Chapter 3

COGNITIVE TRENDS IN MAKING
Future of Networks

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Abstract: We are arguing that some new interesting trends in making are emerging. In this paper we try to identify some aspects that could provide hard problems with potentially high payout for the future research. We also show how some of the topics are shared between both wireless and fixed network domain. We propose as a hypothesis that the key issue in the future is to understand and lower the increasing complexity (increasing abstraction) of communications systems. There are several different ways towards this goal.

1. INTRODUCTION

For this contribution we have chosen few possible trends-in-making that could have a relatively large impact on the future research of wireless and fixed networks. This selection is focused to few possible long term issues, and as such we do not claim to provide comprehensive roadmap of the future technologies. The selection is in large part merely author’s personal guesstimate on emerging and interesting research lines that have been suggested. One could also see this invited contribution as (in part) an extension to earlier work1, which was more firmly based to heterogeneous networking. There are number of interesting reports and works describing the possible future R&D issues, among them we can refer to excellent treatments by Raymond Steele2, David Farber3 and to the NSF report of the future of networking research4.

We focus mostly on wireless communications and networking perspective. The discussion is aimed to look at trends and architectural
principles, so we are not rich on details – taking into account the speculation required to looking for future trends we think that this is somewhat acceptable for invited “future trends” paper. Our main premise is that different adaptive and intelligent approaches will become part of wireless and fixed network architectures. The expressed thinking and work has been influenced and derived from a large part from the viewpoint of wireless communications and software radio research. The seminal work, and highly recommendable paper, approaching the same idea space as ours through innovating \textit{knowledge plane} from the Internet perspective is described by D. Clark \textit{et al.} \cite{Clark2002}.

2. \textsc{Complexity and Tussles}

2.1 Status Quo

The cellular networks, unlicensed short range communications networks, and most notably Internet have been great successes. The incremental works in different subtopics are making these successes even greater and pervasive. However, as has been noted in several contributions\cite{Caldwell2002,Clark2002}, we should be careful on not to abandon more fundamental and disruptive research.

The success of wireless networks and Internet has been driven by many reasons. However, one can claim that in large part the relatively clean and simple architecture has been one of the key ingredients for the success. Both systems have also been providing a relatively easy access to end-users. Especially terminals of mobile communication are typical consumer equipments (mobile phones), i.e. very easy to use, although the technology inside is relatively complex. However, one should note the potential “VCR-clock syndrome”; as the number of features increases with mobile phones ever larger portion of users are not using those or even are not aware of all capabilities.

The number of mobile phones has already exceeded 1 billion worldwide, and also current IPv4 based Internet has become a huge and relatively complex network to comprehend (in part since the end-to-end principle is not anymore fully adhered due to e.g. NATs). In short, networks are becoming larger, there is tendency to glue them together (like all-IP approach), and stakeholders try-and-add ever increasing number of features into them (like QoS, support for multicasting, labeling etc.). All of these interesting and valuable issues are omitted in the following discussion, and