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IEEE Communications Surveys & Tutorials

WELCOME to the first issue of 2011 of the IEEE Communications Surveys and Tutorials. The articles in this issue survey research efforts in areas ranging from coding and MIMO techniques to link layer techniques in wireless mesh networks as well as the application of computational intelligence in wireless sensor networks. Moreover, backhaul from wireless cellular networks as well as failure localization in optical networks are covered in this issue.

Shannon's theory proved that it is possible to transmit information with an arbitrary degree of reliability over an unreliable channel as long as the information transmission rate is less than the channel capacity. Low-density parity-check (LDPC) codes along with turbo codes have been key steps towards making Shannon's theory practical. In "Low-Density Parity-Check Codes and Their Rateless Relatives," Bonello, Chen, and Hanzo first a give a simple and concise introduction to the basic principles of LDPC codes. They then provide a historical review of the major milestones in the development of LDPC codes, ranging from code construction through bit error rate performance metrics to hardware implementations, and quantum error correction codes. They similarly review the history of rateless codes and conclude with a summary and future research directions.

By exploiting the spatial domain, multiple input-multiple output (MIMO) communications technologies have been instrumental in the recent advances in terrestrial wireless systems toward gigabit wireless networking. Inspired by the successes in MIMO-based terrestrial wireless communication, there has been significant recent research effort toward exploiting MIMO techniques in satellite communications. In "MIMO over Satellite: A Review," Arapoglou, Liolis, Bertinelli, Panagopoulos, Cottis, and De Gaudenzi, give a comprehensive review of this research on MIMO over satellite. They first give a brief introduction to terrestrial MIMO, covering both single-user and multi-user MIMO. They proceed to describe the satellite channel characteristics, both for fixed satellites and mobile satellites. For both the cases of fixed and mobile satellites, they then review the existing research on the application of MIMO and outline future research directions.

Wireless multi-hop mesh networking among several mobile devices, such as a group of laptops, is emerging as an important internetworking paradigm. Consequently, the IEEE 802.11 family of wireless networking standards is being extended to cover wireless mesh networking in the IEEE 802.11s amendment. In "IEEE 802.11s Multihop MAC: A Tutorial," Carrano, Magalhães, Muchaluat Saade, and Albuquerque provide a detailed tutorial of the IEEE 802.11s amendment. They first give an overview of the IEEE 802.11 wireless LAN standard, before briefly introducing wireless mesh networks, including their routing protocols. They then give a detailed introduction to the IEEE 802.11s amendment. This detailed introduction covers the principles for the multi-hop MAC mesh network architecture, the path selection mechanisms, as well as the frame structure and syntax. The authors then use an example scenario to explain in detail the mesh network formation and path discovery, which operates with MAC addresses at the link layer.

Wireless sensor networks (WSNs) are complex and changing systems that present challenges in a vast set of areas, including localization, routing and clustering, as well as security and quality of service. Computational intelligence (CI) techniques, such as fuzzy logic and evolutionary algorithms, can be very successful in complex and changing systems. In "Computational Intelligence in Wireless Sensor Networks: A Survey," Kulkarni, Förster, and Venayagamoorthy survey the application of CI techniques to WSNs. They first give overviews of WSNs and CI techniques. They then survey the application of computational intelligence techniques to the WSN areas of (i) design, deployment, security and localization, (ii) energy aware routing and clustering, and (iii) scheduling, data aggregation/fusion, and QoS management. They then conduct a meta-analysis of the application of different CI techniques to the range of WSN challenges to identify promising areas for future research.

The backhaul of mobile device traffic from the base stations to the radio network controllers accounts for a large fraction of the operating cost of wireless cellular networks. Efficient backhaul techniques have therefore become an area of intense study. In "The Evolution of Cellular Backhaul Technologies: Current Issues and Future Trends," Tipmongkolsilp, Zaghloul, and Jukan survey existing backhaul techniques and outline future research trends. They first review the development of backhaul techniques from copper and optical fiber networks through microwave and satellite backhaul to pseudowire techniques. They then delve into more detailed reviews of wireless backhaul solutions as well as the timing and synchronization aspects of backhaul. They conclude with a comprehensive comparison of the reviewed techniques and outline open challenges.

All-optical networks operate at very high transmission rates. Thus, link failures quickly lead to enormous amounts of lost data. Fast link failure localization techniques are critical for promptly detecting and locating any failed links in the network. In "Optical Layer Monitoring Schemes for Fast Link Failure Localization in All-Optical Networks," Wu, Ho, Yeung, Tapolcai, and Mouftah survey fast failure localization techniques operating at the optical layer. They cover monitoring (m)-cycle techniques, non-simple m-cycle techniques, and m-trail techniques. They give a detailed review of the existing bounds on the number of monitors and outline a

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number of future research directions for fast optical layer fault localization.

The expansion of new technologies is expected to offer economic growth in the wired and wireless technological networking environment, while at the same time, it will offer a wide variety of services and give the possibility for utilizing technologies for the benefit of many subscribers. The Pricing Schemes are designed to offer profitable business to the Wireless Service Providers (WSPs), as well as, to create favorable services for the mobile subscribers and eventually to get charged according to their services usage. In "A Survey of Pricing Schemes in Wireless Networks," Gizelis and Vergados classify the Pricing Schemes based on their ability to adapt to the needs of the WSPs and their subscribers during the entire service period, into Static-based Pricing and Dynamic-based Pricing Schemes. The Pricing Schemes are also analyzed in detail and are further classified according to the factors involved in the price calculation of a service, i.e. the Service Level Agreement (SLA), the subscription type, the negotiation capabilities between WSPs and their subscribers, the network capacity, the available bandwidth and frequency spectrum, the network hops, and the Base Stations (BSs). The affected elements by the pricing network are also discussed, together with the performance evaluation of the presented pricing schemes.

We hope that you found the articles of this issue informative and useful. Please bear in mind that we have an open call for submissions of surveys and tutorials on any communications or networking related topic. I hope that you will consider developing and submitting an article. In addition, we would appreciate if you could please encourage others to develop an article whenever you believe sharing their expertise would be valuable to our community. Please refer to the Author Guidelines at http://www.comsoc.org/pubs/surveys for detailed submission instructions and submit your paper at http://mc.manuscriptcentral.com/comst-ieee.

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