

ASEAN IVO 2017 Project Progress Report
Brunei Nov. 24, 2017

Smart Lighting for Internet of Things and Smart Homes

Pham Tien Dat

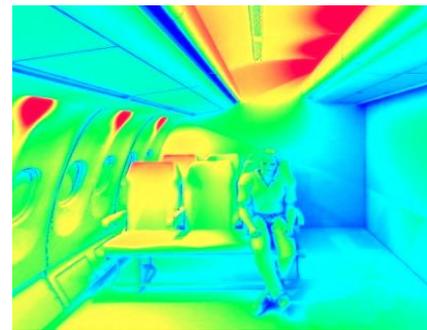
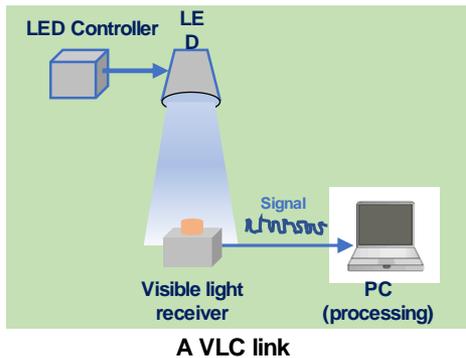
National Institute of Information and Communication Technology

Outline

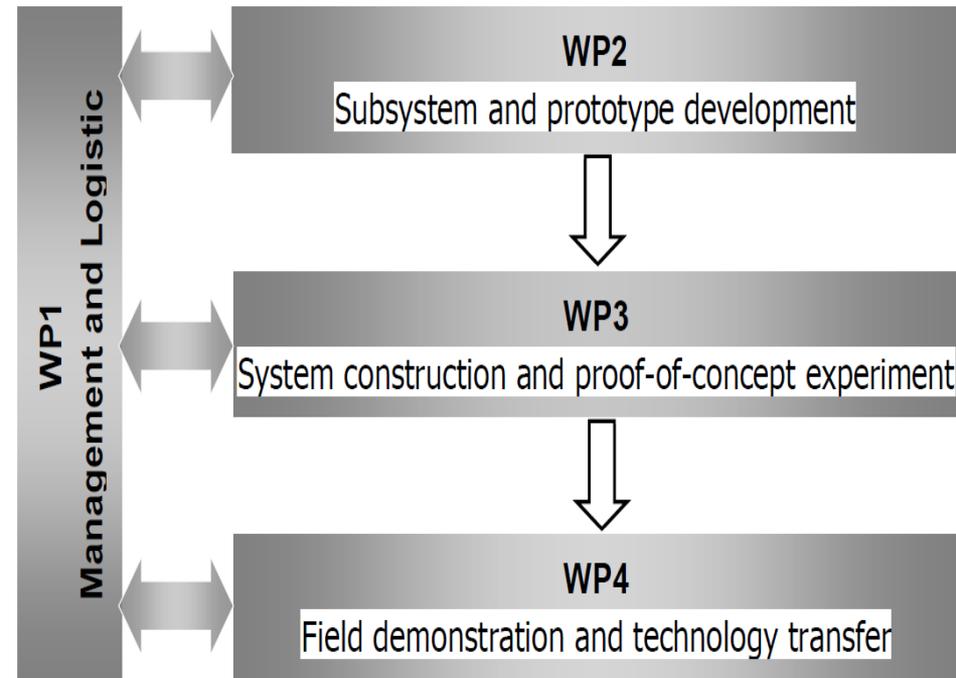
- 1. Project overview**
- 2. Research activities in 2017**
- 3. Proposal on project structure**
- 4. Future Plan**

Smart Lighting for Internet of Things and Smart Homes

Concept of a visible light communication link and its possible applications



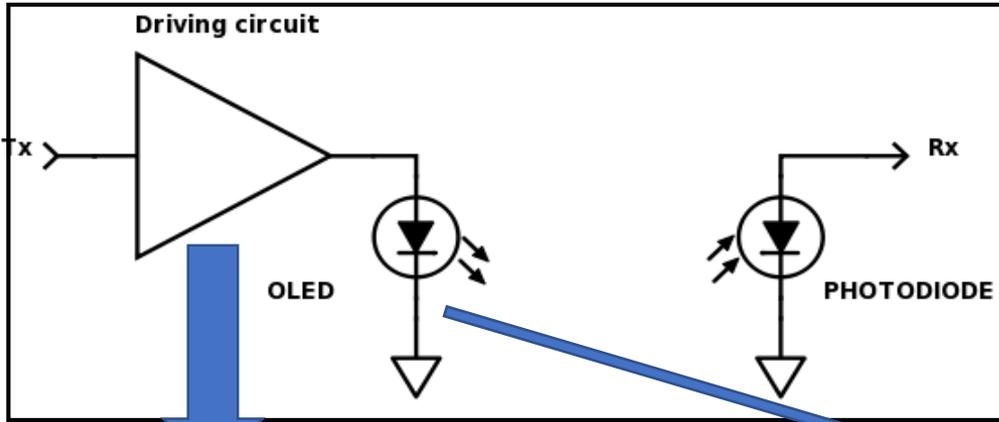
Project implementation and work packages



