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

Submission Title: [VLC using Image Sensor]
Date Submitted: [8 September 2008]
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Abstract: [Advantage of image sensor for optical signal and position detector is explained. The example of high-speed image sensor also are presented.]

Purpose: [Contribution to IEEE 802.15 SG-VLC]

VLC using Image Sensors

Shuji Suzuki

NEC

Contents

- Optical signal detection by Image sensor
- Advantage of Image sensor
- Road map of Image sensor for VL
- Application for warehouse management
- Future applicaion of Image sensor
- **Example of high-speed Image sensor develop ment**

Optical signal receivers

1. Photo diode

Already used for free-space optics receiver (IrDA etc.)

Easy to receive high-speed optical signal

Limited space-division selectivity

→ Weakness for Interference light

2. Image Sensor：New Technology

Optical receiver with position detection

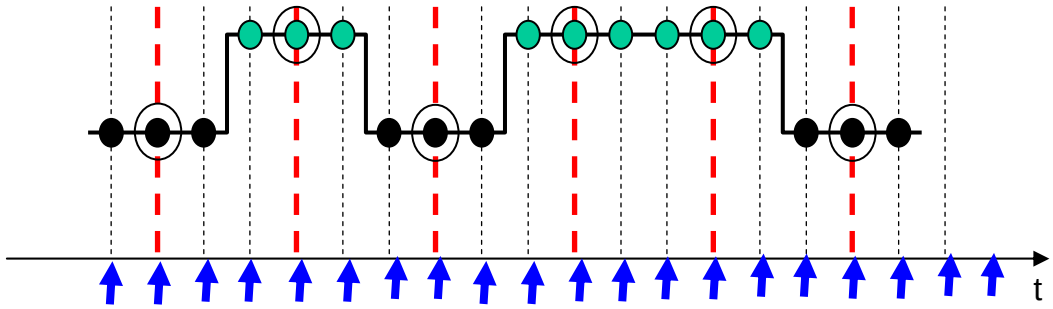
Capability of interference rejection

Low dependency for transmission distance

Future possibility for high-speed transmission

Optical signal detection by Image Sensor (Video Camera)

