# PROCEEDINGS

MAP tele DOCTORAL PROGRAMME IN TELECCOMMUNICATIONS

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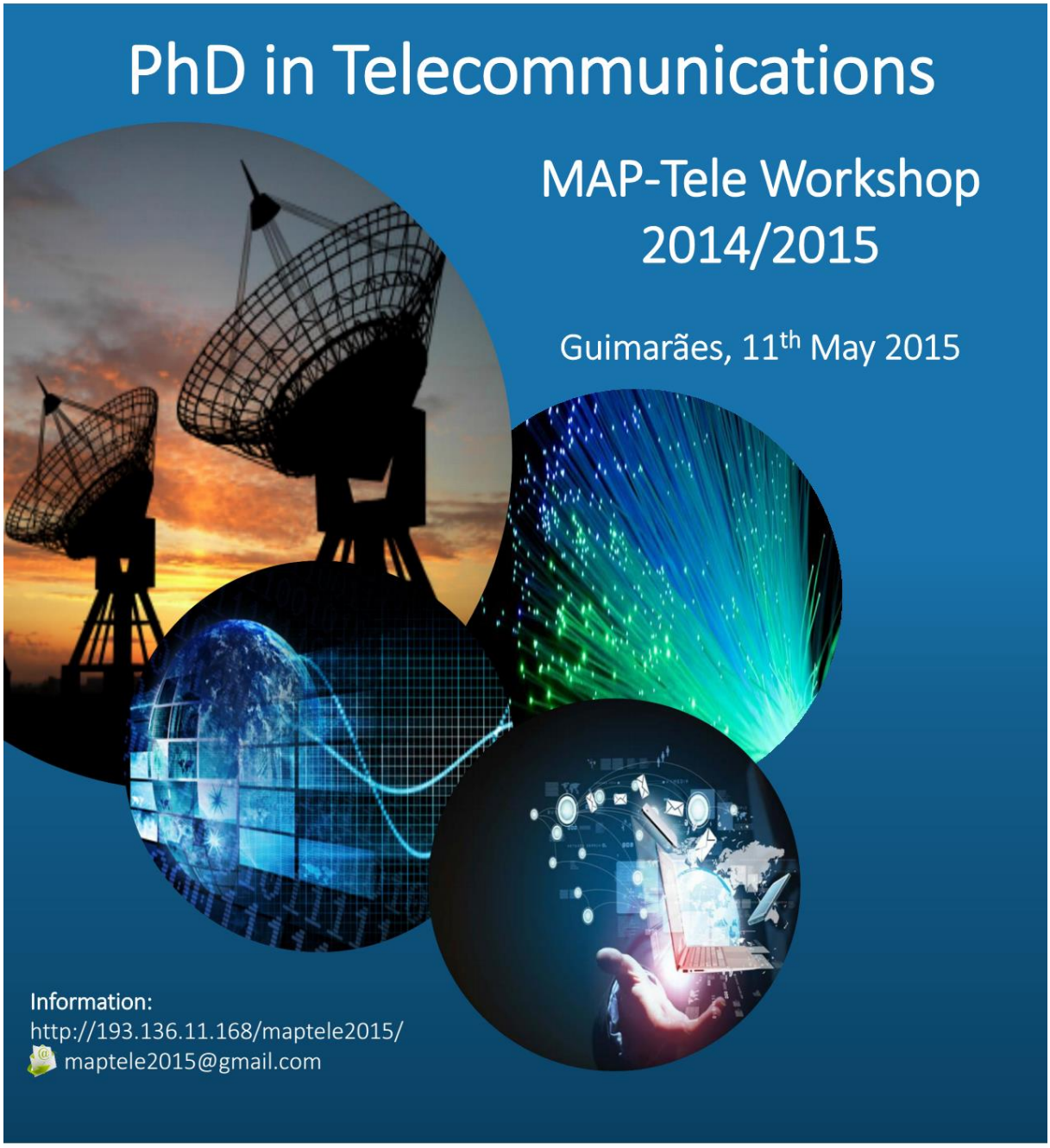


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nodes. The scalability of this technique has been questioned in regards to the maximum temporal misalignment among baseband signals, due to the variety of path delays in the network. By contrast, we find that the scalability is compromised, in the first place, by emerging fast fading in the composite channel, which originates in the carrier frequency disparity of the participating repeaters nodes. We investigate the multisource wave problem and show the resulting signal becomes vulnerable in the presence of noise, leading to significant deterioration of the link whenever the carriers have similar amplitudes.