❑ Project Leader: Pham Tien Dat (NICT, Japan)

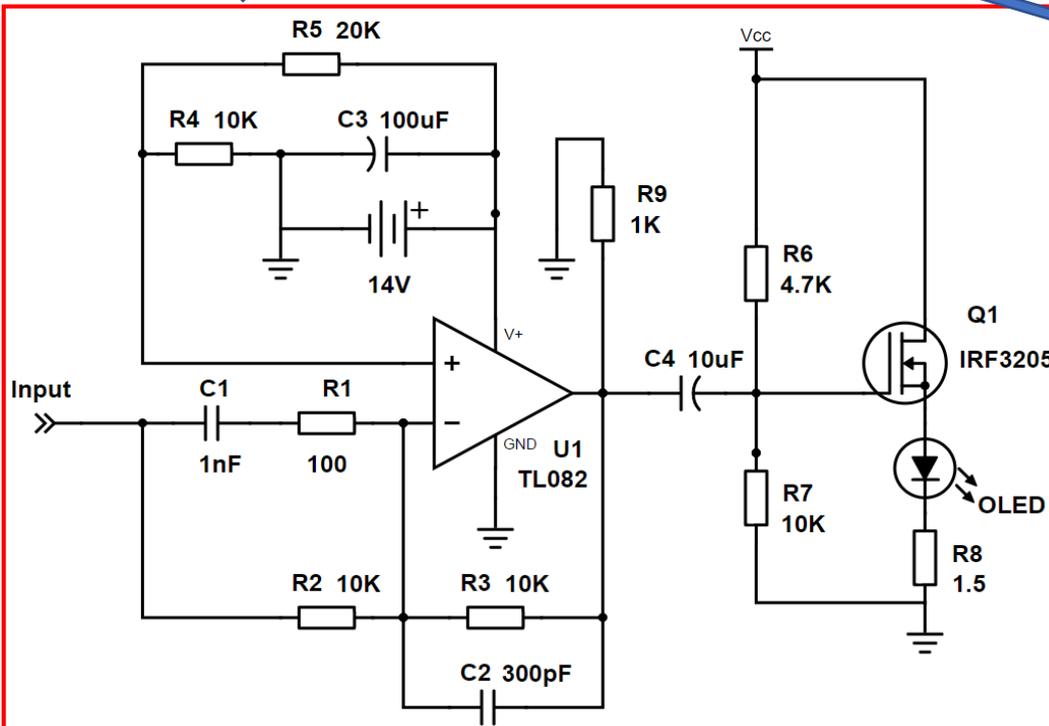
❑ Project Members: Phi Hoa Binh (VAST, Vietnam); Pham Quang Thai (HCMUT, Vietnam); Yusuf Nur Wijayanto (LIPI, Indonesia); Dang The Ngoc (PTIT, Vietnam); Jiang Liu (Waseda University, Japan); Purwoko Adhi (LIPI, Indonesia); Naokatsu Yamamoto (NICT, Japan); Mitsuji Matsumoto (Waseda University, Japan)

High-bandwidth-efficiency OLED-based VLC system (1)

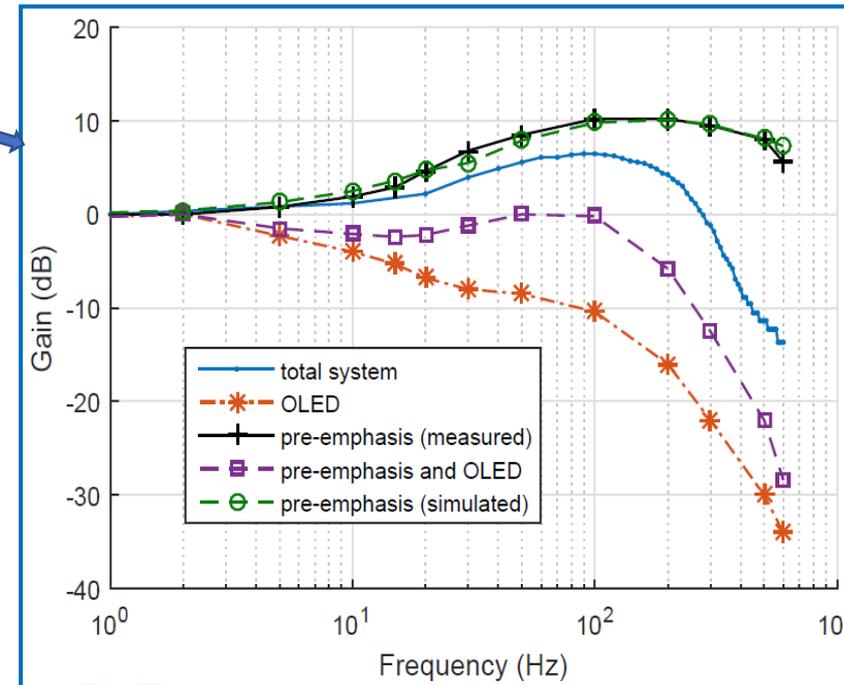


General OLED-based VLC system:

