Closing the Gap Between Industry, Academia and Users: Is There a Need for QoS in Wireless Systems ?

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Abstract. In this short paper we make the point that although there may be a gap between academic and industrial research in the area of quality of service (QoS), this gap can be narrowed. In order for this to happen, it is important that the academic and industrial players jointly make an effort to better understand business drivers and end user needs and analyze how networks are used and how they are likely to evolve. That is, understanding the key drivers (the "why"-s) in the QoS area is the key in bringing academic and industrial research (that aims to answer the "how"-s) closer to each other.

1 Introduction

The convergence of the tele/datacommunications, computer and consumer electronics industry offers players in these areas opportunities for expanding their sales and profit, but also the threat of being marginalized. While it is difficult to predict the winners, we believe that those who understand key research challenges and invest in the "right" research and development (R&D) projects have an advantage. Therefore, understanding the reasons behind the different directions taken in industrial and academic research is of interest for both of these groups.

The "industry-academia gap" cannot be understood and overcome without analyzing the relationship between industry players and the actual end users. The downtrend in the data- and telecommunications market in the past years has brought industry players to focus on delivering technology tailored to immediate customer (for example large telecommunications operator) needs. This has contributed to widening the gap in some areas between the industry and the academia. This effect has been exacerbated by efforts devoted by the industry (along with the networking research community) to technologies that did not prove successful in terms of end user deployment. The lesson learned is that the research community should be taking a step back and take a realistic look at how networks are used and how they are likely to evolve [1], [2]. Specifically, in the area of wireless QoS solutions, it seems especially important that the driving factors are well identified. This is because sophisticated QoS techniques tend to tempt researchers (notably the performance evaluation community) to propose far too complex architectures and algorithms that are not justified by end user requirements.

2 QoS and Price Differentiation in Wireless Mobile Systems

We are currently witnessing a rapid growth of the wireless voice and data market. This in turns results in an increasing traffic volume over wireless network segments both in the local and wide area and both in private and public environment. [1]

The vast majority of IP networks is lightly loaded, and there are research data available that indicate that it will remain that way for the foreseeable future. In addition, overprovisioning helps to eliminate the need to maintain state information in the network, which helps in keeping the network architecture as simple as possible [4].

As IP meets the wireless world, the debate whether overprovisioning is a viable solution for QoS is still open. On one side, the proponents of open spectrum argue that spectrum itself is not such a scarce resource as many believed so far [5]. Also, the success of wireless local area networks, basically without any support for QoS differentiation mechanisms seemed to reinforce the argument that providing application level QoS is technically possible over best effort networking technologies. On the other side, the WLAN community has also recognized the technical benefits of supporting traffic differentiation over the air interface and started work on QoS within the 802.11 standards suite (802.11e). Also, claims about the abundance of spectrum resources remain questionable (just think of the tight regulatory policies, the narrowness of the ISM bands, and the price GSM operators in Europe had to pay for licences). Third generation cellular networks employ sophisticated QoS management and make very efficient use of spectrum resources, be they based on the wideband code division multiple access (WCDMA) or the cdma2000 standards suite. 3G network operators are interested in QoS mechanisms, because they help reduce operational and capital expenditures and facilitate the timely introduction of new services.

Finally, the emergence of beyond 3G architectures and the integration of various multiple access technologies over scarce wireless spectrum opens new exciting issues on the design of QoS architectures, which need to include resource management mechanisms at various levels (admission control, scheduling, routing when multi-hop wireless networks are considered, differentiated channel access mechanisms and priority support, etc.) to either differentiate the treatment encountered by different services and traffic categories, as well as provide adequate service quality on an end-to-end basis.

3 Radio Resource Management: Admission Control or Session Drop ?

The management of radio resources (RRM) involves a number of related areas, including power control, admission control, channel allocation, load balancing, hand-over management and packet scheduling. Early works on RRM issues mainly focused on applications that can be characterized in terms of some resource requirements. The prime objective of the RRM functions is to maximize the number of accommodated applications (predominantly voice). With the advent of IP services, adaptive and rate controlled applications have gained increasing attention, stimulating a number of research contributions in the area of joint rate- and power control (see [6] for an overview

[1] In this section we reuse parts of [3].

and extensive literature survey). Rate adaptive applications are attractive because of two main reasons. First, such applications tend to perform well over various networks employing different QoS mechanisms (including best effort networks). Also, being rate adaptive is a kind of exception handling when such applications run across ”provisioned bandwidth” and congestion occurs due to, for instance, a failure situation.

There are arguments for decreasing the role and complexity of admission control techniques and to complement them with rate adaptation and autonomous or network enforced session drop based solutions. These types of discussions and debates strongly resemble those discussed by the Internet community [7] and call for research both in the architecture and performance evaluation areas. It is however not clear whether these solutions are indeed viable (just think of the issue that enforced session termination is perceived much more negatively by users than session blocking by some admission control mechanism). Also, relaxing the admission control mechanisms may make the network vulnerable to denial of service attacks and can result in extreme unfairness between ”well behaving” and greedy users.

4 Conclusions

In this short paper we addressed the issue of the ”research gap” between academic and industry players in the area of wireless QoS. We made the point that this gap cannot be overcome without understanding the main drivers for wireless QoS solutions before devising and debating the actual QoS architectures and algorithms. We expect that wireless resources will remain more scarce than wireline resources which calls for some form of QoS handling.

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