Optical signal of LED Tags



Sampling by Image sensor

LED Tag

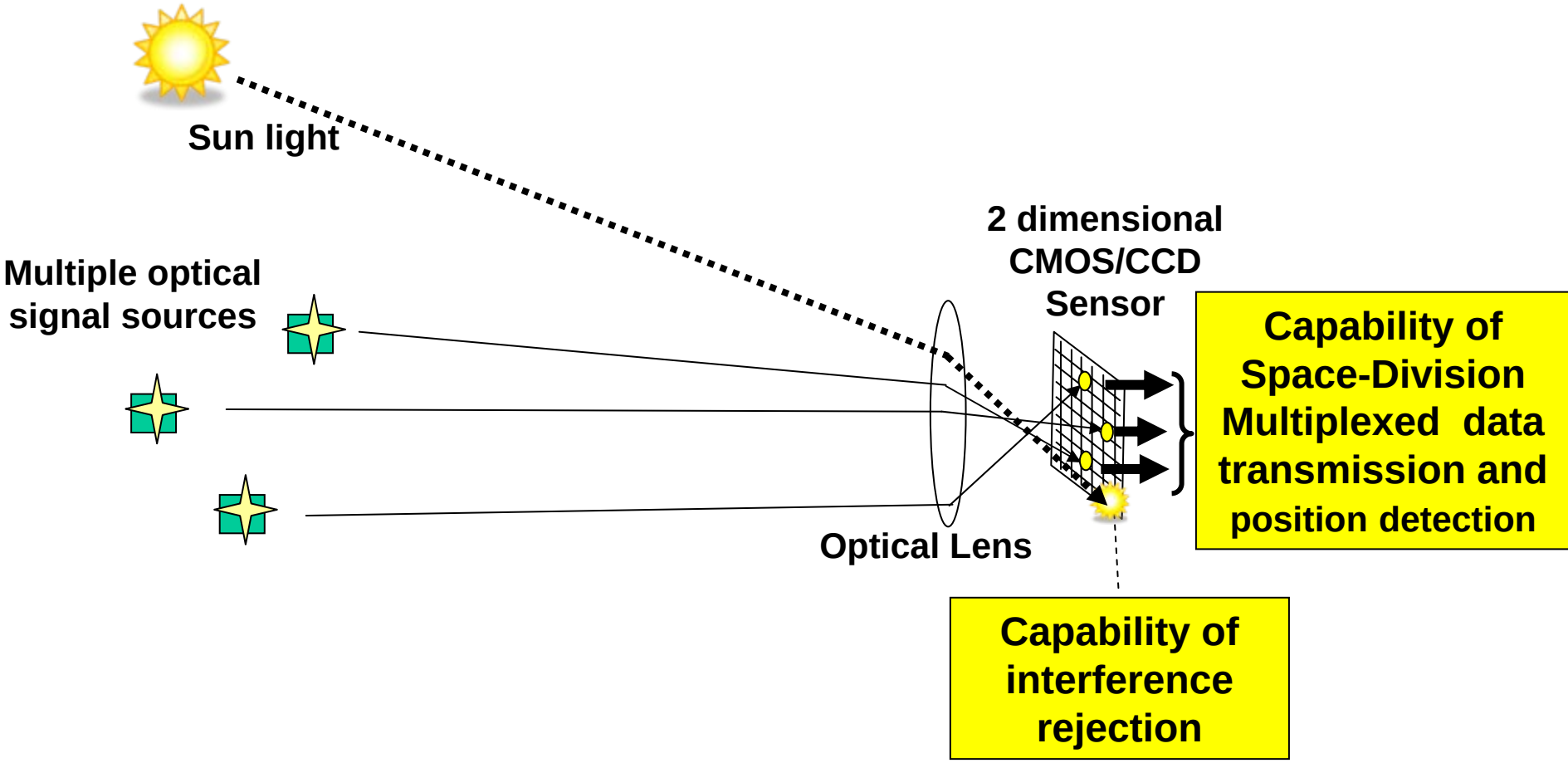
