

“Visible Light Beacon System for Multimedia Applications”

Shinichiro Haruyama

Chairman, Visible Light Communications Consortium, Tokyo, Japan

Professor , Graduate School of System Design and Management

Keio University, Yokohama, Japan

Email: haruyama@sdm.keio.ac.jp

IEC/TC100 Advisory Group on Strategy (AGS)

At British Standards Institution, London, United Kingdom

June 5, 2013

Contents

1. Scope
2. Use cases for multimedia applications
3. Purpose and Justification
4. Target date
5. Relevant documents to be considered
6. Abstract of the proposed standard
 - 6.1. Function
 - 6.2. Physical layer
 - 6.3. Frame layer
7. Installation examples of “Visible Light Beacon System for Multimedia Applications”

1. Scope

This proposal of “Visible Light Beacon System for Multimedia Applications”

- specifies a method of visible light communication
- specifies a system for sending data using lighting equipments
- gives guidelines for use cases for multimedia applications

“Visible Light Beacon System for Multimedia Applications” can be applied for various multimedia applications, such as transmission of advertisement or security information, detection of a user’s position, and indoor navigation, using visible light sources.

2. Use cases for multimedia applications

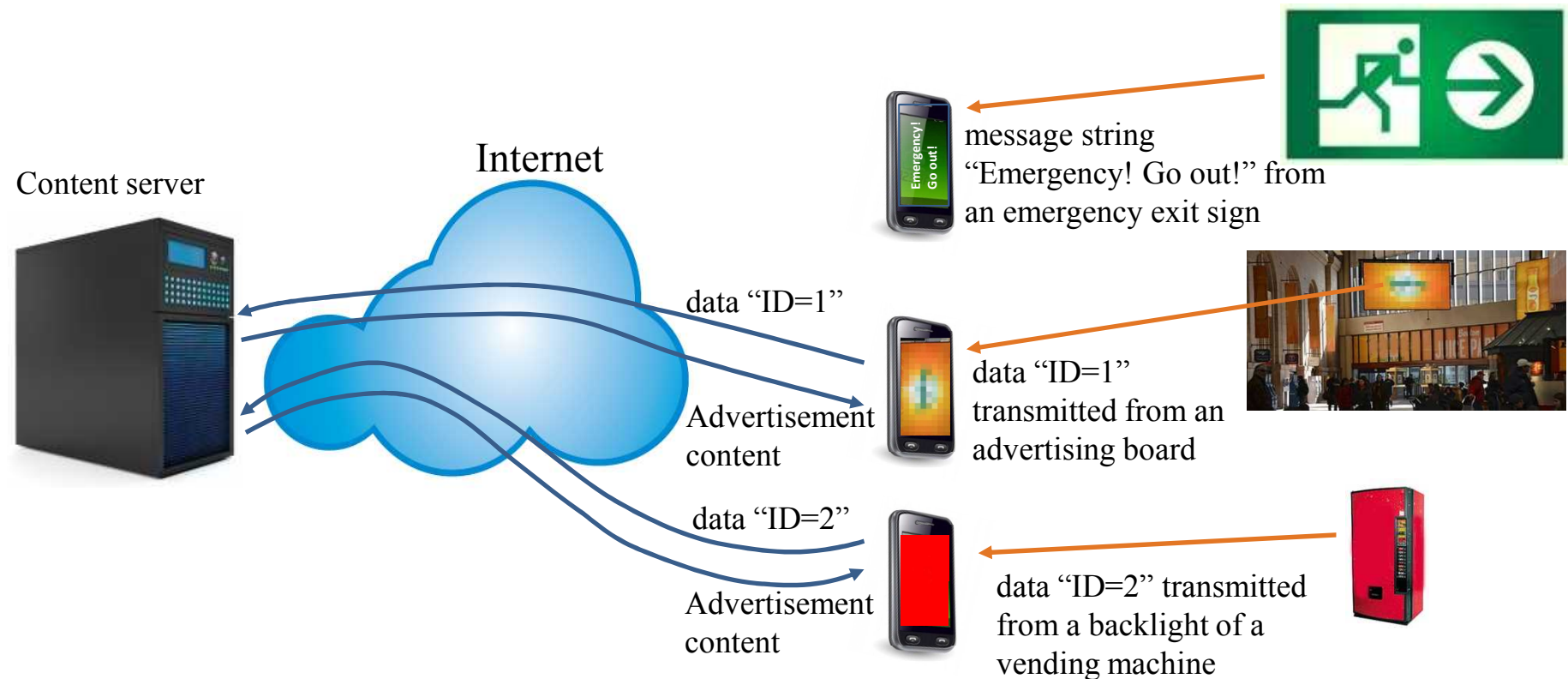
Use case 1: Visible Light Beacon System for multimedia devices receiving multimedia information from LED light

