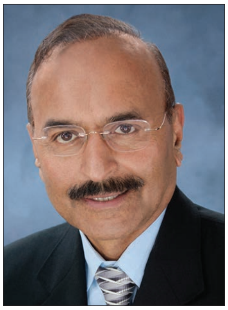
RADIO COMMUNICATIONS: COMPONENTS, SYSTEMS AND NETWORKS



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Primarily due to the integration of concepts from networks as diverse as cognitive radio, 5G cellular, sensors, and WLANs, coupled with the desire to provide seamless connectivity across multiple technologies and the proliferation of the number of mobile applications and attached devices, modern wireless networks are becoming (if not already) quite complex and heterogeneous. An emerging communication paradigm encompasses device-to-device multi-hop interactions in a dense urban environment, performing traffic offloading and relaying from one network to the other. Examples include cellular to WLAN handoffs and vice versa, and multi-tier cellular networks. These networks may even belong to different operators.

In emerging wireless networks a call or connection may have to traverse more than one link from its origin to reach a base station (BS). The same holds true at the destination. For example, assume that a call originates on a cognitive link, but the primary user (PU) arrives sooner than the call can complete. As a result, the call will need to be switched to another available link provided a backup link is available. Otherwise, the call may have to be dropped, or some other option must be pursued.

A multiplicity of options exist. If the PU does not return, then the call may move to a mobile receiver via a relay, assuming that relaying is the only means that has been provisioned for mobile to mobile communication, and there is such a receiver for the specific session in the neighboring small cell. It is possible that there is no such receiver; in this case, the system has no choice but to relay the call to a neighboring WLAN, if one is available in the neighborhood.

In addition to WLAN offloading, there may be other options for traffic offloading: for example, utilizing the presence of femto-cells or small cells, or other tiers of a cellular network. If none of these options is available and there is no return of the PU, then the user may alternatively transmit toward a base station directly, or by relaying through a neighboring small cell. Similar options need to be pursued at the terminating end-point as well. Thus, in the near future a user will have more than one choice for mobile network connectivity. The offloading decisions, however, will be made by network operators considering factors such as cost, traffic volume, terminal interfaces, and interference (SINR) among cells in the neighborhood.

As you can guess, traffic offloading, multi-hop relaying, and mobile handoffs from one network to the other will take place in the presence of all sorts of interference and impairments. To facilitate reliable communication in such an environment, we need to research and develop novel interference and impairment mitigation techniques.

In this issue of Radio Communications, we include an article, "The Sector Offset Configuration Concept and Its applicability to Heterogeneous Cellular Networks," which focuses on interference mitigation techniques used when a call moves from a small cell to a serving macro-cell through multiple handoffs. As discussed above, femto-cells are deployed indoors in large numbers today, and small cells (pico- or micro-cells) are deployed outdoors to interwork with macro-cells to provide enhanced coverage.

In general, small cells are configured to transmit on a dedicated frequency carrier, which limits the number of channels that small cells and macro-cells can access. A better solution is to utilize co-channels that are available to both the small and macro-cells. However, this co-channel solution introduces additional cross-tier interference that affects coverage, capacity, and handoff management. Recently, enhanced inter-cell interference coordination (ICIC) techniques have been proposed to overcome cross-tier interference, such as carrier aggregation (CA) in frequency domain, and the almost blank subframe (ABS) approach in the time-domain. The article describes both approaches in detail along with their limitations and effectivenesss.

In this article, authors present a novel technique for cross-tier interference mitigation based on a sector offset configuration that significantly improves cell-edge user throughput without affecting the frequency reuse factor. They show via simulation that the proposed technique provides an improvement to ICIC between small and macro-cells, particularly for users of small cells who are located at the edge of the coverage area. The improvement of ICIC additionally leads to an improvement in the handover performance for both single and multi-carrier cellular networks.

In future issues of this Series, we look forward to bringing you similar timely articles from our community of authors covering emerging trends in wireless communications R&D. We also thank our readership for their time and attention.

BIOGRAPHIES

THOMAS ALEXANDER [M] (talexander@ixiacom.com) is a senior architect at Ixia. Previously, he has worked at VeriWave Inc. (acquired by Ixia), PMC-Sierra Inc, and Bit Incorporated (acquired by PMC-Sierra), and prior to that was a research assistant professor at the University of Washington. He has been involved in various aspects of wired and wireless networking R&D since 1992, in the areas of ATM, SONET/SDH, Ethernet, and (since 2002) wireless LANs. He is also active in standards development, and has served as editor of IEEE 802.3ae, chief editor of IEEE 802.17, and technical editor of IEEE 802.11. He received his Ph.D. degree from the University of Washington in 1990.

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