Optical signal bitrate:40bit/sec

Image sensor :

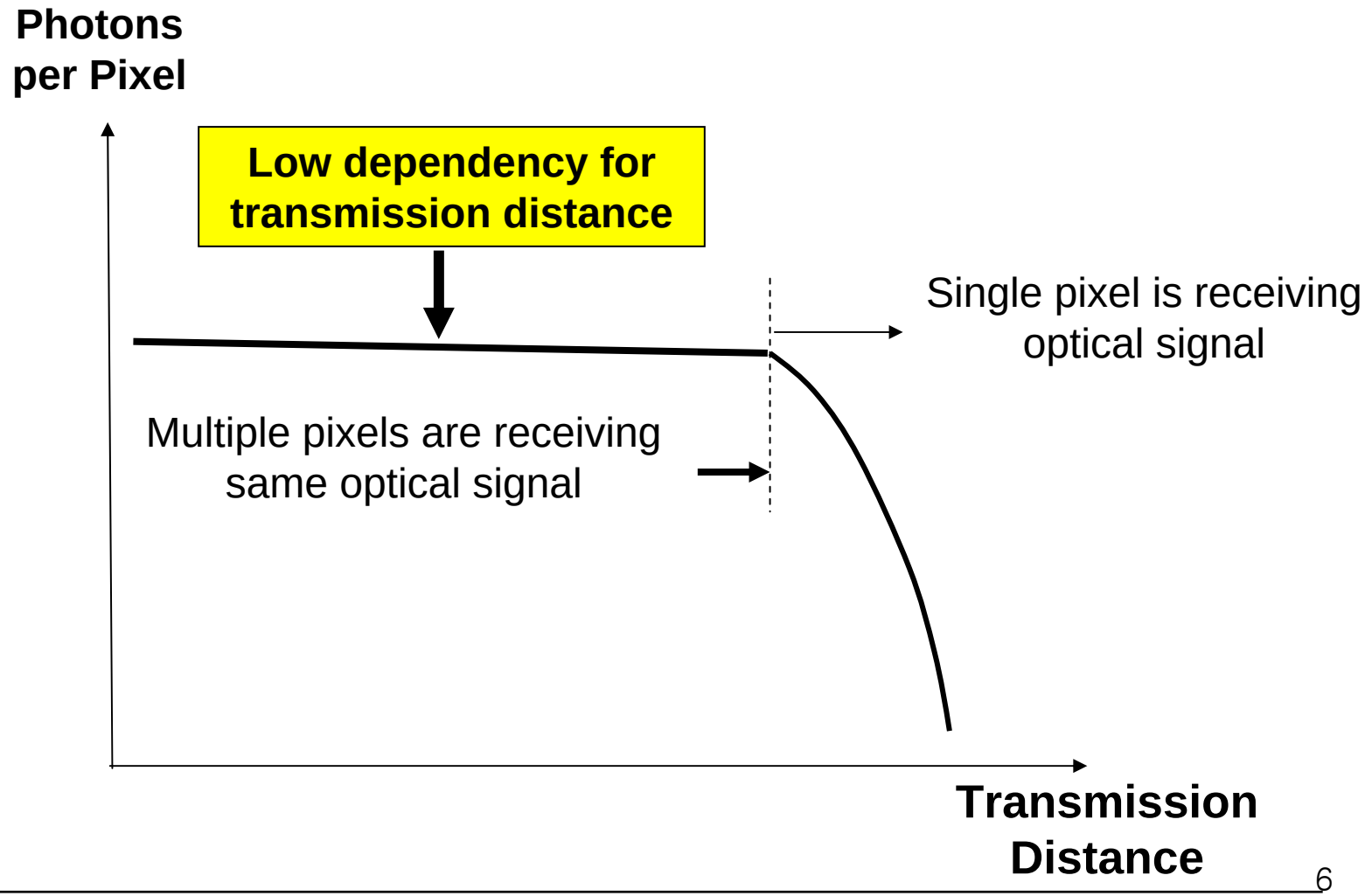
120fps (frame per second)