Use case 2: Visible Light Beacon System for multimedia devices receiving location-dependent advertisement multimedia information from digital signage

Use case 3: Visible Light Beacon System for guiding and navigation system

Use case 1:

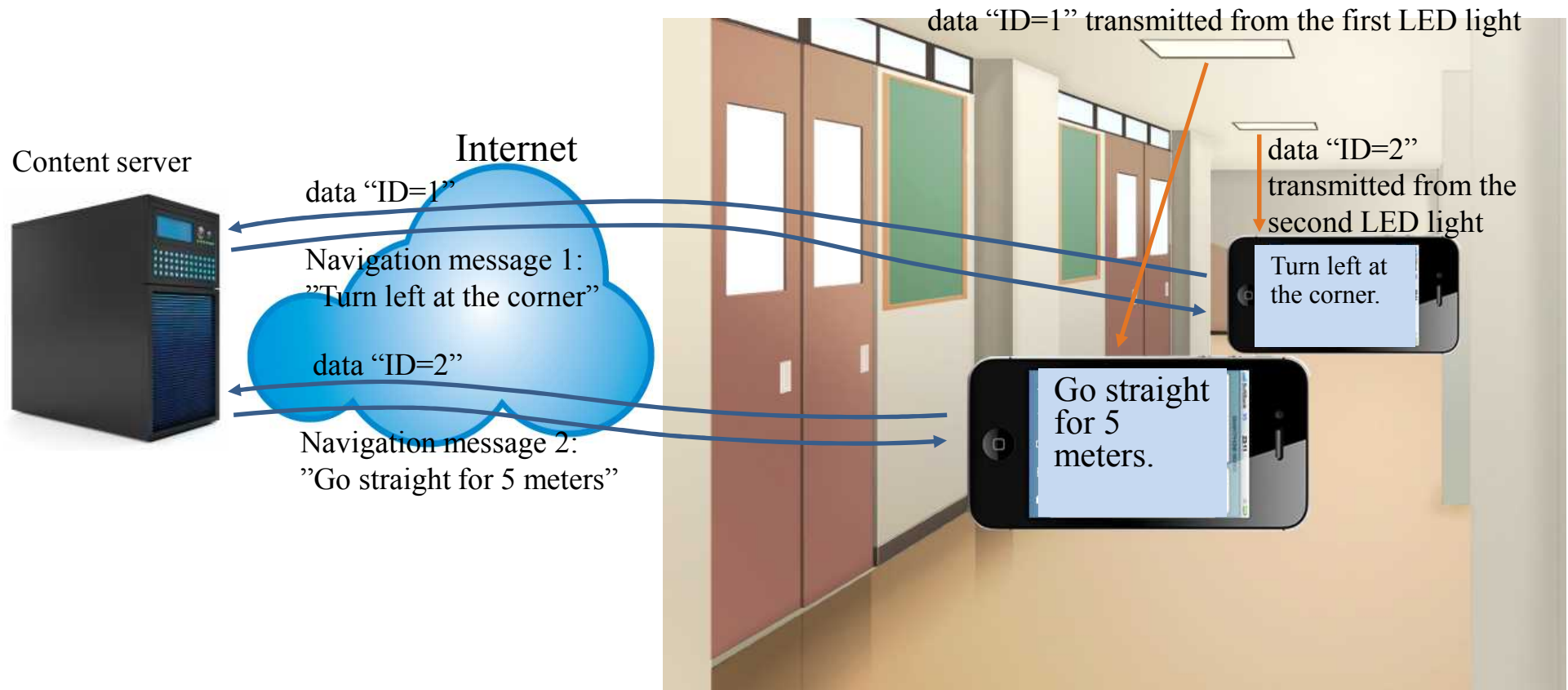
Visible Light Beacon System for multimedia devices receiving location- depend contents such as advertisement or security messages from illuminated advertising boards or emergency exit signs



