



DTG202 BENGKEL KOMUNIKASI NIRKABEL



By Dwi Andi Nurmantris

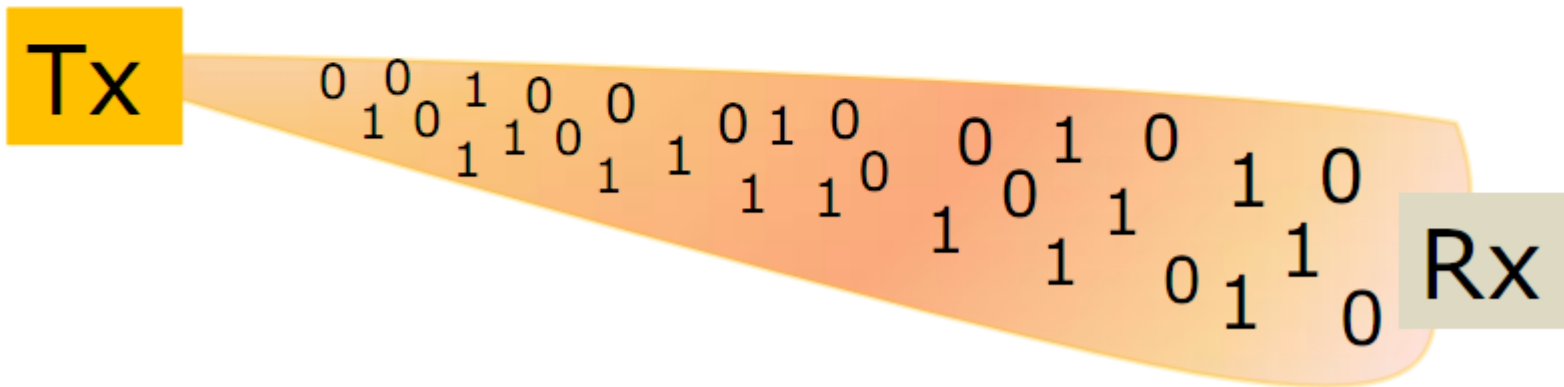
Visible Light Communication (VLC)



Pendahuluan

What is VLC?

Communication using visible light
Wirelessly.



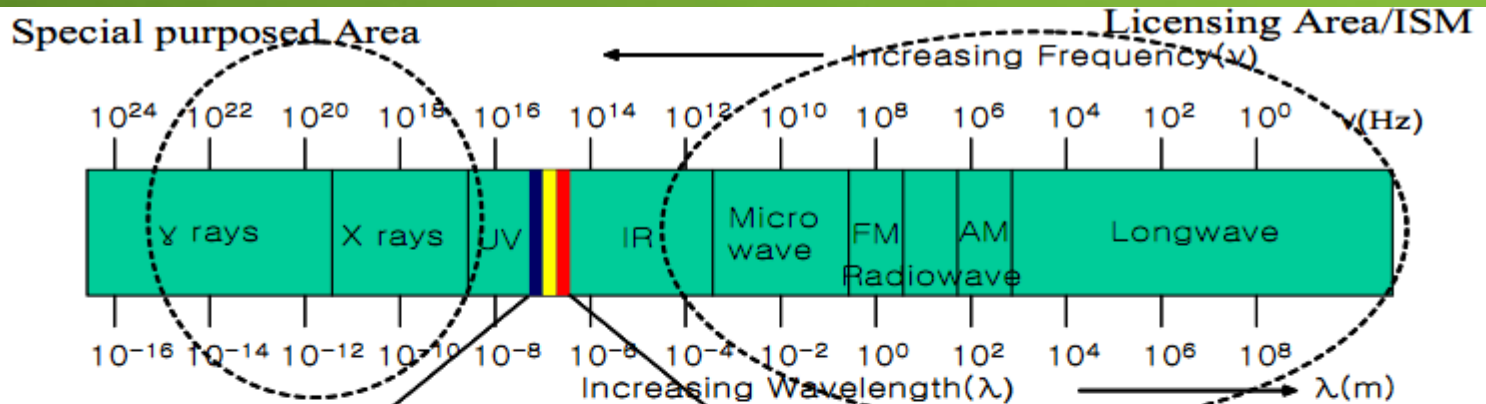
Pendahuluan

- ❑ Visible Light Communication is a Novel kind of Optical Wireless Communication which uses visible light **(400THz to 790THz)** from Light Emitting Diodes (LEDs) as a medium for data communication.
- ❑ That is, Communications of information using light (visible to the human eyes).
 - VLC offers short/medium range data communication



Pendahuluan

VLC Spectrum



**Low Frequency
(High wavelength)
Large Coverage
Mobility**

**High Frequency
(Small wavelength)
High Bandwidth
Security**



Pendahuluan

VLC History

~ 800 B.C. 405 B.C. 280 B.C. 1800s 1880 1900s Current

Sunlight

Heliograph

Photophone
By Bell

Fire

Beacon
Fire

Pharos
Lighthouse

Burning Kite
In Battle

Lamp

Ship-to-ship
Comm.