Signal processing by PC or within Image sensor

Advantage of Image Sensor as an Optical signal detector



Another Advantage of Image Sensor as an Optical signal detector



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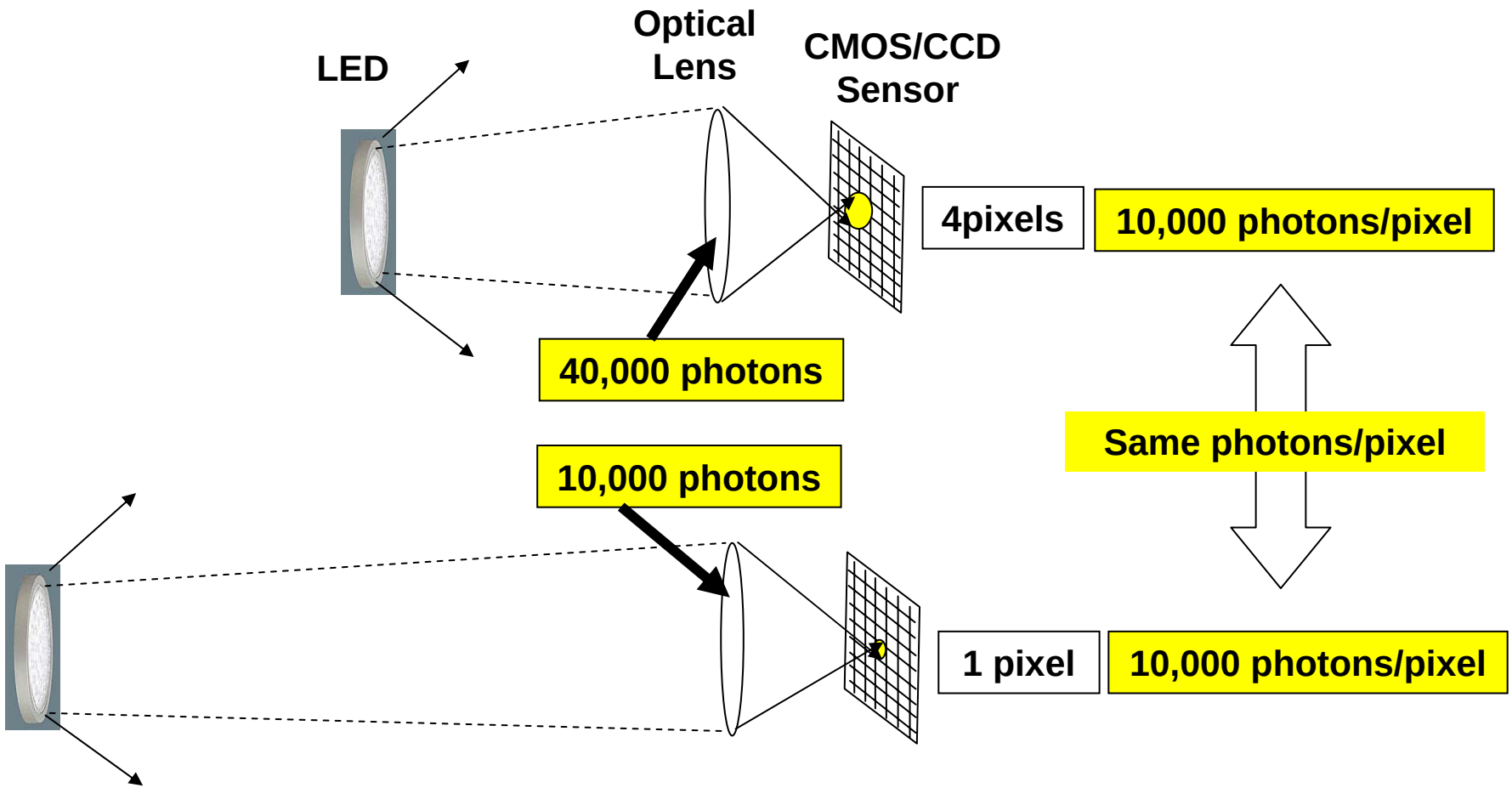
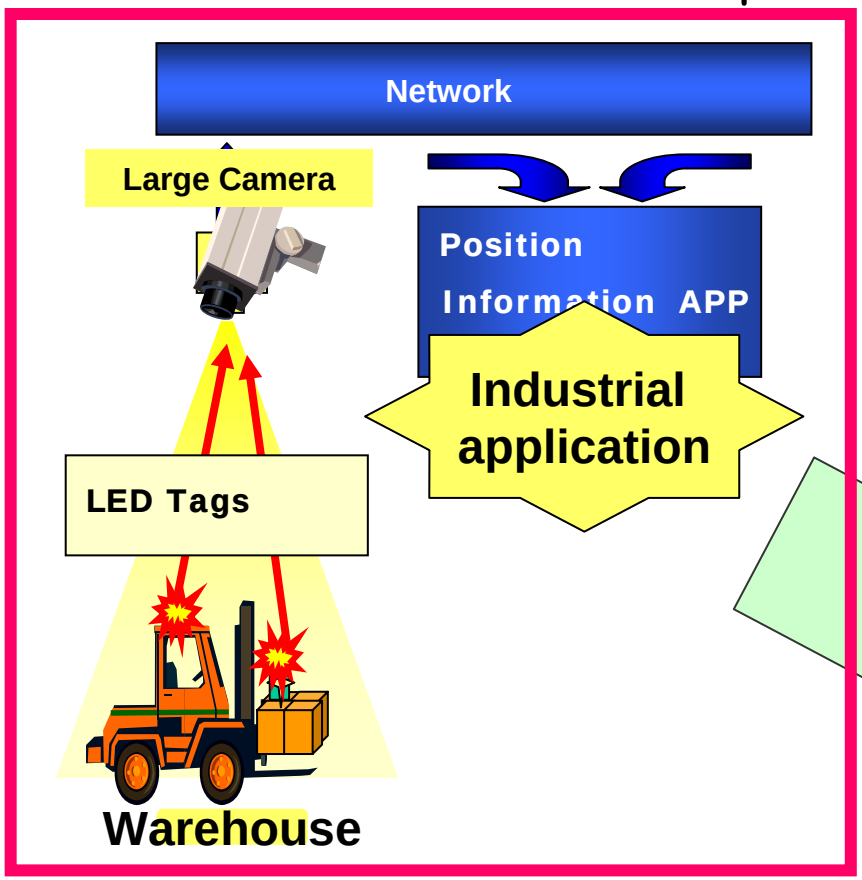
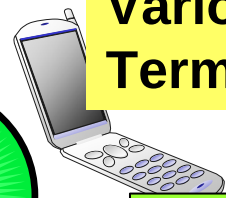