Content ID is sent from an LED light, and a terminal retrieves various location-dependent contents directly from the light or from a server. 5

Use case 2:

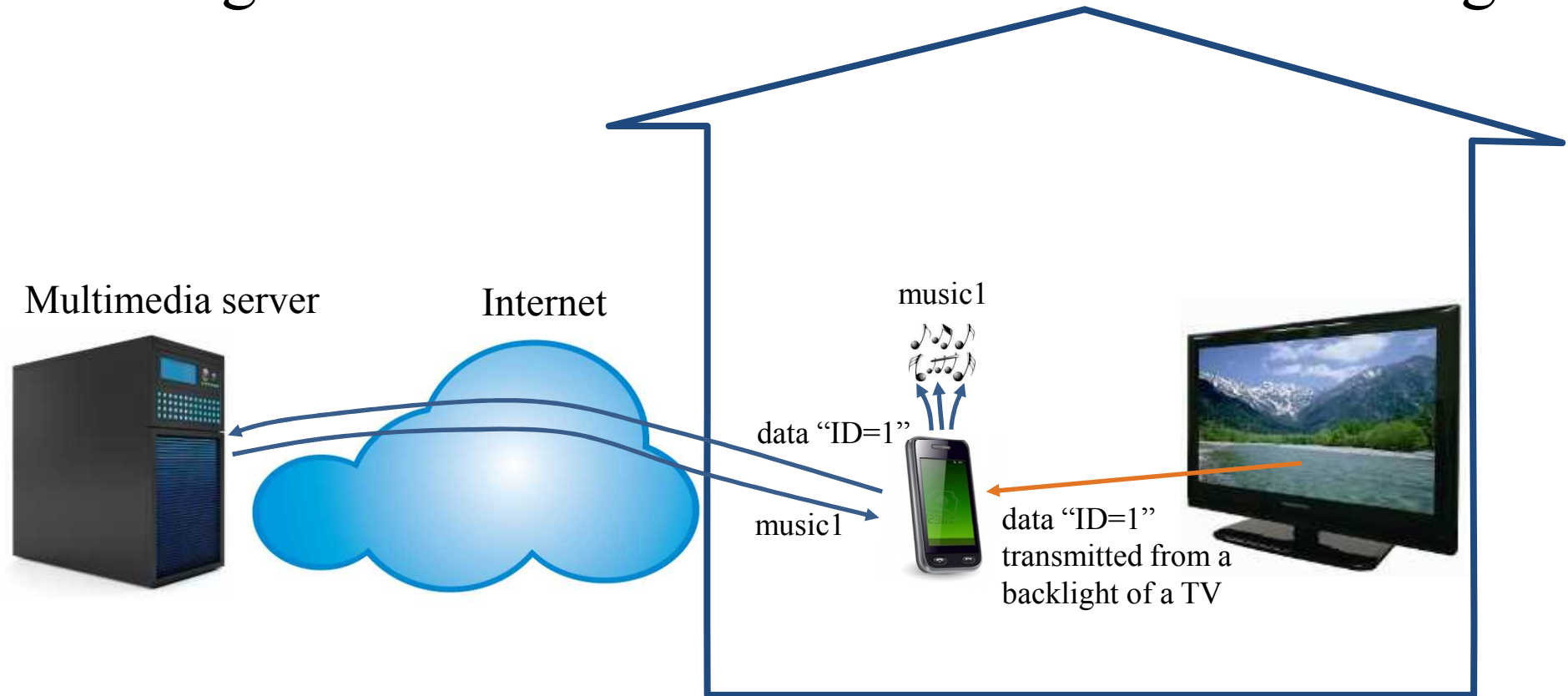
Visible Light Beacon System for multimedia devices guiding and navigation system



Location ID is sent from an LED light, and a terminal retrieves a navigation message with that ID from a server. 6

Use case 3:

Visible Light Beacon System for multimedia devices receiving multimedia information from a TV backlight



Music ID is sent from an LED backlight of a TV, and a terminal retrieves, for example, the music associated with the TV contents.

3. Purpose and Justification

There is a market need to use location-specific multimedia data for consumers. Such data includes location-specific multimedia contents, advertisement, security messages, and navigation information.

The purpose of this proposal is to use solid state lights such as LED lights for sending such data by modulating light intensity.