Traffic Light
/Signboard Light

LED

VLC

Pendahuluan

Why Optical?

- ❑ Wireless data transmission via optical carriers: opportunity, many yet unexplored.
- ❑ Optical Wireless Communication (OWC): Significant technical and operational
- ❑ advantages. OWC, in some applications:
 - a powerful alternative to radio frequency (RF) and,
 - complementary to existing RF wireless systems.

Pendahuluan

Why VLC?

❑ LED Advancement

- LED technical evolution (efficiency, brightness)
- LED illumination infrastructure
- Switching Speed

❑ Communication Community trend

- Ubiquitous (Connected anywhere, anytime)
- Security

❑ Environmental trend

- Energy saving
- Green Technology
- Free Spectrum

❑ Intrinsic Characteristic of VLC

- Visibility
- No interference /No regulation



Pendahuluan

VLC Properties

Parameters	Radio	Infrared	VLC
Bandwidth	Around 300GHz	Few 100 THz	300 THz
Data Rate	Few 100 Mbps	Few 10 Mbps	Dependent on distance and limited by LED switching speed
Spectrum Regulation	Licensed	Regulated & Licensed	Not licensed
Safety Issue	Susceptible to the biological damages to humans by the electromagnetic wave.	Eye safety problem	No danger to eyes or biological effect. Easily used with medical instruments or even on airplane.
Usage	Everywhere with cell phones and the wireless LAN, etc	Notebook, Cell Phone, PC etc.	Getting popularity
Suitability	Wide applications and popularity. Restricted in Hospital and airplane	Short range (mostly indoor)	Short & Medium, both indoor and outdoor
Implementation and cost	Complex, Costly	Easier, cost effective	Cost effective, Used on existing infrastructure or with slight modification
Security	Many complex algorithm needed	May be secured (very short distance)	Secured (What you see is what you transmit)
VLC Can be a supplementary and not replacement to Radio			Complex and Challenging

Pendahuluan

VLC Vs RF

Property	VL Comm.	RF Comm.
Bandwidth	Unlimited, 400nm~700nm	Regulatory, BW Limited
EMI	No	Yes
Line of sight	Yes	No
Standard	Beginning	Matured
Power consumption	Relatively low	Medium
Visibility security	Yes	No
Infrastructure	LED Illumination	Access Point
Mobility	Limited	Yes
Coverage, Distance	Narrow, Short	Wide, Medium

