

**Title:** Cross-Layer Design for Multi-hop Wireless Networks: A Loose-Coupling Perspective

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**Abstract:**

The layered networking architecture has been key to the enormous success and widespread usage of the Internet, as well the initial development of wireless systems. The success of the layered architecture has been its ability to provide modularity and transparency between the layers. However, it is becoming increasingly clear that optimizing within layers is insufficient to obtain the orders-of-magnitude performance gains necessary to fuel major growth in next-generation wireless services. To achieve these performance gains, it is imperative that network protocols and designs are engineered by optimizing across the layers (cross-layer design). The idea is that by jointly optimizing the control over two or more layers, cross-layer solutions can yield significantly improved performance by exploiting the tight coupling between the layers in wireless systems. However, the Achilles heel of cross-layer design is its potential to destroy modularity, and make the overall system fragile. Thus, there is a fundamental tradeoff between efficiency and modularity that needs to be carefully taken into account in any cross-layer solution.

In this talk, we will emphasize the importance of taking a "loose-coupling" approach in the development of cross-layer solutions for wireless systems. By loose-coupling we mean that that there must be only a minimal amount of interaction between the layers, and the overall solution must be robust to imperfect decisions/information at each layer. Thus, the goal is to obtain a high degree of efficiency while retaining modularity. We will provide three relevant case studies to demonstrate the importance and efficacy of this approach, starting with cross-layer design between the MAC and physical layer, and work our way up to the transport layer.

**Intended Audience:** This tutorial is intended for researchers and engineers in both industry and academia that would like to have a deeper understanding of the issues and challenges involved in the development of cross-layer design for wireless networks. Researchers with either a CS or EE background will be able to follow and benefit from this tutorial.

**Biography:** Ness B. Shroff is a Professor of Electrical and Computer Engineering at Purdue University. He is also the director of the Center for Wireless Systems and Applications (CWSA), a university-wide multi-disciplinary center on wireless systems and applications.

His research interests span the areas of wireless and wireline communication networks. He is especially interested in fundamental problems in the design, performance, pricing, and security of these networks. His research is funded by various companies such as Intel, Hewlett Packard, Nortel, AT&T, BAE systems, and L. G. Electronics; and government agencies such as the National Science Foundation (NSF), Defense Advanced Research Projects Agency (DARPA), Indiana Dept. of Transportation, and the Indiana 21st Century fund.

Dr. Shroff is an editor for IEEE/ACM Trans. on Networking and the Computer Networks Journal, and past editor of IEEE Communications Letters. He has served on the technical and executive committees of several major conferences and workshops. He was the technical program co-chair of IEEE INFOCOM'03, the premier conference in communication networking. He was also the conference chair of the 14th Annual IEEE Computer Communications Workshop (CCW'99), the program co-chair for the symposium on high-speed networks, Globecom 2001, and the panel co-chair for ACM Mobicom'02. Dr. Shroff was also a co-organizer of the NSF workshop on Fundamental Research in Networking, held in Arlie House Virginia, in 2003. He received the NSF CAREER award in 1996 and the best paper of the year award for Computer Networks, in 2003. See <http://www.ece.purdue.edu/~shroff/> for further details.