- Very narrow bandwidth
- Low speed data rate

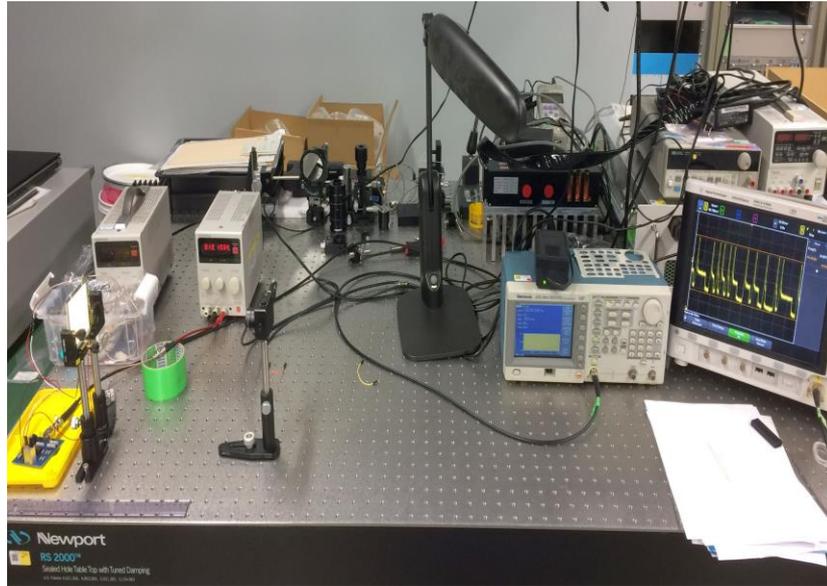


Developed driving circuit

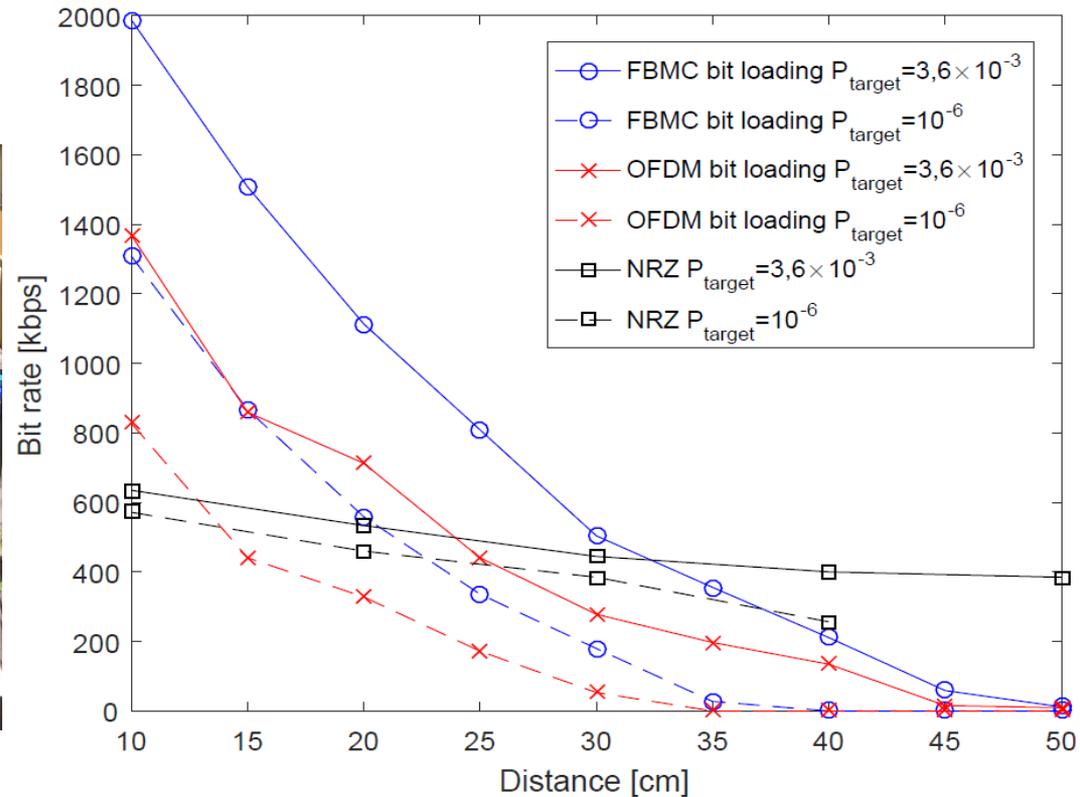


Increasing the available bandwidth

High-bandwidth-efficiency OLED-based VLC system (2)



Experimental setup (in NICT)



