

Project: IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs)

Submission Title: Some CamCom Applications

Date Submitted: March, 2014

Source: Vijay Auluck, Rick Roberts (Intel), Kouji Horisaki (Toshiba)

Email: richard.d.roberts@intel.com, kouji.horisaki@toshiba.co.jp

Voice:

Re:

Abstract:

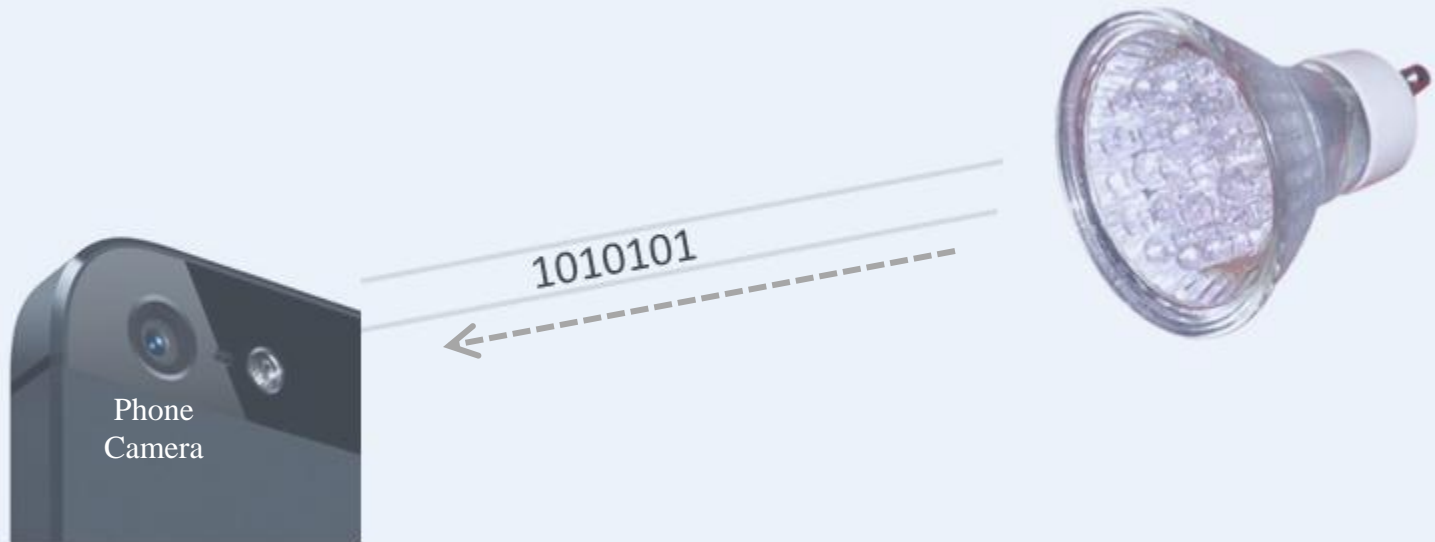
Purpose: Call for Applications Response

Notice: This document has been prepared to assist the IEEE P802.15. It is offered as a basis for discussion and is not binding on the contributing individual(s) or organization(s). The material in this document is subject to change in form and content after further study. The contributor(s) reserve(s) the right to add, amend or withdraw material contained herein.

Release: The contributor acknowledges and accepts that this contribution becomes the property of IEEE and may be made publicly available by P802.15.

Camera Communications (CamCom)

