HETNETS – A NEW PARADIGM FOR INCREASING CELLULAR CAPACITY AND COVERAGE

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Wireless data traffic has been increasing exponentially in recent years. Driven by a new generation of devices (smart phones, MIDs, netbooks, etc.), capacity demand increases faster than spectral efficiency improvement, particularly at hotspots/areas. Also, as services migrate from voice centric to data centric, more users operate indoors, which requires increased link budget and coverage extension to provide uniform user experience. Traditional networks optimized for homogeneous traffic face unprecedented challenges to meet the demand cost effectively. Most recently, Third Generation Partnership Project (3GPP) Long Term Evolution (LTE)-Advanced has started a new study item to investigate heterogeneous network (HetNet) deployments as an efficient way to improve system capacity as well as effectively enhance network coverage. Unlike traditional heterogeneous networks that deal with the interworking of wireless local area networks and cellular networks, which the research community has already studied for more than a decade, in this new paradigm in the cellular network domain, a HetNet is a network containing nodes with different characteristics such as transmission power and radio frequency (RF) coverage area. Low-power micro nodes and high-power macro nodes can be maintained under the management of the same operator. They can share the same frequency band, provided by the operator. In this case, joint radio resource/interference management needs to be provided to ensure the coverage of low-power nodes. In some other cases, the low- and high-power nodes can use discontinuous bands of an operator separately (e.g., through carrier aggregation) so that strong interference with each other can be avoided. Macro network nodes with large RF coverage areas are deployed in a planned way for blanket coverage of urban, suburban, and rural areas. Local nodes with small RF coverage areas aim to complement the macro network nodes for coverage extension or throughput enhancement. In addition to this, global coverage can be provided by satellites (macrocells) according to an integrated system concept. The objective of HetNets targets the improvement of overall capacity as well as a cost-effective coverage extension and green radio solution by deploying additional network nodes within the local area range, such as low-power micro/pico network nodes, home-evolved Node-Bs (HeNBs)/closed subscriber group (CSG) cells, and femto and relay nodes.

The topic of HetNets has gained much momentum in the industry and research community very recently. It has attracted the attention of the standardization bodies, such as 3GPP LTE and IEEE 802.16j, whose objectives are to look into increasing the capacity and coverage of cellular networks. There is an urgent need in both industry and academia to better understand the technical details and performance gains made possible by HetNets. We planned this special issue to help address that need, and would like to focus on recent advances as well as survey papers in HetNets.

The response to our Call for Papers was overwhelming, with a large number of papers submitted from around the globe. During the review process, each paper was assigned to and reviewed by at least three independent experts in the relevant area, with a rigorous two-round review process. Due to the lack of space, we can only accommodate eight excellent articles covering various aspects of heterogeneous networks involving interference coordination, capacity and coverage enhancement, cooperative relay-based HetNets, macro-femto cell deployment and management, and efficient HetNet implementation.

The first article is an invited article from a group of experts in R&D for HetNets, Damnjanovic *et al.* "A Survey on 3GPP Heterogeneous Networks" gives an excellent summary on the current state of the art in heterogeneous deployments and focuses on the 3GPP LTE air interface to describe future HetNet trends.

The second article, "Enhanced Intercell Interference Coordination Challenges in Heterogeneous Networks" by Lopez-Perez *et al.*, focuses on the standardization activities within 3GPP related to enhanced intercell interference coordination for HetNets.

The third article, "Capacity and Coverage Enhancement in Heterogeneous Networks" by Yeh *et al.*, provides an overview of heterogeneous network architectures comprising hierarchical multitier, multiple access technology deployments based on newer infrastructure elements.

In the fourth article, "On Exploiting Cognitive Radio to Mitigate Interference in Macro/Femto Heterogeneous Networks," Cheng *et al.* study possible interference mitigation approaches including orthogonal radio resource assignment in the time-frequency and antenna spatial domains, as well as interference cancellation via new decoding techniques, to explore cognitive radios in HetNets environment.

Peng *et al.* in the fifth article, "Hierarchical Cooperative Relay-Based Heterogeneous Networks to Support Unicast and Multicast Services," present a hierarchical cooperative relay-based HetNet to support both unicast and multicast services, where hierarchical cooperative relay nodes are deployed to provide cost-effective coverage extension based on the convergence of heterogeneous radio networks.

In the sixth article, "Improving Physical Layer Multicast by Cooperative Communications in Heterogeneous Networks," Xie *et al.* study the deployment of HetNets from the perspective of cooperative communications to improve the performance of physical layer multicast.

The seventh article, "Macro-Femto Heterogeneous Network Deployment and Management: From Business Models to Technical Solutions" by Lin *et al.*, discusses the business model in macro-femto heterogeneous networks. They propose three frameworks according to the deployment types of femtocells, which are joint deployment, wireless service provider deployment and user deployment frameworks.

Last but not least, Li *et al.* present the eighth article, "Efficient HetNet Implementation Using Broadband Wireless Access with Fiber-Connected Massively Distributed Antennas Architecture." In this article, the authors introduce a new HetNet architecture employing fiber-connected distributed antenna systems, which facilitates coordination of resource allocation and interference management.

In closing, we would like to thank all the authors for their excellent contributions. We would also like to thank all the reviewers for their dedicated time in reviewing the papers, and for their valuable comments and suggestions for improving the quality of the articles. Finally, we appreciate the advice and support of the Editor-in-Chief of *IEEE Wireless Communications* Dr. Yuguang Michael Fang for his strong support and help in the publication process.

BIOGRAPHIES

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