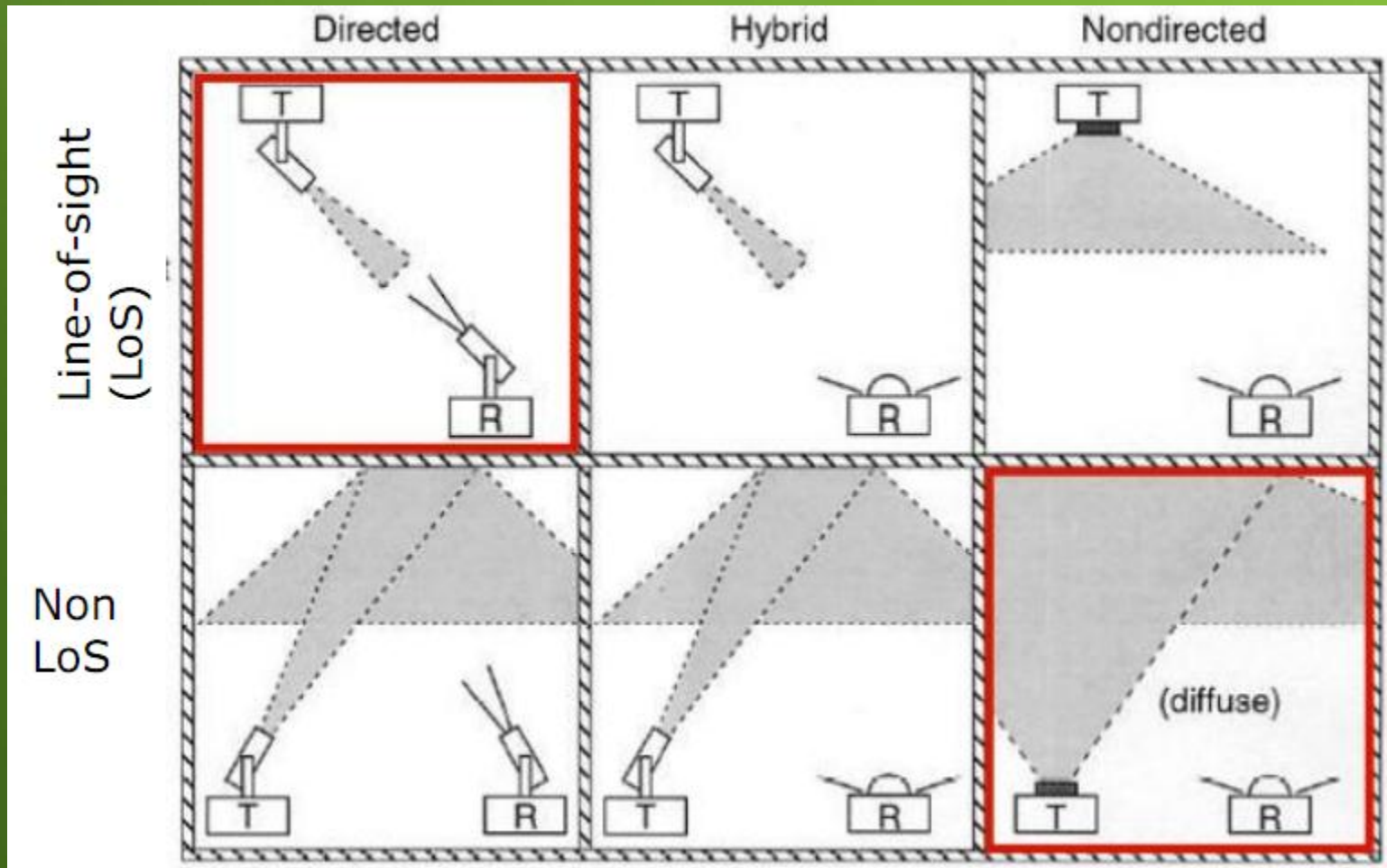
Pendahuluan

VLC Vs RF

Property of Medium	RF	OW	Comments on OW
Bandwidth : Regulated?	Yes	No	Approval not required; Worldwide compatibility.
Passing Through Walls?	Yes	No	Less coverage but more secured; Independent links in different rooms.
Path Loss	High	High	High requirement on alignment; scattering loss
Dominant Noise	Other Users	Background Noise	Limited Range
Alignment	Low requirement	Usually sensitive	
Power Consumption of the Link	High	Low	




Pendahuluan

VLC Configuration



Pendahuluan

VLC Application

	Application	Function
<p>Mobile to Mobile</p>	 <p>Handheld device, Portable device</p>	<ul style="list-style-type: none"> ■ Contents-sharing ■ Data transfer
<p>Mobile to Fixed</p>	 <p>CE, Kiosk, Printer</p>	<ul style="list-style-type: none"> ■ File transfer ■ Video streaming ■ M-commerce
<p>Infrastructure to Mobile</p>	 <p>CE, Signboard, Traffic Signal, Illuminator</p>	<ul style="list-style-type: none"> ■ Indoor Navigation ■ Information-broadcast

Pendahuluan

VLC Application

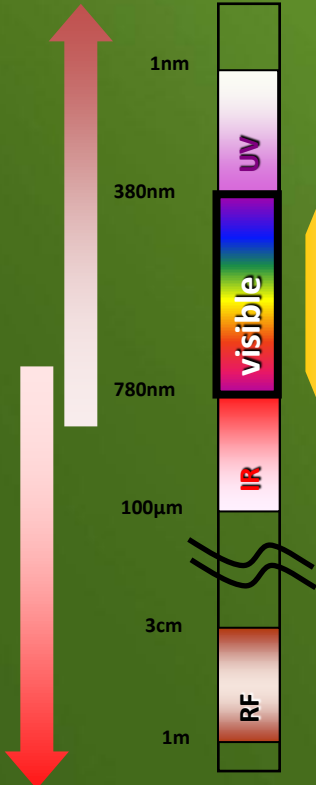
- SMART LIGHTING
- MOBILE CONNECTIVITY
- HAZARDOUS ENVIRONMENTS
- VEHICLE & TRANSPORTATION
- DEFENCE & SECURITY
- HOSPITALS & HEALTHCARE
- WiFi SPECTRUM RELIEF
- AVIATION
- UNDERWATER COMMUNICATIONS
- LOCATION BASED SERVICES