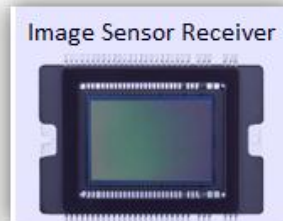
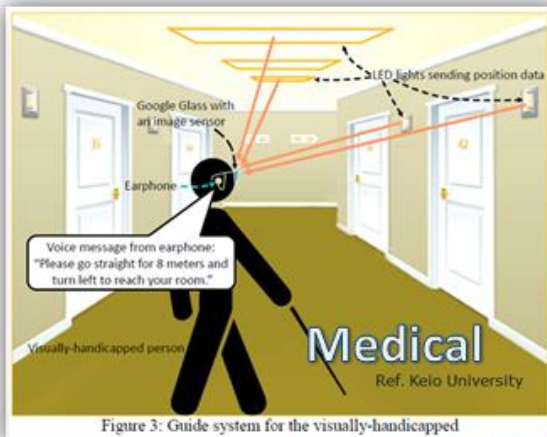
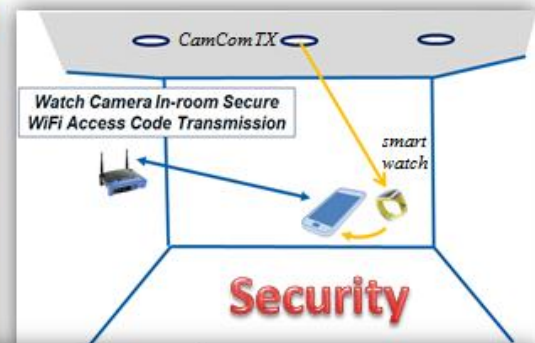
A Pragmatic Form of Visible Light Communications



Today we have millions of mobile devices enabled to receive visible light communications via the camera, but we lack standards to describe the modulation format.

This contribution presents some CamCom applications of interest

Camera Communications & Photogrammetry Positioning Applications



Retail

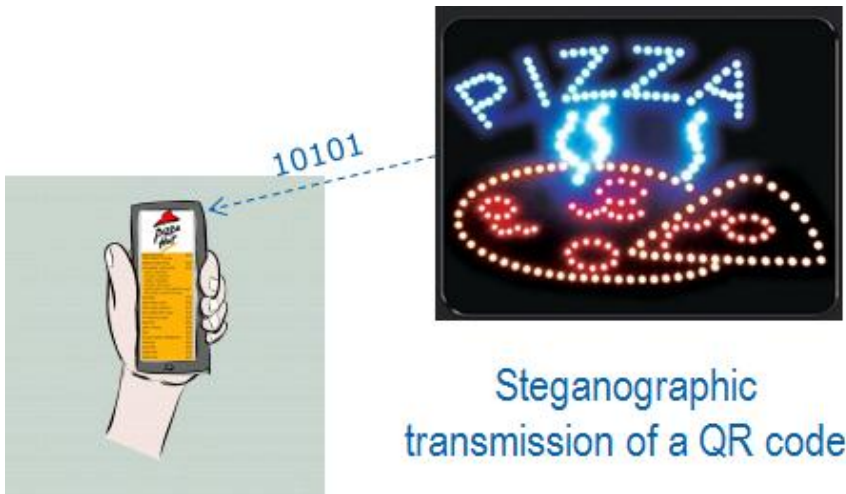


Steganographic transmission of a QR code



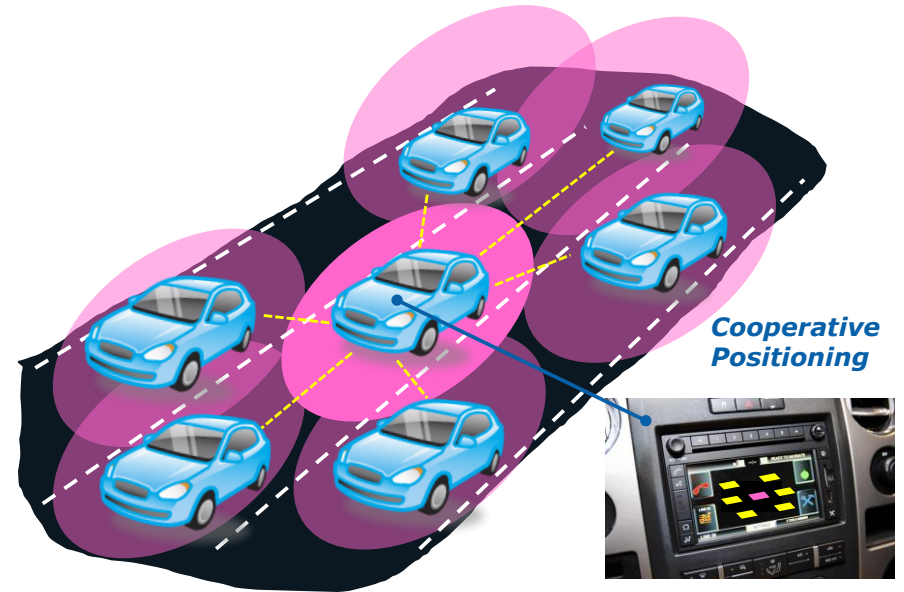
Two Possible Market Segments

Low cost, low throughput consumer market



- Client is implemented via a smartphone APP
- Light is low complexity LED driver modification

