

Ditze

# **Bidirectional Cross-Layer Management of QoS Capabilities in Wireless Multimedia Environments**



# C-LAB Publication

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**Michael Ditze**

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# **Bidirectional Cross-Layer Management of QoS Capabilities in Wireless Multimedia Environments**

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## **Dissertation**

**A thesis submitted to the  
Faculty of Computer Science,  
Electrical Engineering and Mathematics  
of the  
University of Paderborn  
in partial fulfillment  
of the requirements for the degree of Dr. rer. nat.**

**by**

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**Paderborn**

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**Prof. Dr. Holger Karl, University of Paderborn**

**Date of public examination: September 15, 2008.**

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# Abstract

The massive increase of bandwidth availability in access networks has triggered a shift in consumer computing paradigms toward a progressive deployment of networked multimedia applications. Their transmission across wireless networks imposes new and unique design challenges to the QoS traffic control which requires leveraging of the interaction among individual QoS approaches across different layers in the communication model. The new challenges trace back to imperfect wireless transmission channels and the indeterministic behavior of wireless medium access control schemes. In conjunction with highly fluctuating traffic arrivals of multimedia applications they result in a low utilization of resources and inefficient packet schedules on the communication model's lower layers. On the higher layers, the unpredictably changing environmental conditions claim for an improved adaptation support to adjust the source coding rate to the present network conditions.

This thesis motivates, develops, and implements BiCyQLE, a framework for bidirectional cross-layer management of QoS capabilities in wireless multimedia environments. It is bidirectional in that it improves the utilization and provisioning of scarce wireless network resources toward the lower layers of the communication model. In direction of the higher layers, it performs adaptive source rate control of multimedia transmissions with different levels of granularity. The rate adaptation gracefully adjusts the user-perceived QoS to presently experienced link conditions. The purpose of BiCyQLE is to increase the visual quality and the quality-cost ratio of multimedia transmissions.

The evaluation of BiCyQLE in the ns-2 simulation environment confirms its significant impact on the transmission of multimedia traffic in fluctuating wireless networks. It outperforms several other combinations of QoS approaches, and its individual components are superior to comparable solutions.





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