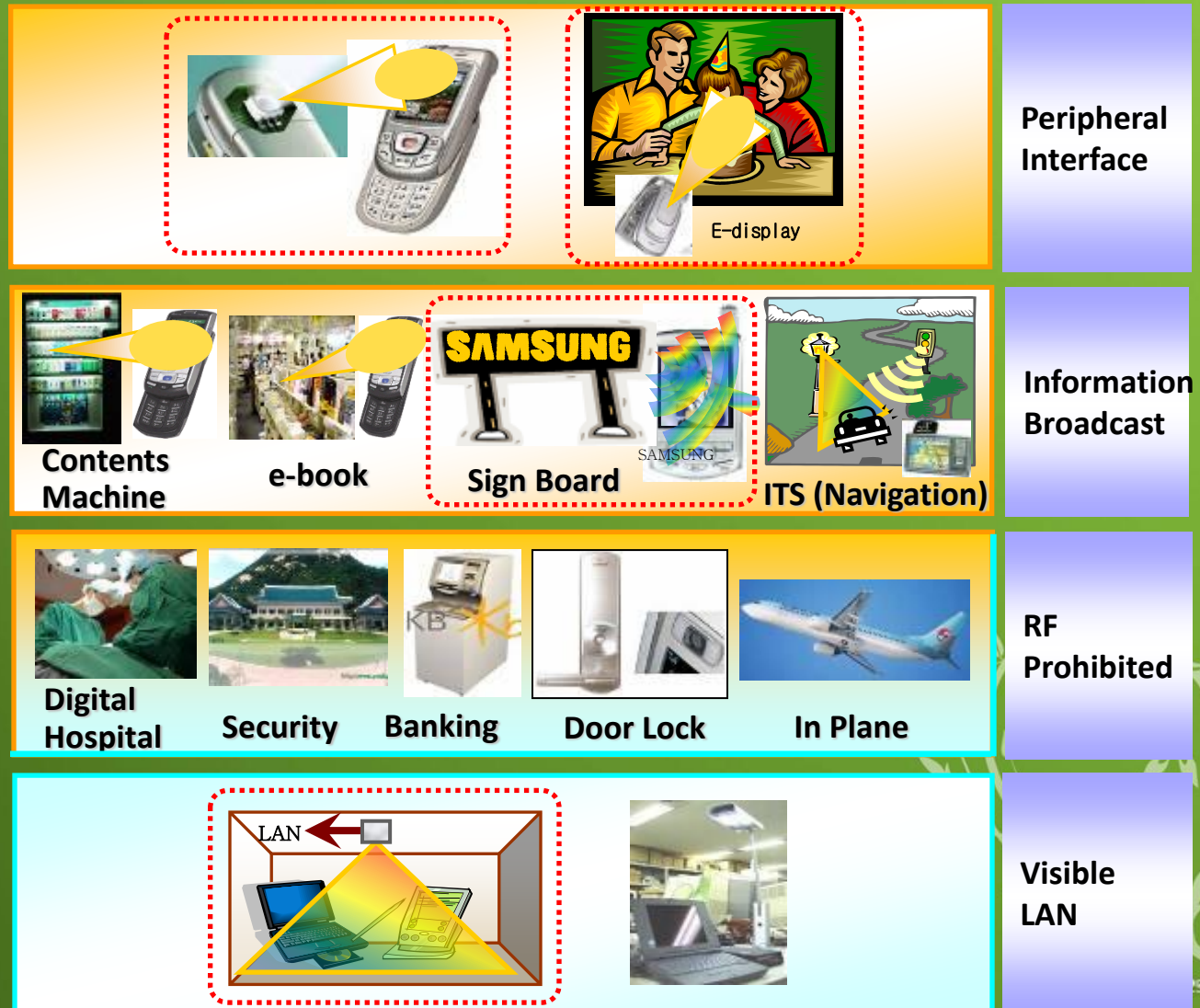
Pendahuluan

VLC Application

Bandwidth
Security



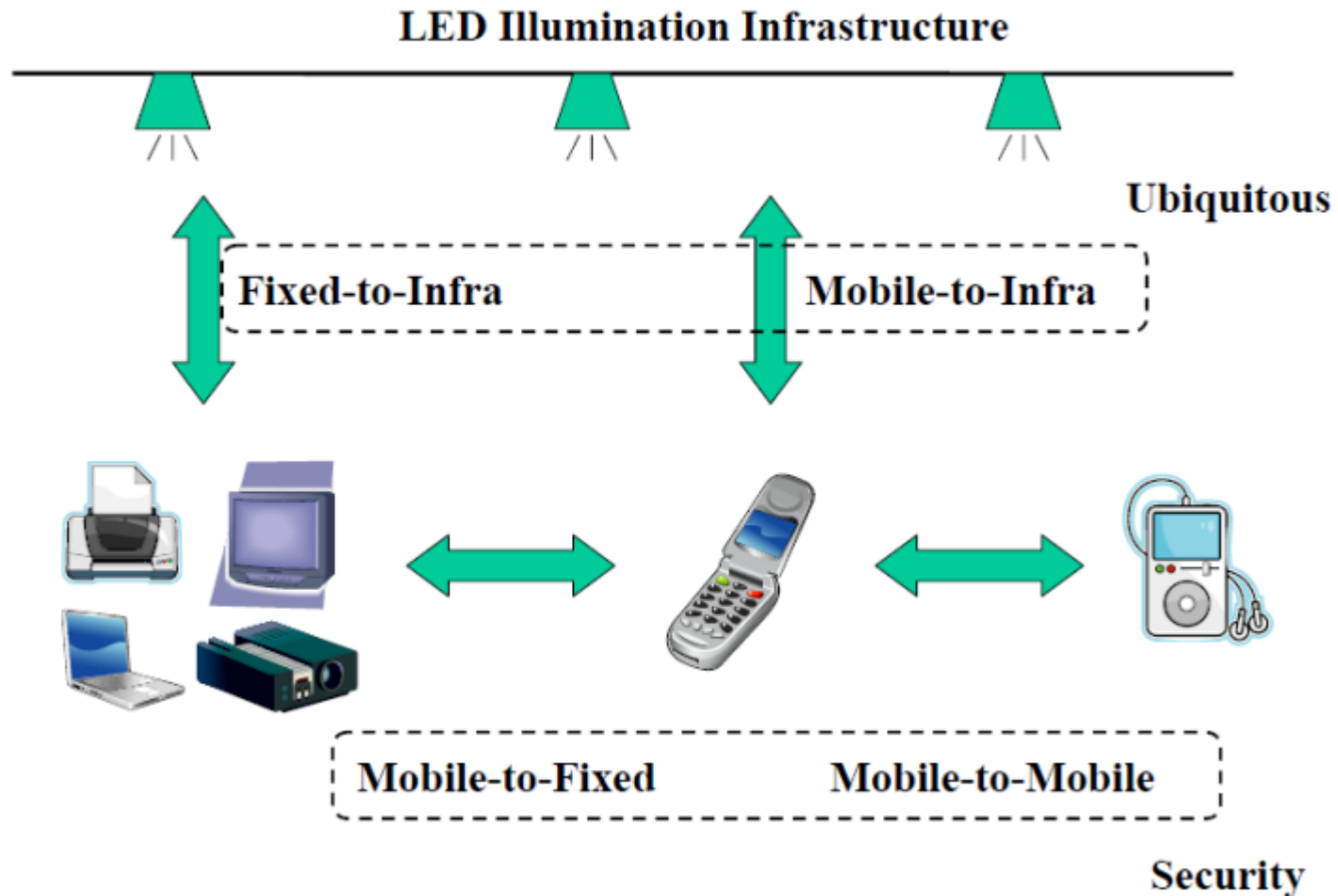
Coverage
Mobility



Pendahuluan

VLC Application

Indoor



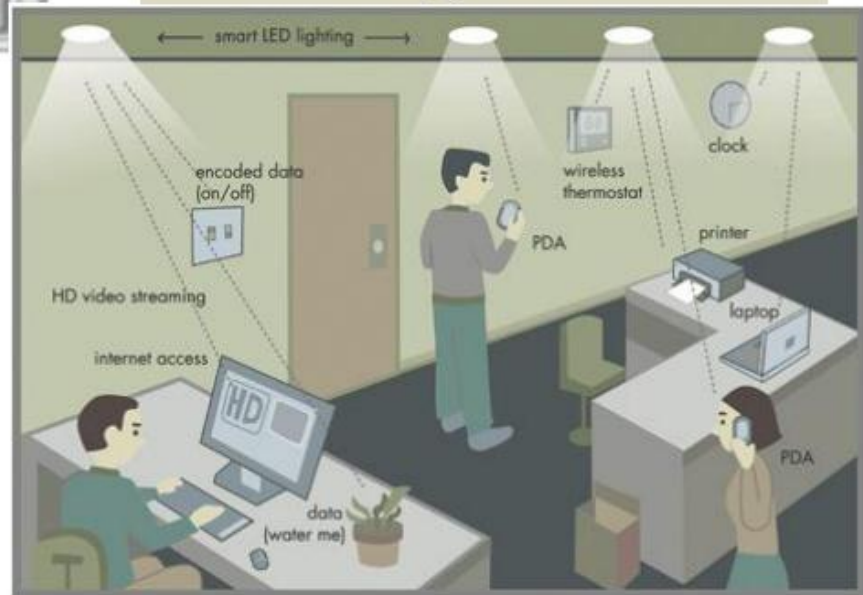