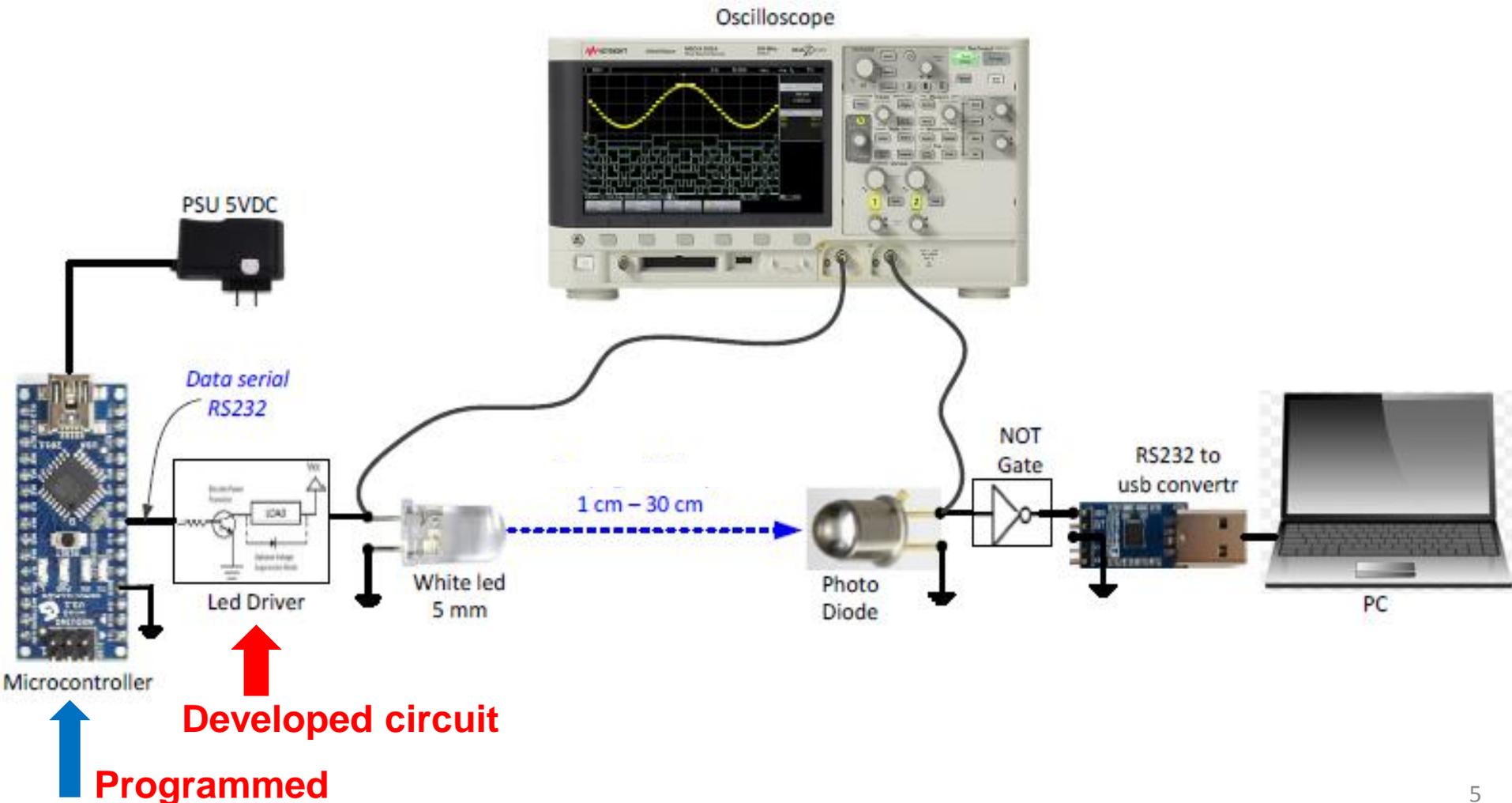
Experimental results

- ❑ A new combination of active pre-equalizer and Filter Bank Multi-Carrier modulation for VLC system with OLED.
- ❑ A bandwidth efficiency of 286 bps/Hz, which was 5 times higher than the state-of-the-art system.

