

# Performance for Wireless Mesh Networks

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Tutorial

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**Abstract**

Mesh networks have become increasingly important because they can be easily implemented without much infrastructure and can support adequate bandwidth with a flexible multi-hop wireless communication among their routers serving the clients. Besides broadband internet connectivity, WMN envision a numerous applications such as building automation, VoIP over wireless, video delivery, home networking etc.

This tutorial provides an overview of the Wireless Mesh Networks (WMNs) and identifies various associated characteristics. We present the evolution of mesh technology and also describe the IEEE 802.11s standard that formalizes the physical and MAC layer of WMN. We systematically analyze the key challenges in each layer of the network and discuss feasible state-of-the-art protocols. We provide a broad insight into many open research issues such as radio resource management, multipath route determination protocol, queue management policy to ensure fairness of multihop flows, etc. As WMNs are envisioned for supporting high bandwidth applications with minimum investment costs, it is important to develop a guideline for designing and deploying a WMN. We address in this tutorial some fundamental design issues such as optimal number of MRs and IGWs and an optimal placement strategy to maximize the network capacity. Further, we analyze important channel assignment strategies to be followed during deployment of a WMN that maximally utilizes the network resources such as radio interfaces, channel. We also address other issues such as load balancing among MRs to avoid congestion near the IGW and ensure a scalable operation. Finally, we outline various security challenges that are impeding the rapid deployment of mesh networks.

We also cover key results from our research and other active researchers that address the above research issues in WMNs. We also identify useful research directions which can catalyze

new research efforts. Future widespread deployment of the WMN seems quite promising, even though several design issues still remain real bottlenecks. After attending this tutorial, attendees will have a clear understanding of the mesh technology, the various security issues pertinent to mesh networks and some elegant solutions to deal them.

**Dharma P Agrawal** was on sabbatical leave at the CMU during 2006-2007. His current research interests include resource allocation and security in mesh networks, efficient deployment and security in sensor networks, use of Femto cells, and heterogeneous wireless. At UC, he has led implementation of 26 nodes Wireless Mesh Network in 8th floor of 3 Engineering buildings. He has co-authored a textbook entitled Introduction to Wireless and Mobile Systems, third edition, and Ad hoc and Sensor Networks- Theory and Applications. He has been the Program Chair and General Chair for numerous international conferences and meetings. He was awarded a "Third Millennium Medal," by the IEEE for his outstanding contributions. He has published over 580 papers, delivered keynote speech for 22 international conferences, and given 29 different tutorials and extensive training courses in various in the areas of Ad hoc and Sensor and Mesh Networks, including security issues. He has graduated 59 PhDs and 45 MS students. He has been named as an ISI Highly Cited Researcher and has been recently awarded IEEE CS Harry Goode Award. He is a Fellow of the IEEE, the ACM, the AAAS and the World Innovation Foundation.

**Authors:**

Agrawal , Dharma P

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