Visible Light Communications
A new way to communicate: potential and challengers

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Visible Light Communication (VLC) is currently a research topic under severe development due to the possibility to provide high data rates and handle the general, worldwide demanding need for climbing bandwidth. VLC uses Light Emitting Diodes (LED), operating in the visible part of the electromagnetic spectrum, as optical sources for optical wireless communication. The technology provides dual functions of lighting and communication. Its main advantages are related to high data rates, higher bandwidth, reliability and a secure data transmission compared to other wireless technologies (such as Wi-Fi).

This tutorial, entitled "**Visible Light Communications: a new way to communicate; potential and challenges"** provides an overview of visible light communication and sensing. It mainly reports four work areas focusing on "indoor and outdoor communication". It provides a survey of visible light sensing and application such as indoor geolocation, vehicular networking and bidirectional communication. We also outline important challenges that need to be addressed in order to design high-speed mobile networks using visible light communication.

In the first work area, "**Optical Communications**" it is presented some tunable WDM converters, based on amorphous SiC multilayer photonic transducers. Those transducers combine the simultaneous demultiplexing operation with the photodetection and self-amplification. They are optimized for provide the high-sensitivity needed for low-light applications, such as medicine, lighting, sensing and measurement. Additional parity logic operations are performed and checked for errors together.

Positioning, also known as localization, is the process of determining the spatial position of an object or person. The leading technologies (GPS and mobile networks) are not suitable for use within buildings. In the second work area, "**Geolocation and Wayfinding using a-SiC:H technology**" the applicability of an intuitive wayfinding system in complex buildings using Visible Light Communication (VLC) is demonstrated. The results showed that the system allows determining the position of a mobile target inside the network, to infer the travel direction along the time and to interact with information received optimizing the route towards the destination.

In the third work area, indoor localization information and navigation services inside a warehouse and information on available stock are supplied as a future application. "**Bidirectional Optical link"** using cooperation services in the grabbing task of mobile robots are provided through the robot and the infrastructure link, with the mobile robots informing the infrastructure about the items of the rack that are being removed and carried to the packaging station. Requirements related to synchronous transmission and flicker mitigation were addressed to enhance the system performance.

Finally, in the fourth work area, "**VLC Connected Cooperative Driving"** Using a new concept of request/response in a two-way-to-way traffic light controlled crossroad, the redesign of the trajectories is accomplished by the application of methods for navigation, guidance and combination of expert knowledge of vehicle road traffic control. Bi-directional communication between the Vehicles (V2V), between vehicles and Infrastructures (V2I)) is performed through Visible Light Communication (VLC), using the street lamps and the traffic signaling to broadcast the information, allowing digital safety and data privacy. The results confirm the cooperative VLC architecture. A significant increase in traffic throughput with the least dependency on infrastructure is achieved.