a hierarchy in the network architecture with the implementation of dedicated nodes (called wireless routers) communicating among each other and providing wireless transport services to data traveling from users to either other users or access points (access points are special wireless routers with a high-bandwidth wired connection to the Internet backbone). The network of wireless routers forms a wireless backbone (tightly integrated into the mesh network), which provides multihop connectivity between nomadic users and wired gateways. The meshing among wireless routers and access points creates a wireless backhaul communication system, which provides each mobile user with a low-cost, high-bandwidth, and seamless multihop interconnection service with a limited number of Internet entry points and with other wireless mobile users. Specifically in the mesh case, the traffic is originated in the users' devices, traverses the wireless backbone, and is distributed over the Internet network. To summarize, Figure 1: illustrates the mesh network architecture, highlighting the different components and system layers.

IV POPULAR COMMERCIAL APPLICATIONS FOR WIRELESS MESH NETWORKS

4.1 Intelligent Transportation Systems

Several public transportation companies, government agencies, and research organizations are looking for viable solutions to realize intelligent transport systems (i.e., integrated public transportation systems that are built to be safe, cost effective, efficient, and secure). Wireless mesh could be the flexible solution to implement the information delivery system required to control transportation services, as depicted in figure 2.



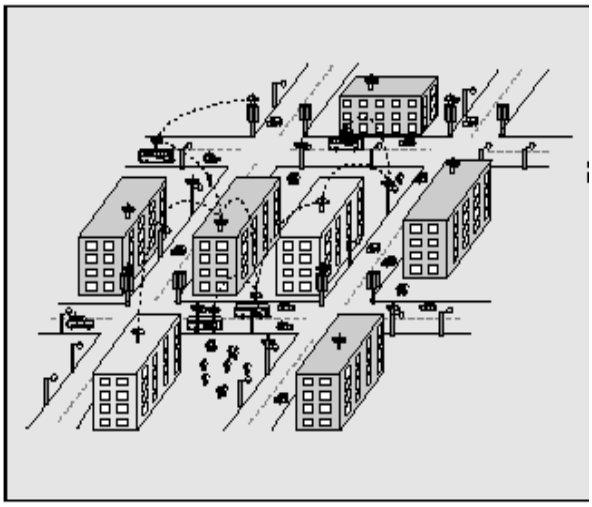
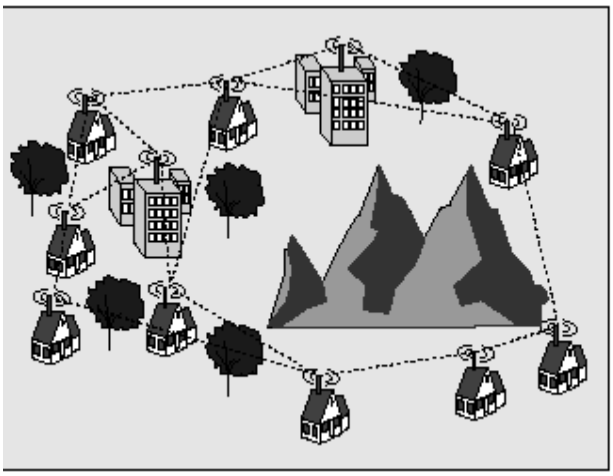


Fig 1: Three-Tier Architecture For Wireless Mesh Network Fig 2: Intelligent transportation system

4.2 Public Safety

The 9/11 events have dramatically increased interest in public safety (police, fire departments, first responders, and emergency services), creating additional demand and urgency for wireless network connectivity to provide mobility support, reliability, flexibility, and high bandwidth. For years, solutions based on cellular technologies have been used, but they have proved to be unsatisfactory in many aspects as shown in Fig 3:



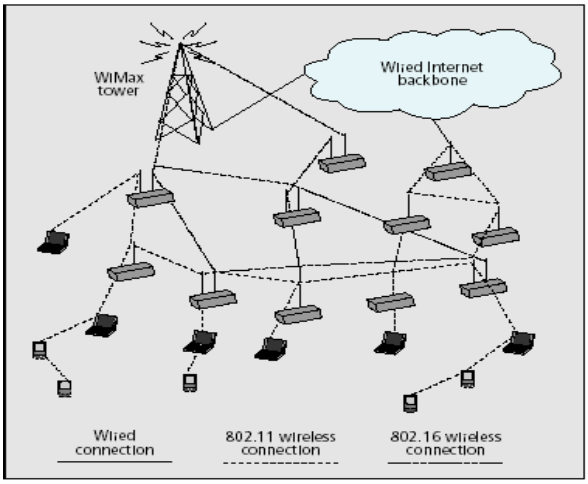


Fig 3: **Fig 4:**

Fig 3: Residential Broadband Access for Hard to Reach and/or Scarcely Populated Areas.

Fig 4: Integration of WiMAX and Wi-Fi technologies in large-scale Wireless mesh networks.

V CHARACTERISTICS

1) Multi-hop wireless network-An objective to develop WMNs is to extend the coverage range of current wireless networks without sacrificing the channel capacity.

2) Support for ad hoc networking, and capability of self-forming, self-healing, and self-organization- WMNs enhance network performance, because of flexible network architecture, easy deployment and configuration, fault tolerance, and mesh connectivity, i.e., multipoint-to-multipoint Communications.

3) Multiple types of network access- In WMNs, both backhaul access to the Internet and peertol peer (P2P) communications are supported.