Pendahuluan

VLC Application



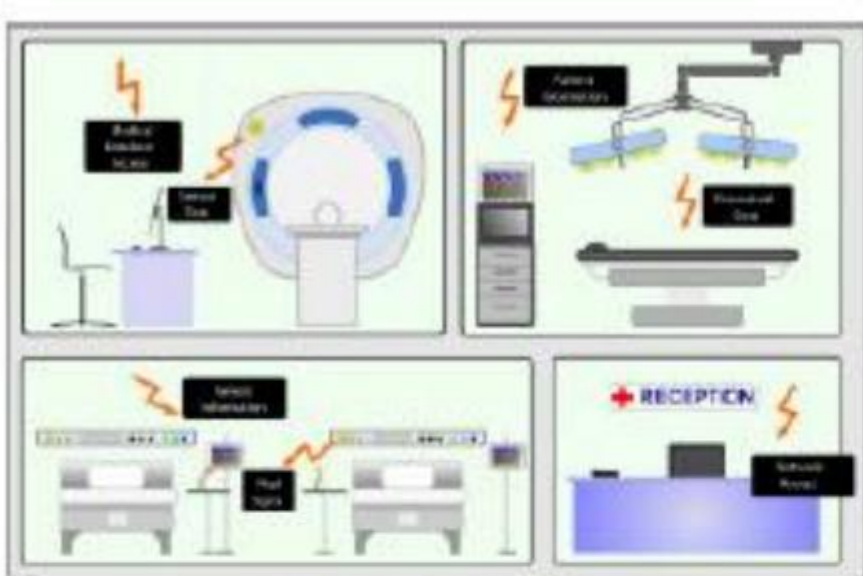
Smart Lighting in the home

LiFi Configuration



Pendahuluan

VLC Application



VLC used in Hospitals

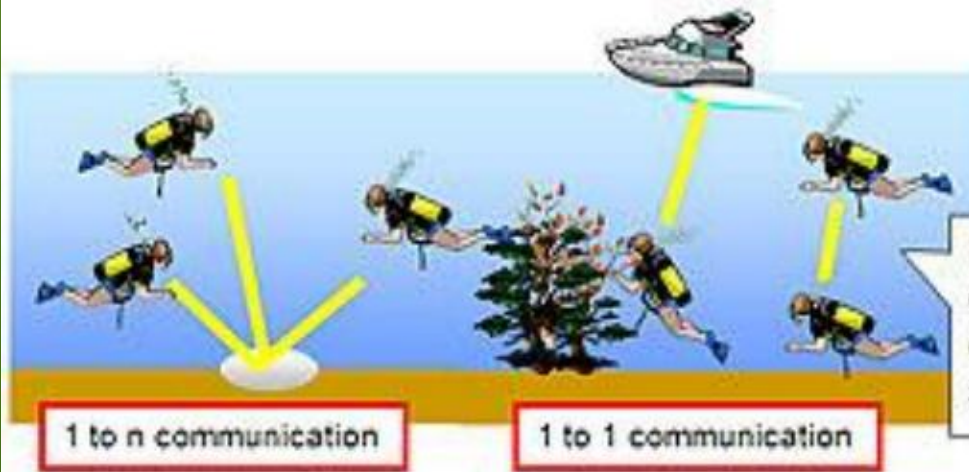


Music Broadcast **Parallel Transmission** (Taken from Nakagawa Lab, Japan)

Pendahuluan

VLC Application

UNDERWATER



It is only our commodity that enables the communication that two or more people can enjoy talking in a comparatively narrow area.