High performance embedded vehicular positioning market



- Vehicular camera based
- Automobiles equipped with IR/VIS beacons

Low Cost Consumer Applications

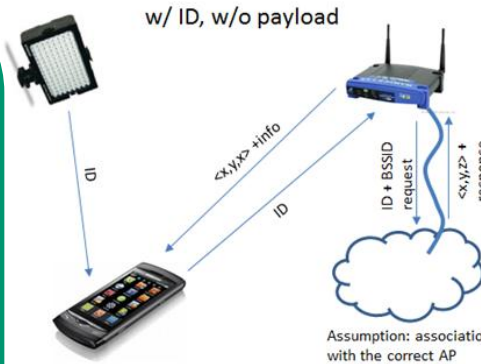
Use cases of interest for consumer camera communications (CamCom)

Short message broadcasts ... typically a few bytes

Information Broadcast



Lights send an "invisible QR code" that provides radio access network (RAN) setup information



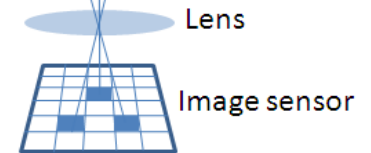
Smartphone Camera

- Readily available
- Cost effective
- Lower data rates
- Shorter packets
- Longer ingest time
- Satisfies market
- No need for faster

Pedestrian Positioning

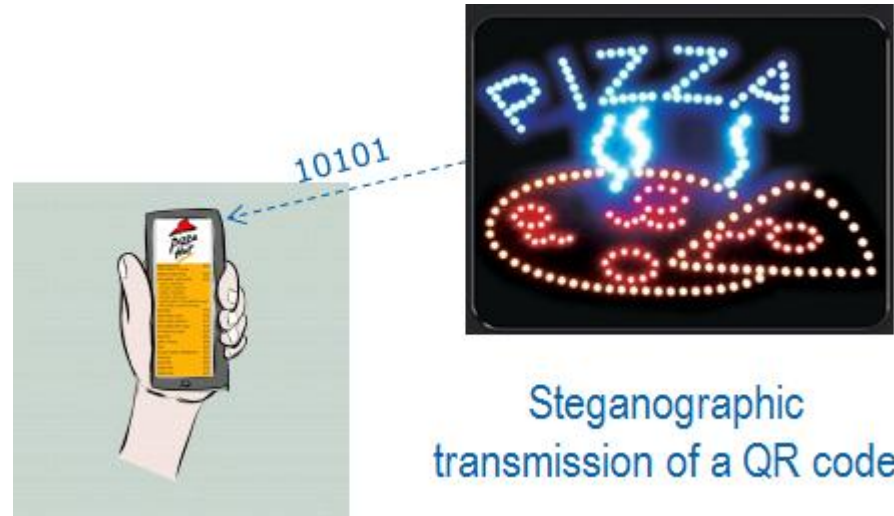
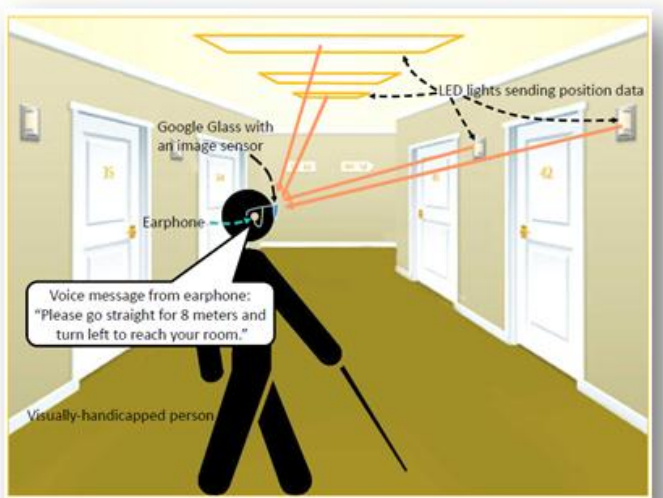


photogrammetry positioning



Lights send short ID codes for data base lookup to obtain room coordinates for the lights

Wearable applications – a potentially huge market!