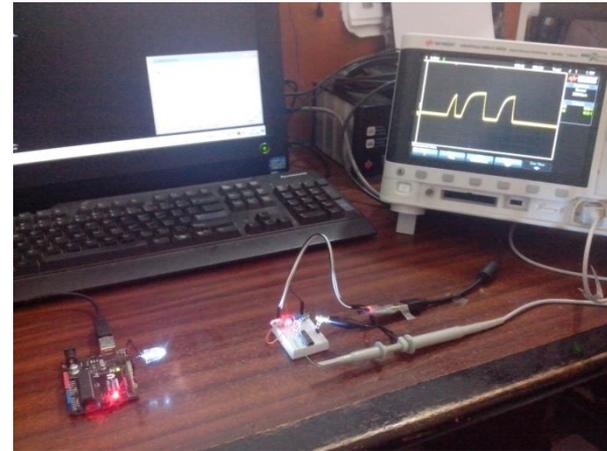
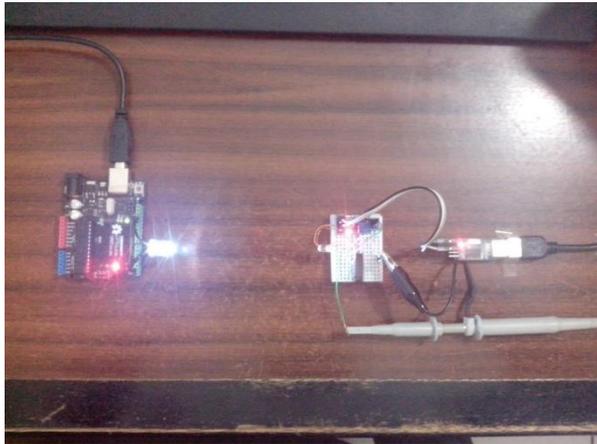
LED-based VLC system (1)

- Preliminary experiment

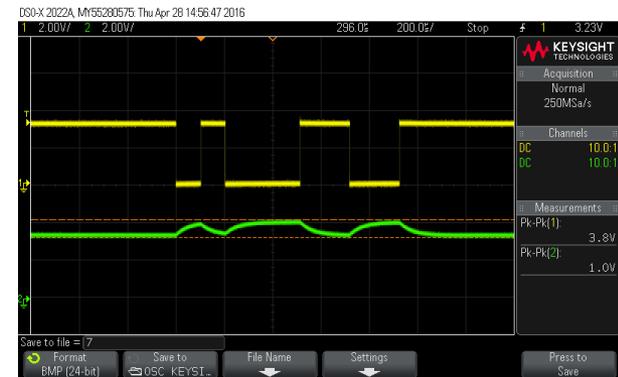
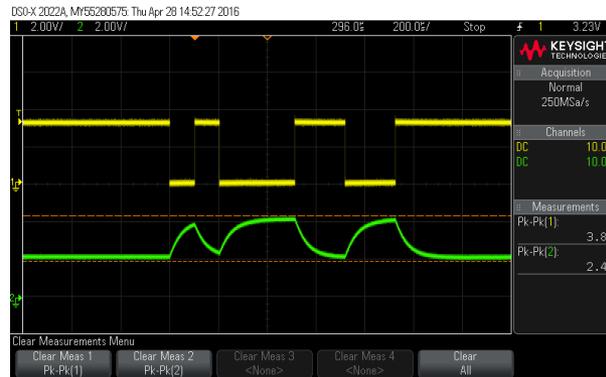
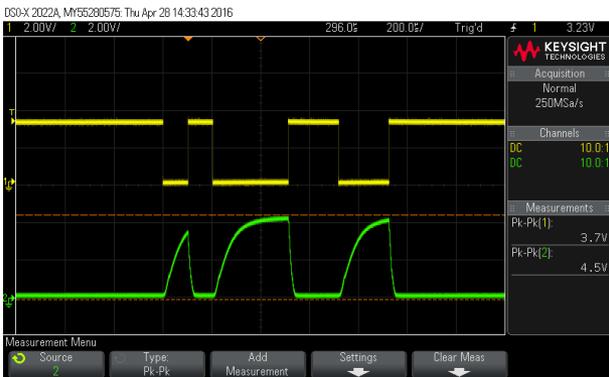
Using available and cheap electronic and optical components



LED-based VLC system (2)



Experimental setup (at LIPI)

