Chapter 8
Mobility Management and QoS Support in Wireless Environments: Trends and Open Issues

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ABSTRACT

Researchers are trying to find viable means to support the quality of services for fixed IP users for quite some time. This is a difficult task and even up until today there is no universally accepted mechanism to assure the quality of an operational service from the one end to the other. As years were passing, the need of IP users to keep their network connectivity while on the move, introduced a family of mobility management protocols. However, it was soon noted that these mobility management protocols were inter-working rather inefficiently with the protocols for the quality of services’ support. Thus, new protocols are under design to tackle this issue. However, even with these new protocols there are important issues left unchallenged. This chapter provides all the necessary information for this research area and its current status.

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INTRODUCTION

The wireless and mobile communication devices industry sector is experiencing an enormous growth. People are getting accustomed to be productive while on the move, utilizing the capabilities their wireless and mobile devices offer. The connectivity support, one of the most fundamental requirements, is certain to rely on the ubiquitous Internet Protocol (IP). There are, however, some fundamental challenges that need to be overcome in order to be able to use the same protocol architecture as the fixed users do.

Mobility support, the first of them, stems from the users’ need to communicate in every imaginable way, while on the road, on the train, at home or in the office. The IP protocol suite needs to adapt to nowadays’ era and start offering uninterruptible connectivity to devices and users, irrespective of their location and movement conditions. Several years of research work have been performed to accommodate mobility management in IP. The primary efforts focused on the ability of the mobile node to communicate with any other Internet connected node while being attached to a different network, which led to a procedure satisfying the target set, but not the actual mobility requirements of moving and maintaining an uninterrupted, smooth communication. After the baseline for mobility support was set, multiple optimization efforts began to achieve minimization of disruption time, optimization of resources used and generally satisfaction of the mobile users.

Quality support, the second of the essential requirements, has a more complicated history. The IP protocol stack follows the end-to-end principle, which dictates to keep functionality and complexity out of the core of the network and push it to the end-points. In other words, end-devices can and should bear the complexity of evolution and capability additions, whereas internal devices, i.e. the routers, should be kept as simple as possible. The simplicity requirements for the routers extend to simple processing for data packets, and memory-less operation. Following the guidelines strictly, every incoming packet would receive the same priority and would be forwarded to the same output queue waiting for transmission. In today’s Internet, however, not all packets are created equal. Some packet flows can cope with long delays and/or packet loss, whereas other flows can only bear extremely small delays and jitter (real-time voice or video communication). The desire to offer prioritized treatment to certain packets, so as to offer either guarantees or just better service, led to Quality of Service (QoS) schemes, which add processing and possibly state-fullness requirements to the routers.

The aforementioned efforts to provide mobility support and QoS guarantees in the Internet began – and mostly continued independently, leading to inefficiencies and/or incompatibilities. The most obvious and cited example is the usage of the end-points’ IP addresses to refer also to a QoS state along the data path (Balakrishnan, Lakshminarayanan, Ratnasamy, Shenker, Stoica & Walfish, 2004). This QoS state identifies the packets that will receive a certain priority treatment and needs to be modified in an end-to-end fashion when mobility causes the modification of an end-point’s IP address. Thus, the net result is the invalidation of the existing QoS setup along the data path, and, thus, the need to re-establish the QoS reservation according to the new IP address and the need to tear down the now invalidated QoS state throughout the data path containing the previous IP address.

The mobility management and QoS incompatibilities have been identified in the research literature practically from the beginning of the individual standardization efforts. However, the relative isolation between the QoS and mobility management specification groups, the experimental nature of the schemes, and the lack of operational use cases, prevented any harmonization attempt at least in the relevant standardization avenues. This finally has been changed with the creation of the IETF “Next Steps in Signaling”