



**Doctoral Thesis Title:** Advanced management of urban street lighting networks: a smart city approach.

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**Abstract:**

The present work will be developed under the modality of industrial thesis with the collaboration of the Department of Cartographic Engineering, Geodesy and Photogrammetry (UPV) and Auditesa company. The objective of the thesis is to develop an intelligent management system for public lighting networks, according to current demands in terms of energy efficiency and intelligent management. The idea is to integrate development within the framework of “smart cities” that currently constitute a trend in both technological and social aspects.

A public lighting network is divided hierarchically into three levels: (1) central management system, (2) control centers and (3) luminaires. This network extends throughout the city in a branched manner, which can be used to implement a management system based on communication between the three levels as described below.

At the most decentralized level are the luminaries, which currently have a microcontroller based system. One of the contributions of this thesis is the design of a plate with various sensors that will allow adding value to the network. These sensors include a multi-frequency and multi-constellation GNSS receiver. The characteristics of the luminaires (especially the elevated situation on the surface of the terrain and the static position) allow them to be used as positioning platforms that will allow geolocation with centimeter accuracy. This precision will be achieved by applying advanced positioning algorithms such as Precise Point Positioning (PPP). The microcontroller will allow the connection of other sensors for the collection of variables of interest in urban space management.

At the intermediate level are the control centers that represent network nodes communicated with a section or subset thereof. The communication will be developed using a physical support of direct current (DC) which is another interesting contribution of the present work. This type of communication avoids problems of reaction, harmonics and improves the efficiency of the electrical system. The DC lines allow the use of digital signals with Power Line Communications (PLC) technology that convert the electrical network into an Ethernet communications network. This communication will allow the transmission of GNSS and other sensors data from each luminaire to its corresponding control center in a secure way.

At the most general level is the central management system that will receive data from the control centers through the PLC network for processing. This treatment includes the processing of the GNSS data that will allow updating the geolocation of each luminaire from the moment of its installation until reaching the precision required by the network administrators.

The designed management system is the basis of an intelligent system that allows multiple applications. First, the network management itself to manage the demand for energy or apply rapid attention to preventive or corrective maintenance. The system will also allow the collection and processing of data from the entire urban space, not only at the level of positioning of the elements of urban furniture (luminaires) but of other important environmental variables today as air pollutants.



In addition, the system developed in this thesis may be the basis for other services to the citizen, some of them not yet detected, which we remember is the most important aspect of the smart city concept.

#### Available Means:

This doctoral thesis requires software and hardware resources. Software resources mainly consist of open source programming environments. The hardware resources are very specific and will be acquired for the development of the doctoral thesis. The luminaire prototype consists of the luminaire itself and a microcontroller with positioning and communication devices. Communications between the luminaire and the control center will be simulated in the laboratories of the Department of Cartographic Engineering, Geodesy and Photogrammetry of the UPV and at the Auditesa company facilities.

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