6
Summary and Conclusions

6.1 SUMMARY

Cross Layer Design (CLD) is a study of cooperation between multiple layers of the 7 layer OSI model to combine resources and create a reconfigurable network. Many new cross layer protocols, which enable better performance and throughput without significantly increasing complexity, have been published in the literature. However, one needs to be aware that any unstructured changes to an existing standard can lead to a brittle solution that would be hard to maintain and sustain over a longer period of time. Hence, such proposed changes must be carefully evaluated on an experimentation system, chosen carefully from a large number of academic and commercial systems available today. A novel contribution of this thesis is the presentation of a framework for objectively evaluating these systems. This proposed framework, which contains metrics such as cost, latency and throughput, will help designers make informed trade-off decisions between various requirements and develop systems most optimized for CLD. To prove the utility of this framework, this thesis analyzes various commercial and academic platforms. This analysis shows that while these platforms have significantly accelerated the pace of PHY layer research, they are not perfectly suited for MAC layer research. This has led to the emergence of a new design space for MAC layer prototyping systems where the key requirements are latency, processing speed, and cost. In this thesis, a hardware design has been presented which demonstrates that availability of commercial technology and careful trade-off with other requirements is making it feasible to design a system that meets these key requirements. Finally, this thesis presents a new cross layer protocol which uses knowledge of radio's front end impairments to improve system performance and demonstrates how it can be implemented on the proposed experimentation system.

6.2 CLOSING COMMENTS

This thesis focuses on a single carrier modulation scheme because of the simplicity involved in establishing the mathematical foundations of the proposal. The scope of future work in this area involves validating the proposed idea on SC-FDMA scheme used in LTE uplink modulation and OFDM schemes used in IEEE 802.11 ac standard. Scope of future work includes testing the proposed idea for higher symbol rate communication schemes and for MIMO systems. MAC for multi-user MIMO, meeting latency requirements for deterministic control applications, dealing with increasingly wide bandwidth channels, and hybrid communications that can hand-off between WLAN to 5G standards are some of the many aspects of MAC protocols that require active research. Solving these complex challenges will require a future generation of computer scientists who fully understand the core fundamentals of their work. The purpose of the system proposed in this thesis is to achieve this goal. The scope of future work includes prototyping the system described in this thesis, validating its performance with real-world signals, and exploring creative ways to further lower the cost of the system. Scope of future work also includes creating an open source software library of MAC layer protocols and teaching aids which will help lower the cost of ownership and drive widespread adoption of this system.

…