Road map of Image Sensor

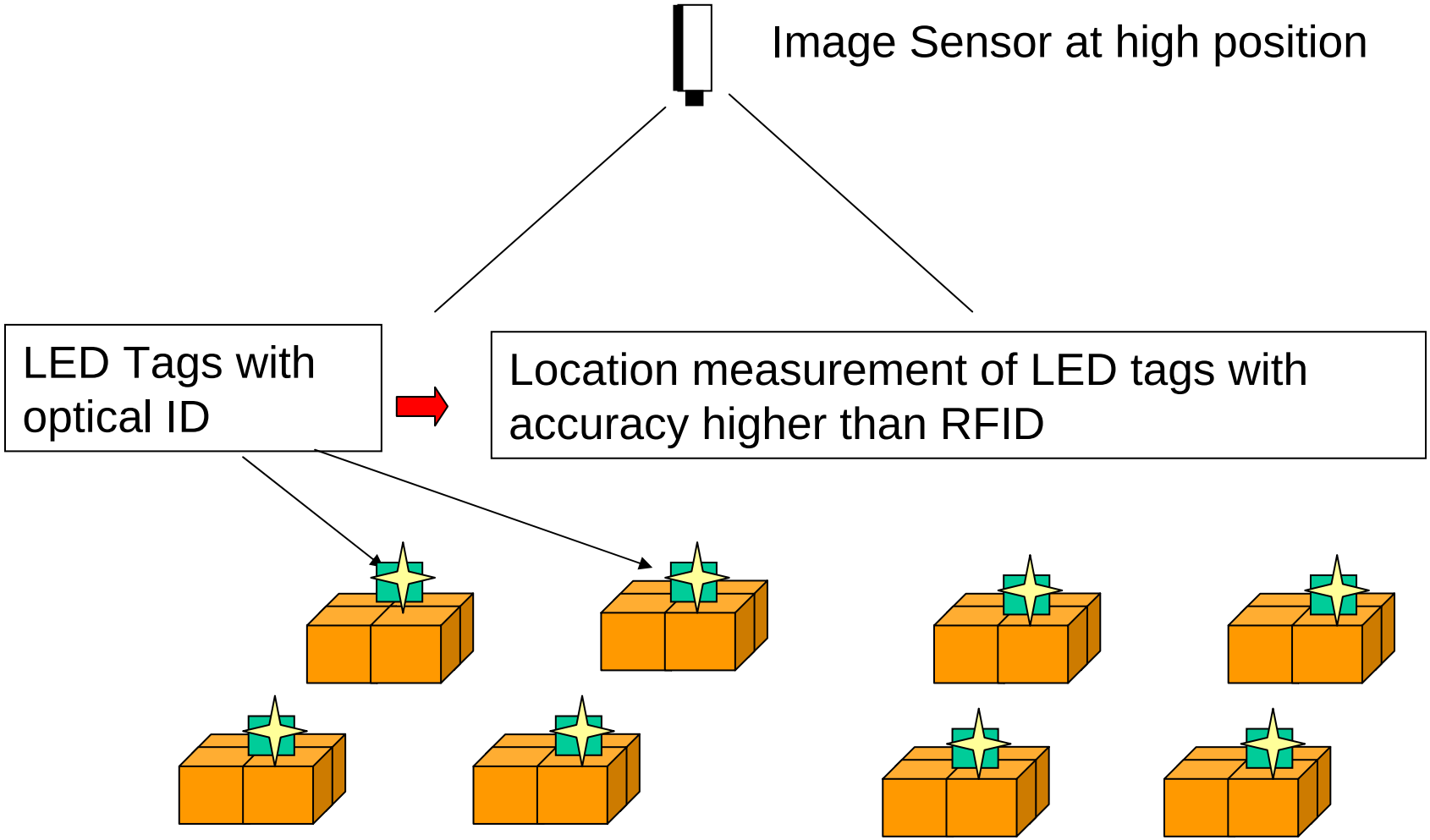




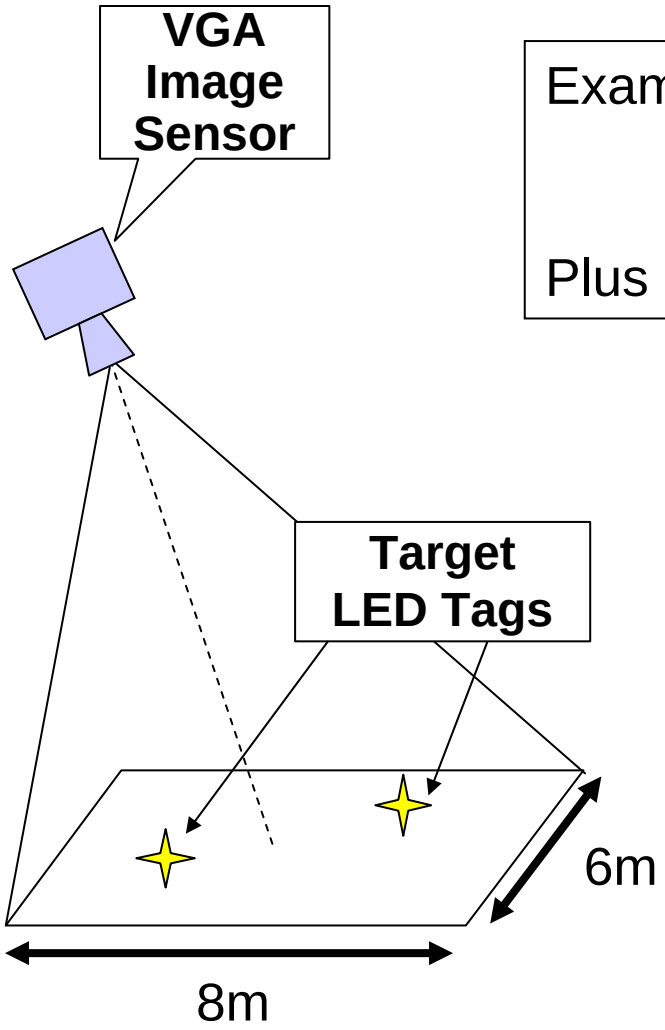
Various Mobile Terminals

Information collection from Various LEDs

Application for Warehouse Management