Google Glass Wearable

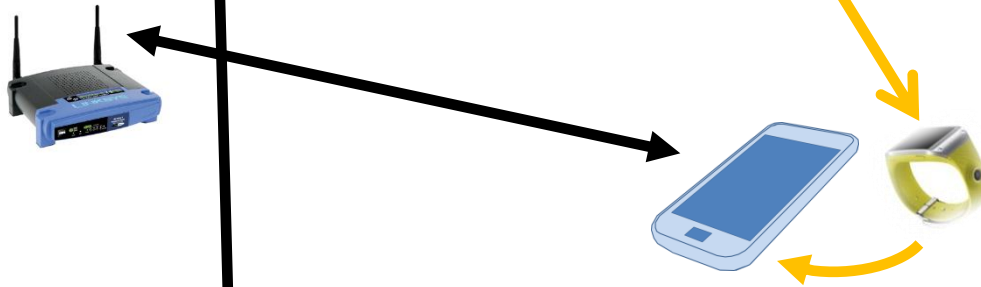
Multiple LED lights act as positioning beacons sending non-flickering messages

Steganographic Data Transmission

Mobile/Wearable device has to be in regional proximity of source. Use cases: line-of-sight marketing, in room transmission of WiFi access codes.

Common feature is CamCom: the merger of image processing with data transmission

***Watch Camera In-room Secure
WiFi Access Code Transmission***



Basic idea:

- lights transmit WiFi access code
- received by the watch camera via CamCom
- code sent to smartphone via encrypted Bluetooth
- smartphone uses code for WiFi association
- secure ... must physically be in room to get code

Smart watch 3-D positioning use case example



Photogrammetry provides 3-D positioning with static heading information.

For example, it can be statically ascertained that this camera watch is at a 3rd shelf elevation, orientated towards the cereal products, and specifically at the coordinates for *Special K* cereal.

Basic idea:

- each LED sign uses CamCom to broadcast URL info
- multiple parallel transmissions received by camera
- each web page accessed via RAN
- Google Glass displays webpage next to related LED sign
- added information augments users reality