4) Dependence of power-consumption constraints on the type of mesh nodes-Mesh routers usually do not have strict constraints on power consumption. However, mesh clients may require power efficient protocols.

5) Compatibility and interoperability with existingwireless networks-

For example, WMNs built based on IEEE 802.11 technologies [133,69] must be compatible with IEEE 802.11 standards in the sense of supporting both mesh capable and conventional Wi-Fi clients. Such WMNs also need to be inter-operable with other wireless networks such as WiMAX, Zig-Bee [148], and cellular networks.

VI ADVANTAGES OF MESH NETWORKS

1) Reduction of Installation Costs

Currently, one of the major efforts to provide wireless Internet beyond the boundaries of indoor WLANs is through the deployment of Wi-Fi hotspots. Basically, a hot spot is an area that is served by a single WLAN or a network of WLANs, where wireless clients access the Internet through an 802.11-based access point.

2) Large-Scale Deployment

In recently standardized WLAN technologies (i.e., 802.11a and802.11g), increased data rates have been achieved by using more spectrally efficient modulation schemes. However, for a specific transmit power, shifting toward more efficient modulation techniques reduces coverage (i.e., the further from the access point, the lower the data rate available).

3) Reliability

The wireless backbone provides redundant paths between each pair of endpoints, significantly increasing communications reliability, eliminating single points of failure and potential bottleneck links within the mesh.

4) Self-Management

The adoption of peer-to-peer networking to build a wireless distribution system provides all the advantages of ad hoc networking, such as self-configuration and self-healingness.

VII KEY RESEARCH CHALLENGES

The wireless infrastructure meshing formed through multihop communications among wireless routers and access points cannot be treated simply as a large multihop ad hoc network, because the structure and functionalities of such a network are radically different from those of a general ad hoc network. Consequently, one of the major problems to address while building a multihop wireless backhaul network is the scalability of both the network architecture and protocols. Hence, in the following sections we discuss the most relevant and promising research activities, focusing on the design and development of a scalable and high-performance wireless backbone for mesh networks.

1) High-capacity and reliable radio interfaces for the wireless backbone

Currently, there are several research efforts to improve the capacity of wireless mesh networks by exploiting such alternative approaches as multiple radio interfaces, multiple-input multiple-output (MIMO) techniques, beam forming antennas, and opportunistic channel selection.

2) Designing scalable and opportunistic networking functions

It is well known that as the number of users increases, random MAC protocols suffer from increased contention in the network. Moreover, users' traffic traversing the wireless backbone does not have a unique fixed destination, but rather can be delivered to any wired access point. As a result, new scalable, MAC, and routing protocols have to be designed to efficiently manage data traffic.

VIII CONCLUSION

The mesh network architecture addresses the emerging market requirements for building wireless networks that are highly scalable and cost effective, offering a solution for the easy deployment of high-speed ubiquitous wireless Internet. Finally, it is worth pointing out that mesh networking, as a special case of ad hoc networking, should fully implement self-management, self-configuration, and self-healing features in all key research challenge is also to ensure that the scalable and opportunistic networking functions designed specifically for the mesh networks effectively fulfill the requirements of the peer-to peer networking paradigm adopted in the wireless backbone. WMNs can be built up based on existing technologies. Some companies already have products for sale, while other companies have started to deploy WMNs in various application scenarios.As explained throughout this paper, many open research issues need to be resolved:

1) Scalability

2) Self-organization and self-configuration-

3) Security

4) Network integration

REFERENCES

[1] Raffaele Bruno, Marco Conti, Enrico Gregori , "Mesh networks: Commodity Multihop Ad Hoc Networks" , IEEE Communications Magazine , vol. 40 , no. 4, Mar. 2005, pp 123-131.

[2] A.A. Abouzeid, S. Roy, Stochastic modeling of TCP in networks with abrupt delay variations, ACM/ Kluwerreless Networks 9 (2003) 509–524.

[3] L. Buttyan, J.-P. Hubaux, Rational exchange—a formal model based on game theory, in: 2nd International Workshop on Electronic Commerce, November 2001.

[4] F. Cali, M. Conti, E. Gregori, Dynamic tuning of the IEEE 802.11 protocol to achieve a theoretical throughput limit, IEEE/ACM Transactions on Networking 8 (6)(2000) 785–799.

[5] S. Cen, P.C. Cosman, G.M. Voelker, End-to-end differentiation of congestion and wireless losses, IEEE/ACM Transactions on Networking 11 (5) (2003) 703–717.

[6] K. Chandran, S. Raghunathan, S.R. Prakash, A feedback-based scheme for improving TCP performance in ad hoc wireless networks, IEEE Personal Communications 8 (1) (2001) 34–39.

[7] W.-T. Chen, P.-Y. Chen, Group mobility management in wireless ad hoc networks, in: IEEE Vehicular Technology Conference, Fall 2003, pp. 2202–2206.

[8] P. Chevillat,[1] J. Jelitto, [2]A.N. Barreto, H.L. Truong, A dynamic link adaptation algorithm for IEEE 802.11a wireless LANs, in: IEEE International Conference on Communications (ICC), 2003, pp. 1141–1145.

[9] M. Chiang,To layer or not to layer: balancing transport and physical layers in wireless multihop networks, in: IEEE Annual Conference on Computer Communications (INFOCOM), 2004, pp. 2525–2536.

[10] C.F. Chiasserini, R.R. Rao, A distributed power management policy for wireless ad hoc networks, in: IEEE Wireless Communications and Networking Conference (WCNC), 2000, pp. 1209–1213.