Location measurement accuracy



Example: 640 x 480 pixels (VGA) resolution

→ 1.25cm resolution for 8m x6m

Plus Measurement error of distortion by optical lens

Experimental Results

5cm resolution for 8m x 6m plane with equalization software for lens distortion

Pretty good measurement accuracy

Road map of Image Sensor

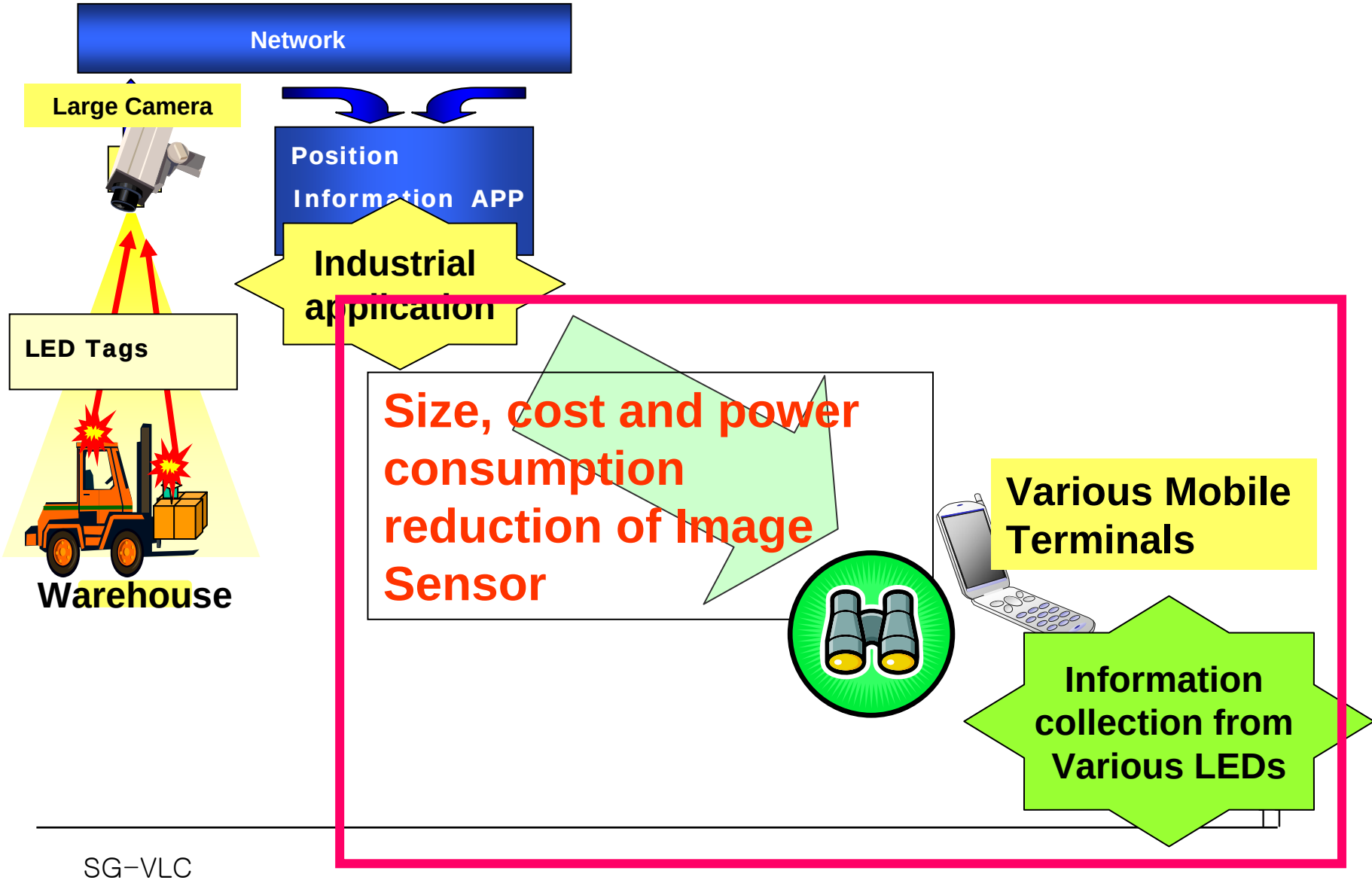
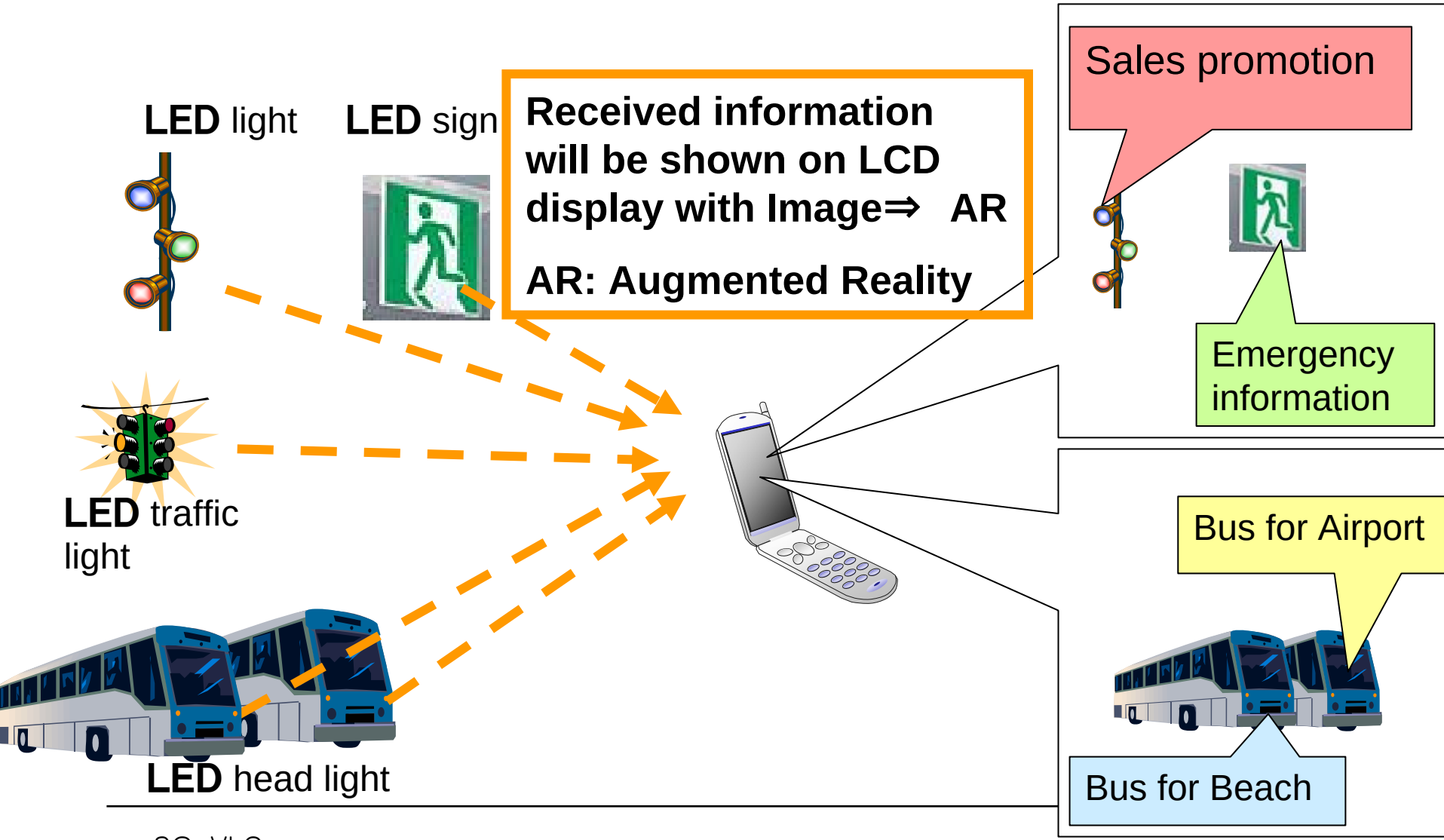
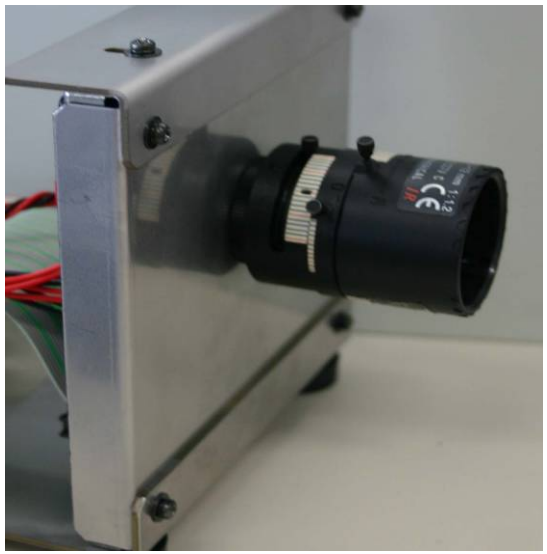