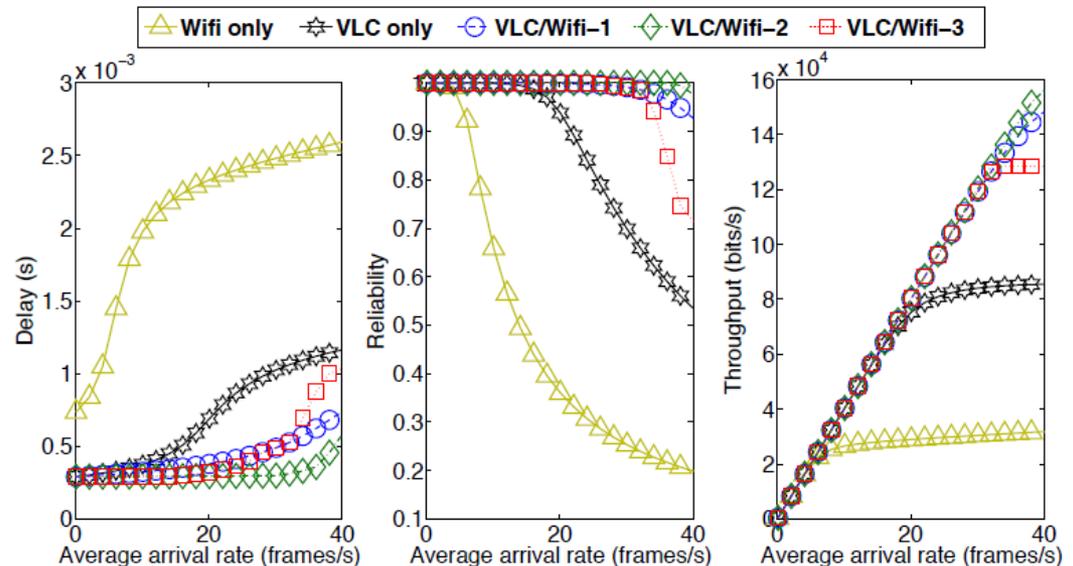
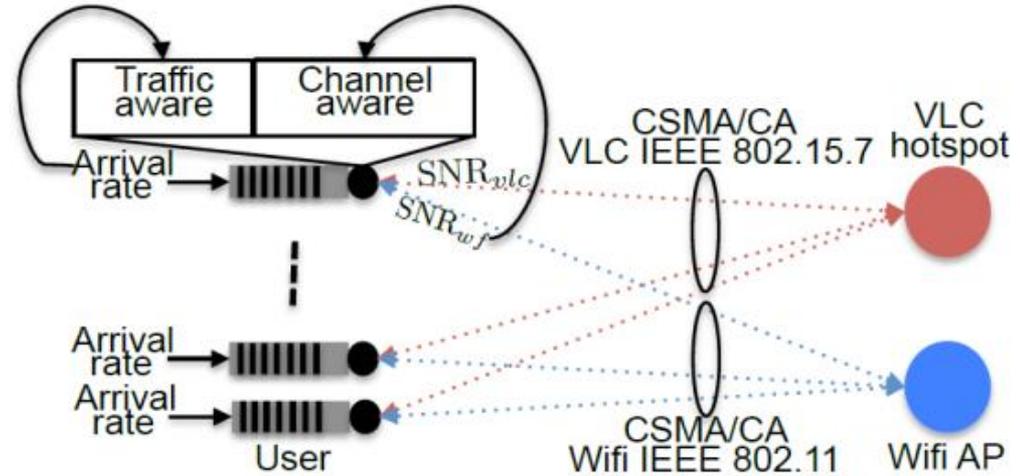


Measured data of transmitting (top) and receiving (below) for 10 mm, 150 mm, and 300 mm.