There has been no proposal in IEC to make a standard using visible light of solid state lights. Therefore, it is necessary to develop a method of visible light communication and its system for sending data using lighting equipment. This proposal will enhance multimedia device market.

4. Target date

For first CD: September 2013

For IS: September 2014

5. Relevant documents to be considered

IEC 62471 :

Photobiological safety of lamps and lamp systems

IEC TR 62471-2 :

Photobiological safety of lamps and lamp systems

Part2: Guidance on manufacturing requirements
relating to non-laser optical radiation safety

6. Abstract of the proposed standard

6.1. Function

6.2. Physical layer

6.3. Frame layer

6.1. Function (1)

The visible light beacon transmitter can transmit information. The transmitted information can be either arbitrary data or an ID code.

The ID code system used is selectable, and various services can be provided or enjoyed through ID resolution (drawing information related to ID).

Following usages can be assumed, for example.

- (1) Equipment identification
- (2) Positional information

6.1. Function (2)

Usages example

- (1) Equipment identification: The visible light beacon transmitter transmits product code of target equipment (Serial number, etc., can be included.). The receiver identifies equipment by ID resolution and can obtain information concerning the equipment. The information includes maker name, product name, specification sheet and manual of the equipment, information of consumables, use history, etc.
- (2) Positional information: The visible light beacon transmitter transmits coded geographical information of the place where the instrument is installed (positional information ID). The receiver can obtain its positional information by ID resolution. Detection of peripheral services based on the present position can be realized in buildings or underground malls where the use of GPS is difficult.

6.2. Physical layer

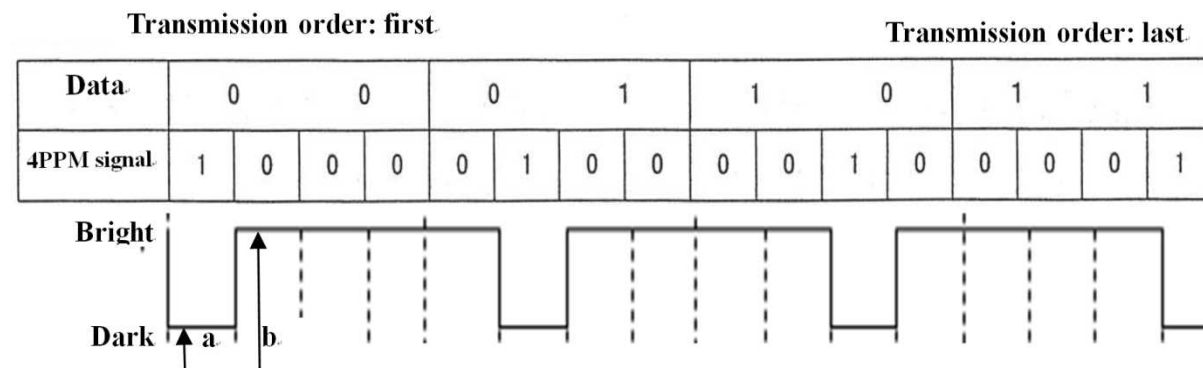
Optical wavelength:
380~780 nm.

Data rate:

4.8 kb/s with its tolerance of data rate shall be
no more than 0.5%

Transmission system:

Inverted 4 Pulse Position Modulation (I-4PPM)



6.3. Frame layer

The frame consists of start part (SOF), Payload, and end part (EOF). Further, SOF is divided into preamble (PRE) and Frame-type (F-TYPE), and information part consists of ID and/or DATA part. The EOF is cyclic redundancy check (CRC-16).

| SOF (Start of Frame) | | Payload | EOF (End of Frame) |
|-------------------------|-------------|--------------------|-----------------------|
| PRE(6bit) | FTYPE(8bit) | ID / DATA(128-bit) | CRC16(16bit) |

7. Installation examples of “Visible Light Beacon System for Multimedia Applications”

Installation example 1: February 2010

Visible Light Beacon System for a game to receive fun contents from an LED light from inside a fish tank