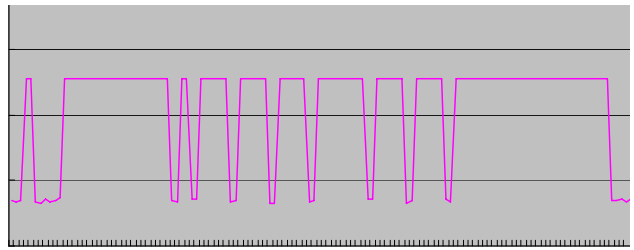
Image sensor in future mobile phone



Example of High-speed Image Sensor

2400 fps Image Sensor is used to
receive 1200bps Optical Signal

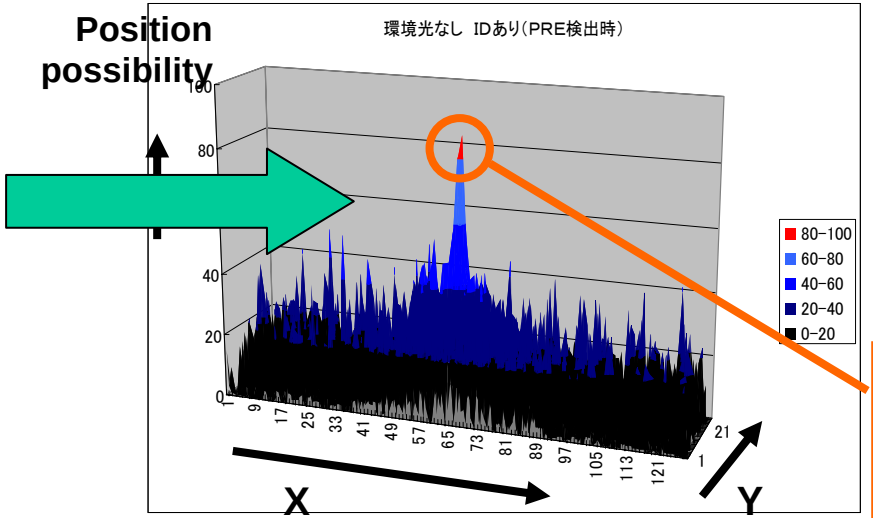




Optical signal detection

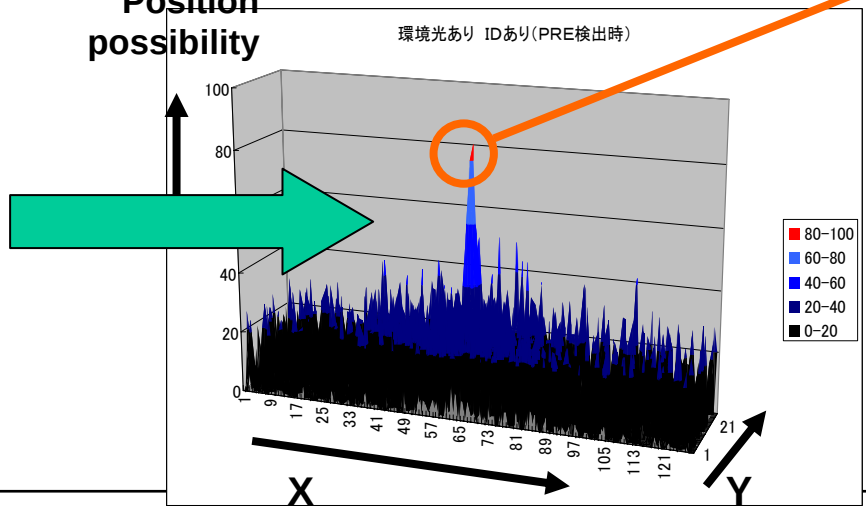
LED only

Position possibility



With interference light

Position possibility



Optical signal can be detected W/WO interference light

Q&A