Pendahuluan

VLC Application

Traffic control Infrastructure



Vehicle-to-Infra



Vehicle-to-Vehicle

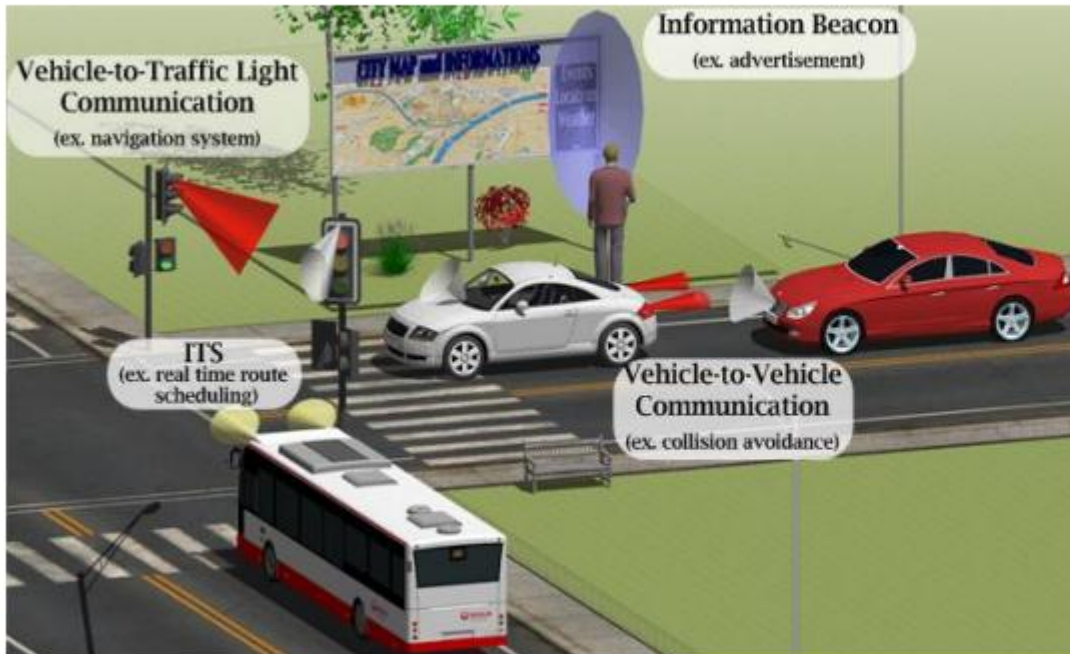
Outdoor advertising



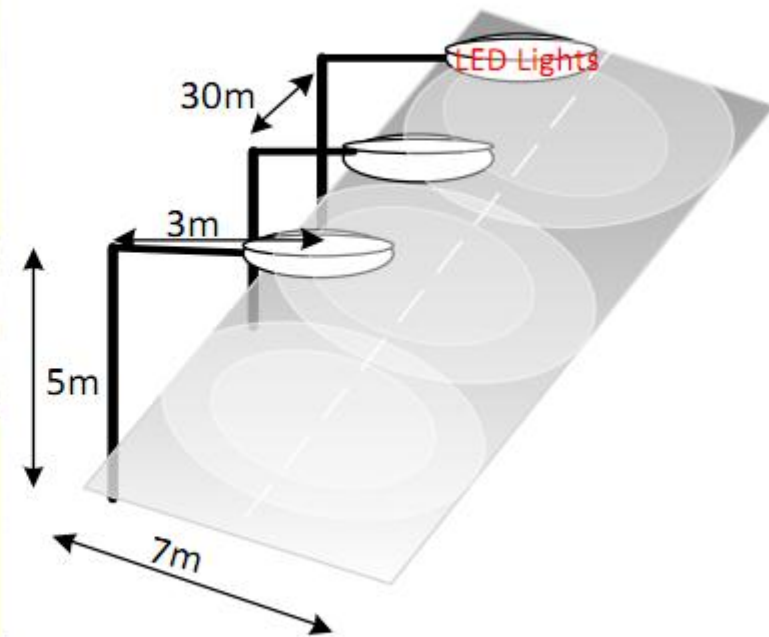
Pendahuluan

VLC Application

► Intelligent Transportation Systems



A scenario of VLC in ITS



Ubiquitous Communication with Road Illumination

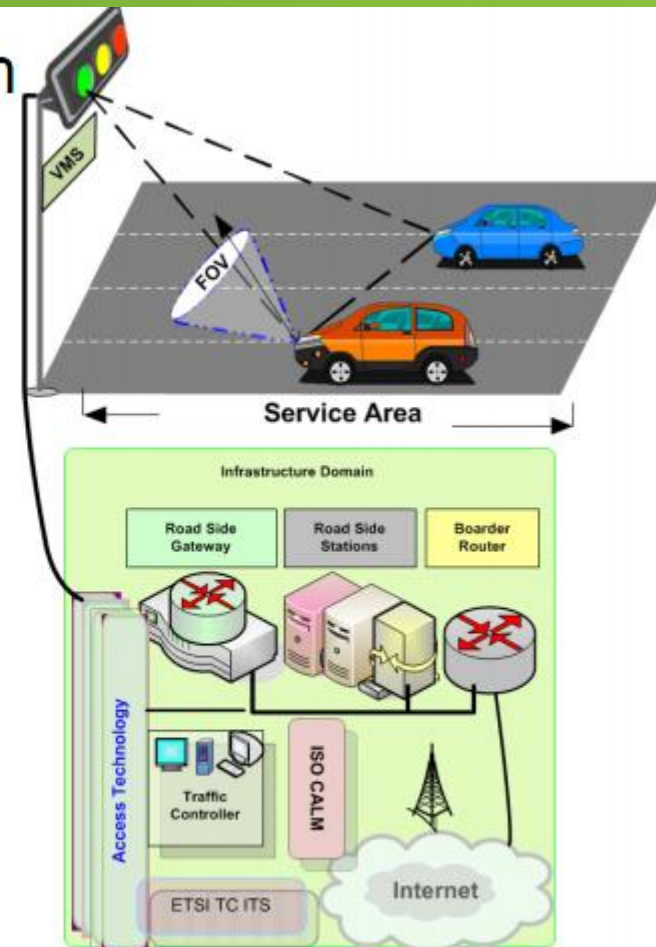
Pendahuluan

VLC Application

▶ Intelligent Transportation System



What's behind the bend?



Integration of VLC with ITS

Pendahuluan

VLC Demonstration

Mobile to Mobile
(100Mbps, Samsung)



Tx, Rx
(~30Mbps, Oxford Univ.)