Installation example 2: February 2012

Visible Light Beacon System for indoor navigation for the visually impaired

Installation example 3: April 2013

Visible Light Beacon System for smartphone users indoor

Installation example 1: February 2010

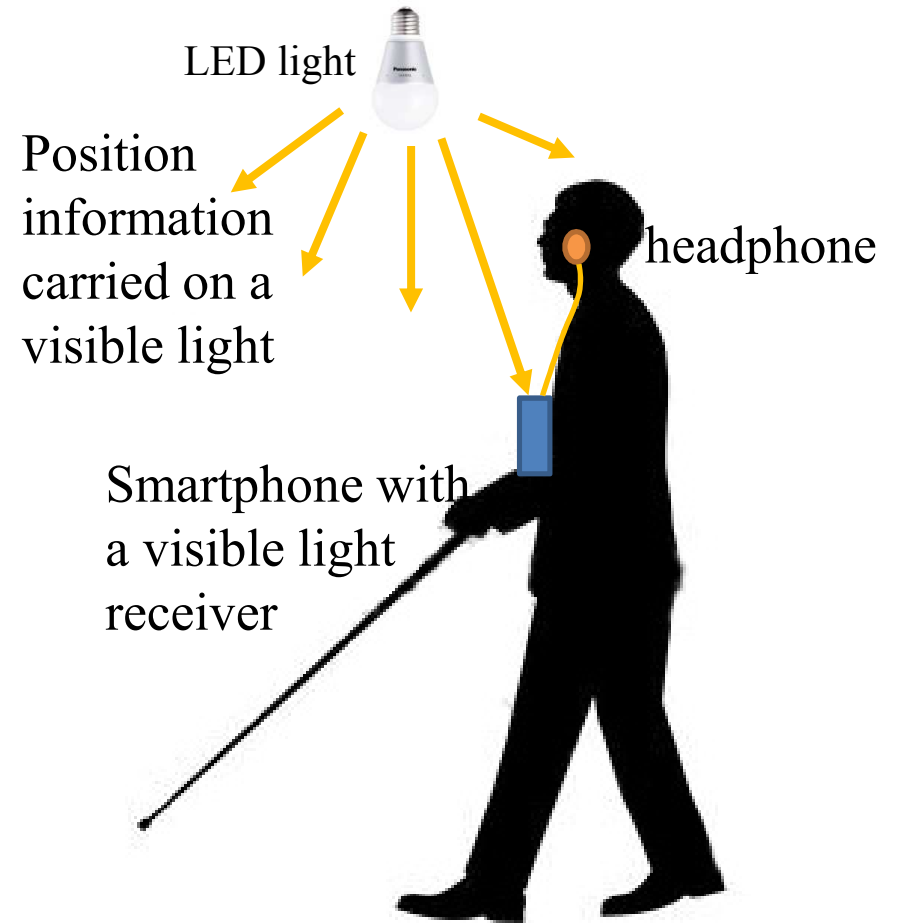
Visible Light Beacon System for a game to receive fun contents
from an LED light inside a fish tank



Visible Light Beacon System where fun contents from a waterproof LED light are sent through water to a customer.

Installation example 2: February 2012

Visible Light Beacon System for indoor navigation for the visually impaired



Visible Light Beacon System detects the position of the visually impaired and sends audio sound of navigation information to him/her.

Installation example 3: April 2013

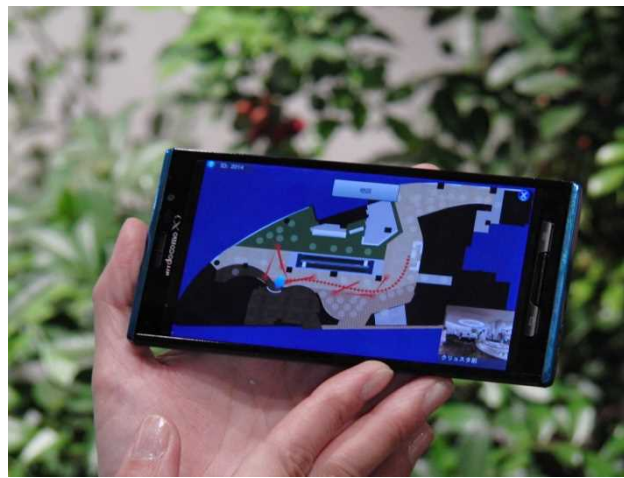
Visible Light Beacon System for smartphone users indoor



Visible light transmitter



Navigation for users



Management of customer flows



Location-dependent game

Visible Light Beacon System sends ID and a smartphone provides multimedia information to a user.