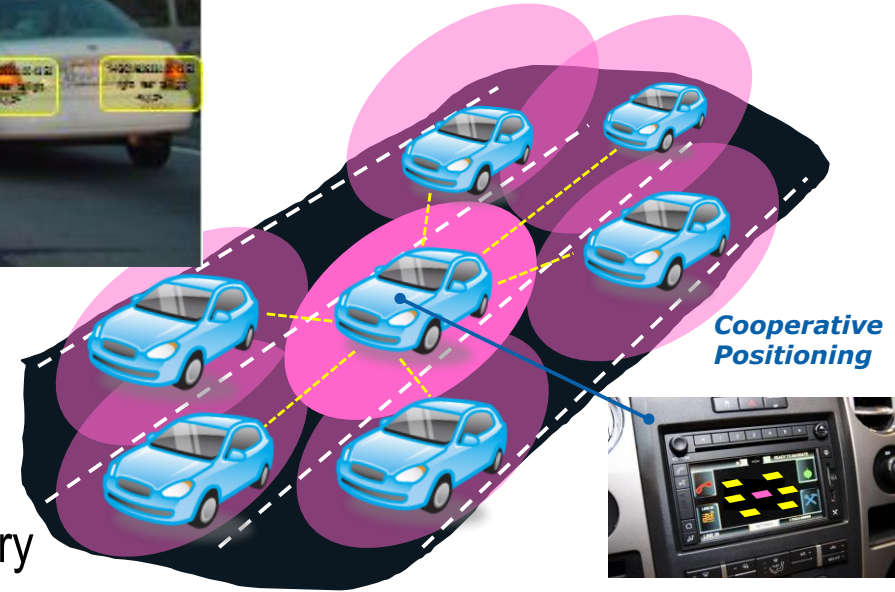
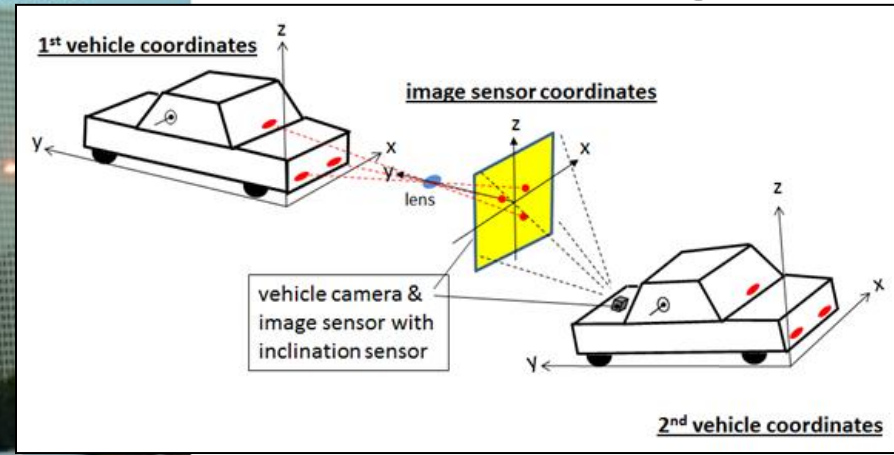
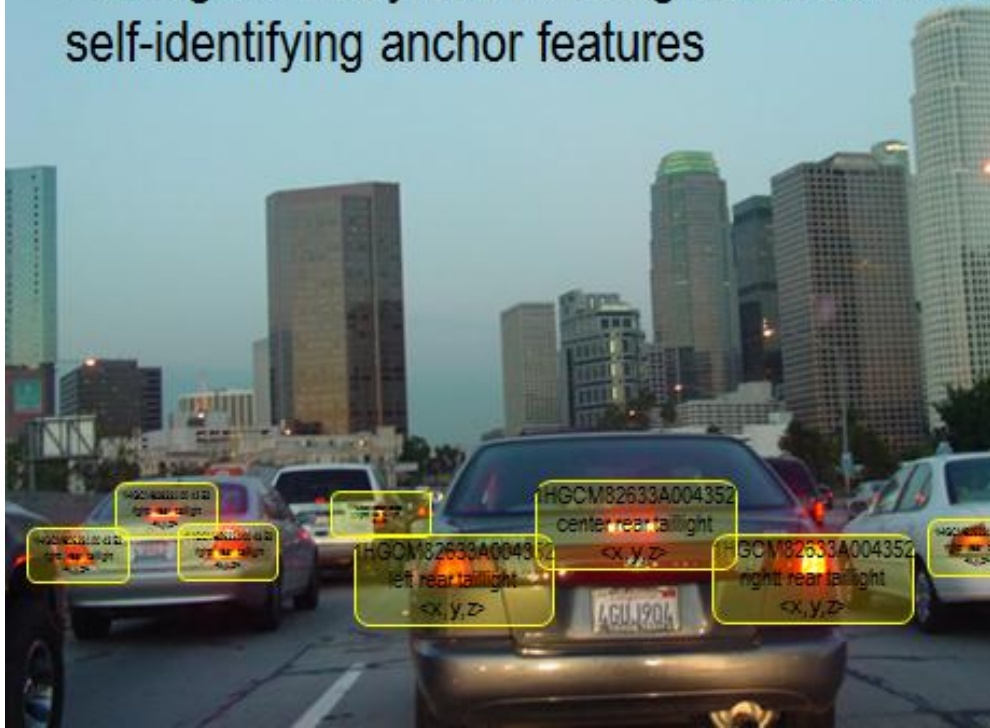
Augmented Reality



Vehicular and Automotive Applications

Comphotogrammetry: the merger of CamCom and Photogrammetry such that light sources become self-identifying anchor features

Photogrammetry Positioning



- car has multiple lights (either visible or IR)
- each light broadcast an ID message
- ID message is processed by camera
- relative position determined by photogrammetry

The End