ERCIM "Alain Bensoussan"
Fellowship Scientific Report

Fellow: Martin VARELA
Visited Location :   SICS
Duration of Visit: 9 months

I - Scientific activity

My scientific activity at SICS has been centered around the development of handover triggers for Voice over IP (VoIP) calls that are to be transferred from a wireless LAN to a cellular network, for example. Wireless LANs are becoming ubiquitous, both in corporate and home environments. With the availability of free (or nearly free) VoIP applications, it is interesting for users to use WiFi--enabled devices instead of using landlines or mobile phones. However, WLANs suffer from some performance problems for this kind of applications, mainly due to losses in the network (which vary with several factors, such as the distance from the access point).

Packet loss can seriously deteriorate the quality of a conversation within VoIP systems. Humans are well aware of disturbances in the spoken speech caused by losses and either interpolate the lost segments, or ask the other person to repeat the last phrase or sentence. From a system perspective, this should be seen as a last resort, it is a user--level repeat request. It would be preferable if the system could detect poor quality conditions on behalf of the user and initiate preventive measures itself. The goal of my research (conducted with Ian Marsh and Björn Grönvall at SICS) is therefore for the system to assess the impairment experienced by the human user measured only from the network parameters and react as needed to maintain an acceptable call quality.

We worked on developing trigger mechanisms which allow for a timely and seamless handover from the WLAN to a GSM network, for instance. To achieve this, a lightweight single-sided quality metric is deployed on the mobile device to determine when a handover to alternative systems needs to be performed.

This work is still ongoing but a loss-driven user perception model is already available, and it is capable of predicting the perceived quality reasonably well based on the WLAN loss process, which provides a basic handover trigger. Current work focuses on the integration of lower-level network metrics into the model, in order to improve its performance.

Besides the work carried out on this subject, I have profited from this period to work on some projects which directly stemmed from my PhD Thesis work. These were carried out in cooperation with INRIA (Projet ARMOR, Irisa, Rennes) and the LAND team at Federal University of Rio de Janeiro, Brazil. The subjects considered in these works were centered around interactive VoIP quality metrics, Neural Network models for multimedia quality assessments, and quality-based pricing schemes for Internet services.

II- Publication(s) during your fellowship (first period)

Conference papers:

1) Martín Varela, Ian Marsh and Björn Grönvall. **A Systematic Study of PESQ's Performance (from a Networking Perspective).** In *Proceedings of MESAQIN'06*, June 2006, Prague, Czech Republic.

Abstract
In this paper we study, in a systematic way, how the behavior of PESQ estimations varies with the network loss process. We assess the variability of the estimations with respect to the network conditions and the speech content, and also their accuracy, by comparing the estimates with subjective assessments.

2) Gerardo Rubino, Pierre Tirilly and Martín Varela. **Evaluating Users' Satisfaction in Packet Networks Using Random Neural Networks**. Accepted for publication at *ICANN'06*, September 2006, Athens, Greece.

Abstract
Quantifying the quality of a video or audio transmission over the Internet is usually a hard task, as based on the statistical processing of the evaluations made by a panel of humans (the corresponding and standardized area is called subjective testing). In this paper we describe a methodology called Pseudo-Subjective Quality Assessment (PSQA), based on Random Neural Networks, which is able to perform this task automatically, accurately and efficiently. RNN had been chosen here because of their good performances over other possibilities; this is discussed in the paper. Some new insights on PSQA's use and performance are also given. In particular we discuss new results concerning PSQA-based dynamic quality control, and conversational quality assessment.

3) Yezekael Hayel, Gerardo Rubino, Bruno Tuffin, Martín Varela. **A New Way of Thinking Utility in Pricing Mechanisms: A Neural Network Approach.** Accepted for publication at XIII CLAIO, November 2006, Montevideo, Urugay.

Abstract
Prcing is regarded as a solution to congestion control in telecommunication networks. Most mathematical models involve a so-called utility function accounting for the users' willingness to
pay. However, this utility function is unknown in practice in terms of shape and important arguments. We propose here to limit this degree of uncertainty by aggregating all arguments in one quantity, the perceived quality of service, estimated using a Random Neural Network as a statistical learning tool according to the PSQA method. After arguing for this approach,
we present a way of applying this tool to a model with two types of traffic and two classes of customers using strict priorities. We illustrate the proposal using a specific simple case.

Journal articles:

1) Ana Paula Couto da Silva, Martín Varela, Edmundo de Souza e Silva, Rosa M. Leao, Gerardo Rubino. **Quality Assessment of Interactive Real Time Voice Applications.** Submitted to *Computer Networks*.

Abstract
The conversational quality of a VoIP communication is dependent on several factors such as the coding process used, the network conditions and the type of error correction or concealment employed. Furthermore, the quality perceived by the users is also dependent on the characteristics of the conversation itself. Assessing this kind of communication is a very difficult problem, and most of the studies available in the literature try to simplify the issue by restricting the analysis to only one or two parameters. However, in doing so, they ignore the interactions among the different parameters, and how they jointly affect the perceived quality. In this paper we study the combined effects of bit rate, forward error correction, loss rate, loss distribution, delay and jitter on the perceived conversational quality. In order to achieve this we use the Pseudo-Subjective Quality Assessment (PSQA) technique, which allows us to obtain accurate subjective—like assessments, in real time if necessary.

III -Attended Seminars, Workshops, and Conferences

1) 5th MESAQIN (2006), International Conference on Measurement of Audio and Video Quality in Networks. Prague, Czech Republic, June 4-6 2006. My attendance was financed by SICS.