Hybrid VLC/WI-FI Networks

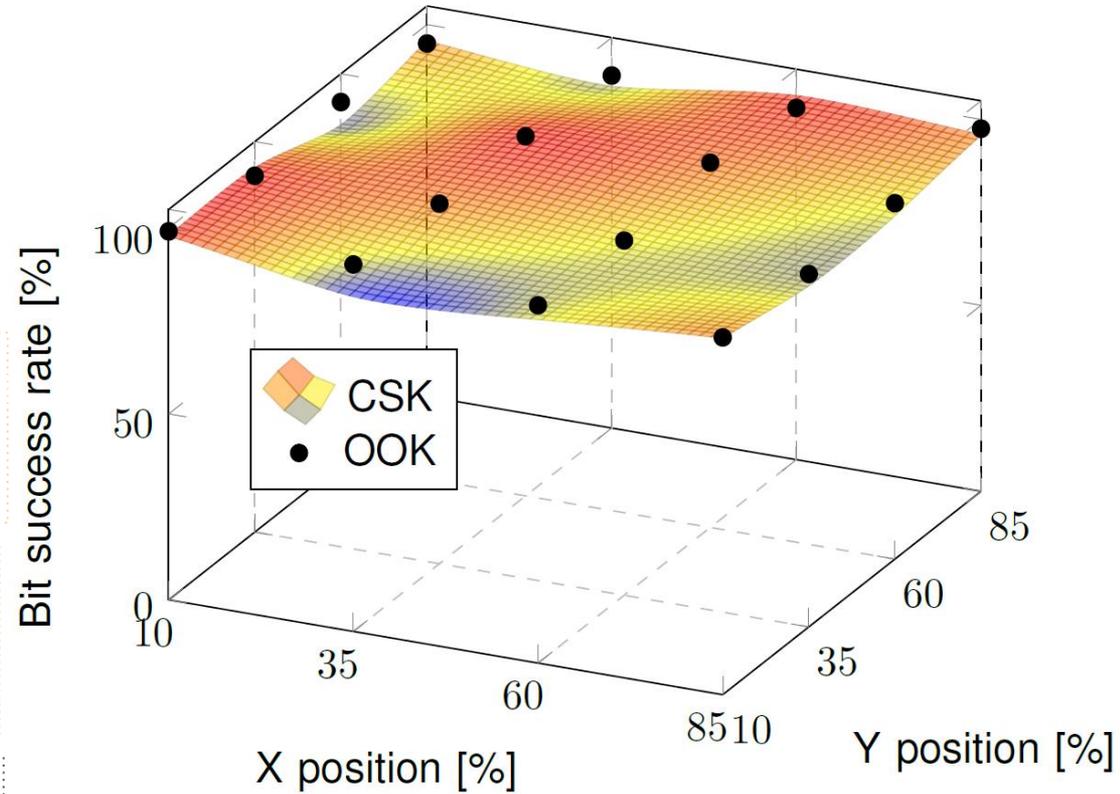
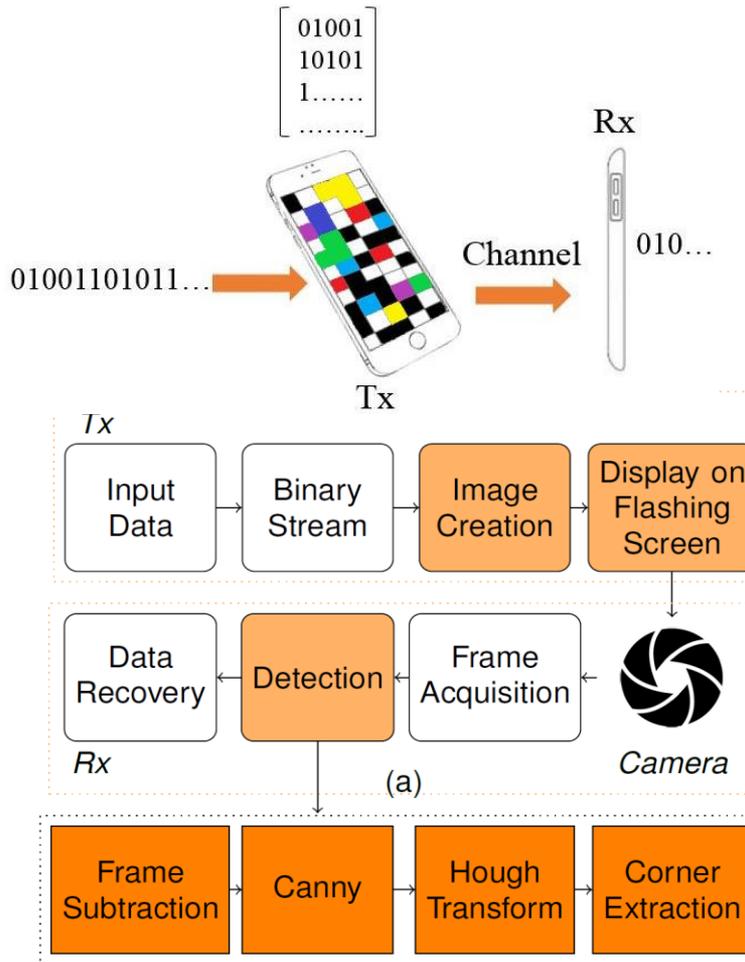
CSMA/CA-based MAC protocol design and performance analysis

- Propose a multi-channel medium access control (MAC) protocol for hybrid VLC/Wi-Fi networks.
- Add on top of current MAC protocols a sub-layer that runs dynamic channel selection by taking intelligent control decisions, regarding channel aware and traffic aware.
- System performance metrics are analytically studied based on a combination of queuing and Markov chain theories.



In preparation for journal submission

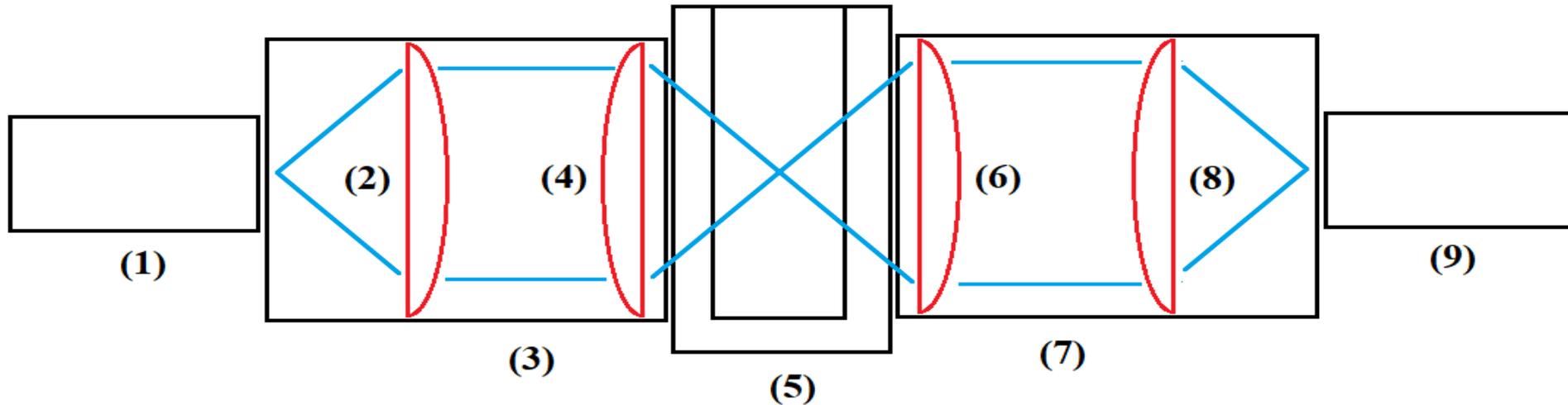
Terminal to Camera Visible Light Communication System



In preparation for journal submission

- ❑ Design and implementation of a complete screen to camera visible light communication system, for smartphones and tablets.
- ❑ Channel capacity of more than 2 kb/frame using On-Off Keying and 5.8 kb/frame using Colour-Shift Keying.