## Implementation of a 2D/3D multimedia content adaptation decision engine

**Rui Fernandes**, M.T. Andrade

Multimedia content consumption has become very popular due to several factors, among which the amount of content available online and the ubiquity of network connectivity. In fact nowadays everyone can be a content producer and be almost permanently connected to the Internet, thus having the possibility to consume content anywhere, anytime. However, content may present itself in a multitude of formats and networks and terminals may offer very dissimilar transport and consumption capabilities, both along time and space. Accordingly, it often happens that the delivery and/or consumption environments do not offer sufficient or adequate resources to allow the remote access to and consumption of original high quality content. Content adaptation techniques establish means to surpass those impossibilities, allowing content delivery to the user regardless of existing constraints. Since there are several ways to adapt multimedia content, to which different users may react differently, the adaptation engine in charge of deciding the type of adaptation to perform, should ideally be driven with the aim of providing the best Quality of Experience (QoE) to the user [1]. To achieve the best possible outcome, the engine should take into consideration the characteristics of every entity and person involved in the content consumption process, which includes, (1) the multimedia content itself, (2) the transport/access network characteristics, (3) the terminal device characteristics and the (4) user preferences.

To take into consideration the multimedia content it is necessary to characterise it and eventually to classify it into a set of limited but meaningful classes. Different metrics were implemented to tackle the content characteristics identification/classification. These were mainly focused on the spatial and temporal complexity classification of the content.

The networks characteristics establish the restrictions the adaptation decision algorithm has to obey. This is also true for the device capabilities/characteristics.

The user preferences are the subjective element that may establish, for one consumption scenario, different QoE, with the use of the same adaptations, for different users. To investigate this parameter, a subjective quality evaluation was performed. Different contents were generated and classified using the metrics devised to perform that task [2] and, based on this classification, four contents with different characteristics were chosen to be presented to the users. Several bitrates were used to simulate different network conditions, three different types of terminals were used (display, tablet and smartphone) and three adaptations were executed over the original contents, namely, spatial, temporal and quality alterations of the content. The users were asked to classify each presented version on a qualitative scale [3]. The obtained results indicate, as expected, the existence of different users profiles and that the (4) users preferences are dependent of the other three factors: (1), (2) and (3). Results from this subjective experiment are now under analysis to generate these user profiles using an approach that complements Multiple Correspondence Analysis and Cluster Identification.

All these characteristics are to be used by a learning algorithm to define the cost of executing a certain adaptation, whenever a certain content is being consumed under specific conditions by a certain user. These

costs are then fed to the adaptation decision engine, already implemented through a Markov Decision Process (MDP) to define the final adaptation decision.

References:

[1] “Definition of quality of experience,”

TD109rev2 (PLEN/12), International Telecommunications Union, ITU-T Study Group 12, 2007.

[2] J. Korhonen, U. Reiter, and A Ukhanova, “Frame rate versus spatial quality: Which video characteristics do matter?,” in Visual Communications and Image Processing (VCIP), 2013, Nov 2013, pp. 1–6.

[3] ITU-R Recommendation BT.500-13, “Methodology for the subjective assessment of the quality of television pictures,” Tech. Rep. BT.500-13, International Telecommunications Union, January 2012.

## SenseMyCity: Crowdsourcing an Urban Sensor

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People treat smartphones as a second skin, having them around nearly 24/7 and constantly interacting with them. Although smartphones are used mainly for personal communication, social networking and web browsing, they have many connectivity capabilities, and are at the same time equipped with a wide range of embedded sensors. Additionally, bluetooth connectivity can be leveraged to collect data from external sensors, greatly extending the sensing capabilities. However, massive data-gathering using smartphones still poses many architectural challenges, such as limited battery and processing power, and possibly connectivity costs.

This article describes SenseMyCity (SMC), an Internet of Things mobile urban sensor that is extensible and fully configurable. The platform consists of an app, a backoffice and a frontoffice. The SMC app can collect data from embedded sensors, like GPS, wifi, accelerometer, magnetometer, etc, as well as from external bluetooth sensors, ranging from On-Board Diagnostics gathering data from vehicles, to wearable cardiac sensors. Adding support for new internal or external sensors is straightforward due to the modular architecture. Data transmission to our servers can occur either on-demand or in real-time, while keeping costs down by only using the configured type of Internet connectivity. We discuss our experience implementing the platform and using it to make longitudinal studies with many users. Further, we present results on bandwidth utilization and energy consumption for different sensors and sampling rates. Finally, we show two use cases: mapping fuel consumption and user stress extracted from cardiac sensors.

## Metalearning: A solution for algorithm selection

**Mohammad Nozari**, Carlos Soares

The problem of selecting the best algorithm arises in a wide variety of situations. Organizations are more interested in having specific model for distinct part of data instead of a single model for all data. From the business perspective, data can be divided naturally in different dimensions. This problem is getting worse when besides selecting the suitable algorithm, the selection of the best level of granularity is also involved. We propose a meta-learning model which recommends the best level of granularity in which, by applying a recommended algorithm by the model, high performance is expected with high probability. The proposed model is evaluated using two different data-sets. The experiments show that the model is very well suited for different problems including classification and regression problems. The obtained results from two case