

# Measuring QoS in class-based IP networks using multipurpose colored probing patterns

Solange Rito Lima<sup>a</sup>, Paulo Carvalho<sup>a</sup> and Vasco Freitas<sup>a</sup>

<sup>a</sup>University of Minho, Department of Informatics, 4710-059 Braga, Portugal

## ABSTRACT

Multiclass IP networks open new dimensions and challenges on active monitoring as efficient strategies of in-band probing are required to sense each class performance without causing noticeable side-effects on real traffic. In our study, we provide new insights on how to perform efficiently active monitoring in these networks, suggesting the use of light and multipurpose probing streams able to capture simultaneously the behavior of multiple QoS metrics of each class. Considering one-way-delay, jitter and loss metrics, we explore different spatial-temporal characteristics of probing, focusing on finding patterns adjusted to each class measurement requirements. We demonstrate that commonly used probing streams fail to capture these metrics simultaneously and we propose novel colored probing patterns able to increase multipurpose active monitoring efficiency. As test environment, we consider a diffserv domain where admission control resorts to feedback from edge-to-edge active monitoring to dynamically control hard real-time, soft real-time and elastic traffic classes. Comparing graphically and statistically the probing and passive measurement outcome of each class, the obtained results show that despite being difficult to match the scale and shape of multiple metrics, a single and properly colored probing stream can capture close and simultaneously the behavior of one-way-delay, jitter and loss, for low in-band probing rates.

**Keywords:** Active Monitoring, Traffic Measurements, Quality-of-Service, Traffic Control, Multiclass Networks, Service Differentiation, Edge-to-edge Service Performance