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Wireless mesh networks: a survey

Ian F. Akyildiz ^a ... Weilin Wang ^b

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Abstract

Wireless mesh networks (WMNs) consist of mesh routers and mesh clients, where mesh routers have minimal mobility and form the backbone of WMNs. They provide network access for both mesh and conventional clients. The integration of WMNs with other networks such as the Internet, cellular, IEEE 802.11, IEEE 802.15, IEEE 802.16, sensor networks, etc., can be accomplished through the gateway and bridging functions in the mesh routers. Mesh clients can be either stationary or mobile, and can form a client mesh network among themselves and with mesh routers. WMNs are anticipated to resolve the limitations and to significantly improve the performance of ad hoc networks, wireless local area networks (WLANs), wireless personal area networks (WPANs), and wireless metropolitan area networks (WMANs). They are undergoing rapid progress and inspiring numerous deployments. WMNs will deliver wireless services for a large variety of applications in personal, local, campus, and metropolitan areas. Despite recent advances in wireless mesh networking, many research challenges remain in all protocol layers. This paper presents a detailed study on recent advances and open research issues in WMNs. System architectures and applications of WMNs are

described, followed by discussing the critical factors influencing protocol design. Theoretical network capacity and the state-of-the-art protocols for WMNs are explored with an objective to point out a number of open research issues. Finally, testbeds, industrial practice, and current standard activities related to WMNs are highlighted.



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Keywords

Wireless mesh networks; Ad hoc networks; Wireless sensor networks; Medium access control; Routing protocol; Transport protocol; Scalability; Security; Power management and control; Timing synchronization

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Ian F. Akyildiz received his BS, MS, and PhD degrees in Computer Engineering from the University of Erlangen-Nuernberg, Germany, in 1978, 1981 and 1984, respectively.

Currently, he is the Ken Byers Distinguished Chair Professor with the School of Electrical and Computer Engineering, Georgia Institute of Technology and Director of Broadband and Wireless Networking Laboratory.

He is the Editor-in-Chief of Computer Networks (Elsevier) Journal and of Ad Hoc Networks (Elsevier) Journal.

He is an IEEE FELLOW (1995), an ACM FELLOW (1996). He served as a National Lecturer for ACM from 1989 until 1998 and received the ACM Outstanding Distinguished Lecturer Award for 1994.

He received the 1997 IEEE Leonard G. Abraham Prize award (IEEE Communications Society) for his paper entitled "Multimedia Group Synchronization Protocols for Integrated Services Architectures" published in the IEEE Journal of Selected Areas in Communications (JSAC) in January 1996.

He received the 2002 IEEE Harry M. Goode Memorial award (IEEE Computer Society) with the citation "for significant and pioneering contributions to advanced architectures and protocols for wireless and satellite networking".

He received the 2003 IEEE Best Tutorial Award (IEEE Communication Society) for his paper entitled "A Survey on Sensor Networks", published in IEEE Communication Magazine, in August 2002.

He received the 2003 ACM SIGMOBILE award for his significant contributions to mobile computing and wireless networking.

His current research interests are in wireless mesh networks, sensor networks, InterPlanetary Internet, wireless networks and satellite networks.





Xudong Wang received his B.E. and Ph.D. degrees from Shanghai Jiao Tong University, Shanghai, China, in 1992 and 1997, respectively. From 1998 to 2003, he was with the Broadband and Wireless Networking (BWN) Lab at Georgia Institute of Technology. He also received the Ph.D. degree from Georgia Institute of Technology in 2003. Currently, he is a senior research engineer with Kiyon, Inc., where he conducts research and development of MAC, routing, and transport protocols for wireless mesh networks. His research interests also include software radios, cross-layer design, and communication protocols for cellular, mobile ad hoc, sensor, and ultra-wideband networks.

He is a technical committee member of IEEE/ACM BroadWISE 2004, SANPA 2004, IEEE ITRE 2005, EWSN 2005, and ConWiN 2005. He has been a technical reviewer for numerous international journals and conferences. He has two patents pending in wireless mesh networks. He is a member of IEEE, ACM, and ACM SIGMOBILE.



Weilin Wang received his BS degree in radio-electronics from Zhongshan University, MS in computer science from New York University, and Ph.D. in electrical engineering from City College of New York. He is the head of Kiyon's™ autonomous networks R&D group. His research interests are in the areas of broadband wireless mesh network architecture and protocols. Prior to Kiyon, he was with Graviton's™ wireless technology division, co-developed a multichannel MAC and multihop routing wireless sensor networking system for homeland security applications. He was previously chief network architect at OMM, working on high speed switching subsystems for wavelength switching, routing, and mesh restoration. Earlier he was a senior advisor and architect at Nortel Networks advanced technology lab and broadband networks division, and contributed to Nortel's™ intellectual property portfolio development, OPS terabit router QoS and MPLS capabilities, and the success of Nortel's™ dynamic routing controller product line. He has a number of issued patents and several pending in the areas of wireless mesh networks.

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