A QoS Model for Differentiated Services in Mobile Wireless Networks

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The current QoS model of the Differentiated Services (DiffServ) [4, 1] approach, including Premium Service [5], Assured Service and a Best-Effort Service, is intended for usage in wireline fixed networks. However, wireless mobile networks will become increasingly popular within the next years, especially on introduction of the 3rd generation wireless networks such as the Universal Mobile Telecommunications System (UMTS). Thus, there is a need for evaluating the DiffServ QoS model for its applicability in wireless mobile networks.

The differences between wireless mobile and wired fixed networks can be categorized into two classes: Those implied by the wireless link such as a higher probability for bit errors and those implied by mobility, i.e., handover between different nodes accessing the wired infrastructure of the wireless mobile network (we assume only a single wireless link to the mobile terminal). In the following sections, we analyze the different legacy DiffServ services with respect to those differences and we present our modified DiffServ QoS model which is especially suited for wireless mobile networks.

Premium service in its current form is generally difficult to provide due to mobility in cellular wireless scenarios. Premium Service resources may no longer be available after a handover if the area, the mobile terminal has moved to, is heavily crowded. This contradicts to the Premium Service definition that the negotiated capacity should be there as soon as the service owner wants to use it.

Therefore, we propose a so-called *Mobile Premium Service*, which provides a similar low-loss low-latency guarantee as Premium Service, but gives a statistical guarantee on the handover success (e.g., 95%) only. This statistical guarantee can be realized by admission control means. For example, a certain amount of bandwidth within a radio cell may be reserved for handover purposes [3]. This reserved bandwidth is available for handover connections only. New emerging connection requests cannot utilize these resources and are, therefore, blocked although the capacity of the radio cell is not fully exhausted.

The legacy Premium Service may be applicable for wireless non-mobile terminals (so-called portable terminals). Since, due to the characteristic of the radio link, the service quality of Premium Service in a wireless non-mobile scenario will be different compared to Premium Service in a wired scenario, we will refer to the former as *Portable Premium Service*.

We expect that quite a lot of Mobile Premium Service capacity may be unutilized due to the following facts:

1. Reservation of bandwidth for handover purposes.

2. Less than 100%-ile utilization of the negotiated Mobile Premium Service bandwidth, e.g., due to a Voice over IP codec with silence suppression.

Therefore, we propose a so-called *Best Effort Low Delay Service* (BELD), which utilizes free Mobile Premium Service resources (bandwidth, buffers). An example application for this kind of service may be 'low-cost IP telephony' where there is not only a probability of loosing the connection during handover (as within Mobile Premium Service), but also at any other instance in time when a Mobile Premium Service user needs all of its assigned bandwidth. The Per-hop behavior (PHB) necessary to build this service (the so-called 'Expedited Forwarding with Dropping' PHB) [2] has been submitted as Internet-Draft to the IETF.

The current Assured Service proposal is well-suited for a wireless mobile environment, since it only gives assurances on the delivered service. The difference between Assured Service in a wire-line fixed network and a wireless mobile network will be in the level of assurance, which will be lower in the second case. One variant of the Assured Service is the so-called Olympic Service, where the different Assured Service classes are used to build Assured Services with a different grade of assurance (Gold, Silver, Bronze, and Standard). However, the Olympic Service may be improved to the so-called Olympic Service with microflow prioritization:

In wireless mobile networks, the available resources may undergo a much higher variation. Therefore, a mobile user should have the possibility to prioritize its data flows in order to ensure that the important ones still get sufficient resources in case of a temporal scarce resources. The drop precedences of the Assured Forwarding Per-hop behavior are well-suited for this purpose. However this interferes with other usages such as traffic conditioning (i.e., marking packets for being in or out of the negotiated traffic profile). Therefore, more than the currently standardized three drop precedences may be necessary.

More details about the mobile QoS model will be given in the presentation. A simulative evaluation using the network simulator ns2 is under way. Initial simulation results will also be shown in the presentation.

References

[1] S. Blake, D. Black, M. Carlson, E. Davies, Z. Wang, and W. Weiss. An architecture for Differentiated Service. Request for Comments (Informational) 2475, Internet Engineering Task Force, December 1998.

[2] Jörg Diederich and Martina Zitterbart. An expedited forwarding with dropping PHB. Internet Draft, Internet Engineering Task Force, October 1999. Work in progress.

[3] K. Lee. Supporting mobile multimedia in integrated services networks. *Wireless Networks*, 2(3):205–217, 1996.

[4] K. Nichols, S. Blake, F. Baker, and D. Black. Definition of the differentiated services field (DS field) in the IPv4 and IPv6 headers. Request for Comments (Proposed Standard) 2474, Internet Engineering Task Force, December 1998.

[5] L. Zhang, V. Jacobson, and K. Nichols. A two-bit Differentiated Services architecture for the Internet. Request for Comments (Informational) 2638, Internet Engineering Task Force, July 1999. URL: ftp://ftp.isi.edu/in-notes/rfc2638.ps.