Non-invasive optical sensor system



Block diagram of the water sensor

- ❖ the UV source (1) is a Deuterium lamp, provides illumination from 200 nm to 400 nm.
- ❖ the UV light is transmitted through free-space along the first lens tube (3)
- ❖ inside the lens tube, two plano-convex lenses (2) and (4) are used to focus the light.
- ❖ both (2) and (4) have to be quartz lenses to transmit UV wavelength.
- ❖ the light beam is then passed through a quartz cuvette (5) holding the sample liquid.
- ❖ the second lens tube (7) has two plano-convex lenses (6) and (8) guide the light beam to the spectrometer (9).

❑ Finished prototype design, and ordered devices for prototype development.

Increase bandwidth efficiency of VLC system with OLED using pre-emphasis circuit and FBMC modulation

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Pham Tien Dat⁴, Shimamoto Shigeru⁵

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Academic conference presentations

The 2017 International Symposium on Electrical and Electronics Engineering

Workshop on Short-range access communications and related technologies

Time	Titles	Presenters
13:40	Short-range access and workshop introduction	Pham Tien Dat
13:45	Overview of Optical Wireless Communications	Mitsuji Matsumoto
14:05	Hybrid VLC/WiFi Networks: CSMA/CA-based MAC Protocol Design and Performance Analysis	Dang The Ngoc
14:25	Short-Range Visible Light Communication with Low-Cost Optoelectronic Devices for Smart Homes	Yusuf Nur Wijayanto
14:45	Pre-Emphasis Circuit for OLED VLC Systems	Pham Quang Thai

Project meeting, HCM City, Nov. 30, 2017

Agenda items (tentative):

1. Welcome

All members

2. ASEAN IVO Project Procedures

Hiroshi Emoto (NICT, Japan)

3. Discussion of Drafting Annual Report

Pham Tien Dat (NICT, Japan)

4. Research plan and budget use

Yusuf Nur Wijayanto, Pham Quang Thai, Dang The Ngoc, Mitsuji Matsumoto, Pham Tien Dat

5. Discussion of plan in JPFY2018

Yusuf Nur Wijayanto, Pham Quang Thai, Dang The Ngoc, Mitsuji Matsumoto, Pham Tien Dat

6. Other businesses

All members

Suggestion on project structure

I. Withdraw

Prof. Phi Hoa Binh, Vietnam Academy of Science and Technology, Vietnam

cannot continue because of some recent serious sick.

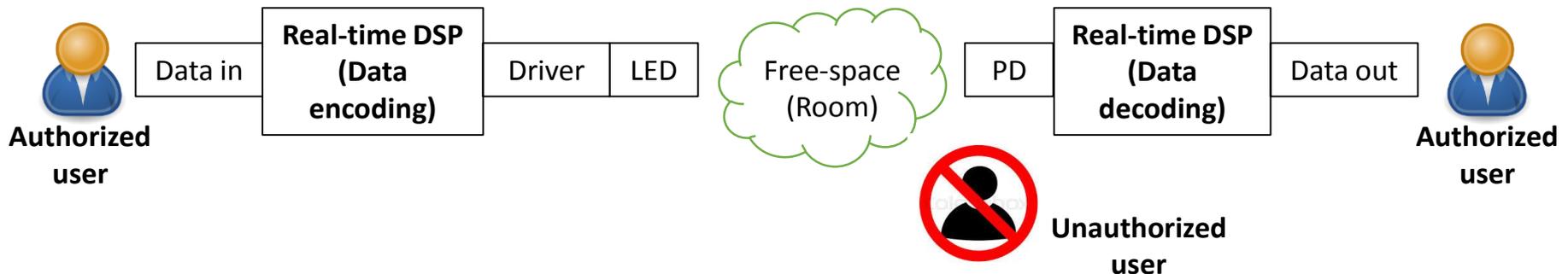
II. New members

1. Dr. Ukrit Mankong, Chiang Mai University, Thailand (IVO ASEAN member)

- Visible light indoor positioning system

2. Dr. Nguyen Tan Hung, Danang University of Science and Technology, Vietnam (IVO ASEAN member)

- Information-secured VLC for real-time applications



Future Plans

- ❑ Focus on collaborations among members: joint researches/experiments, joint publications, research exchanges, joint seminars/workshops.
- ❑ Academic publications and presentations.
- ❑ Sub-system and system prototype development.
- ❑ Proof-of-concept experiments and demonstrations.
- ❑ Field test and measurements on water quality.

Thank you very much!

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