LED array
(~1Gbps, Keio Univ.)



High speed

Music broadcasting
(6Mbps, Oxford Univ.)



Infra to Mobile
(10Mbps, Tamura Inc.)



Sign board
(10Mbps, Samsung)



Infra to Mobile (VLAN)
(4Mbps, Samsung)



Audio system
(100kbps, Hongkong Univ.)



Infra to Mobile, VLCC (Keio Univ., NEC, Toshiba, Sony, Matsushita, Casio etc.)
(4.8kbps, illuminations, visible light ID, sign board, applications based on JEITA)



Low speed

VLC System Architecture

VLC System

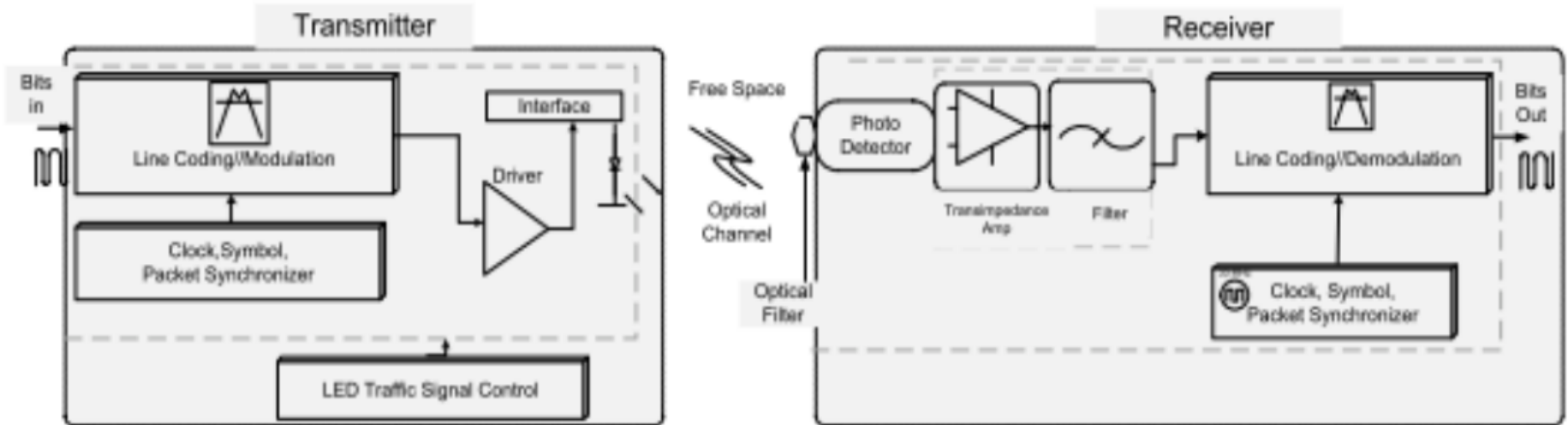


Fig. A VLC System (Overall Architecture)

VLC System Architecture

VLC System

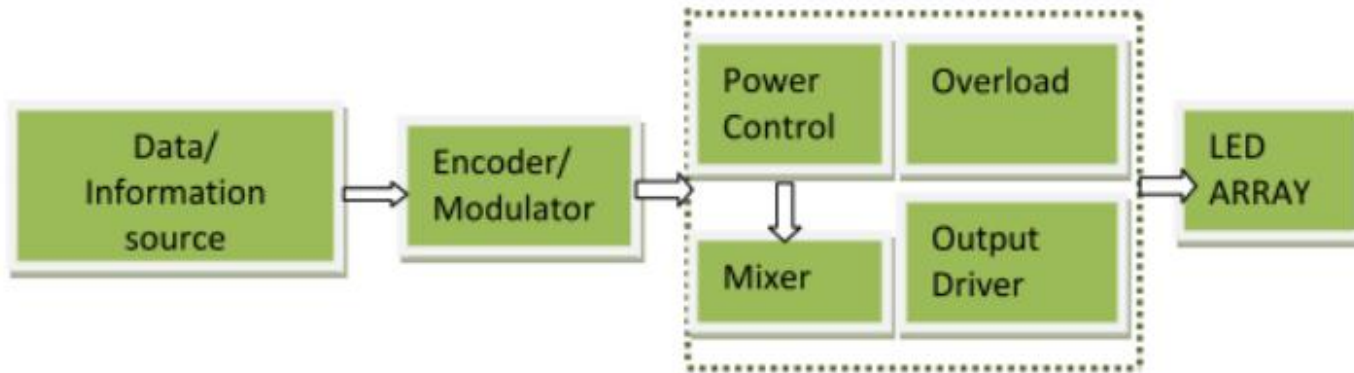


Fig.: Simplified Block diagram of the VLC Emitter

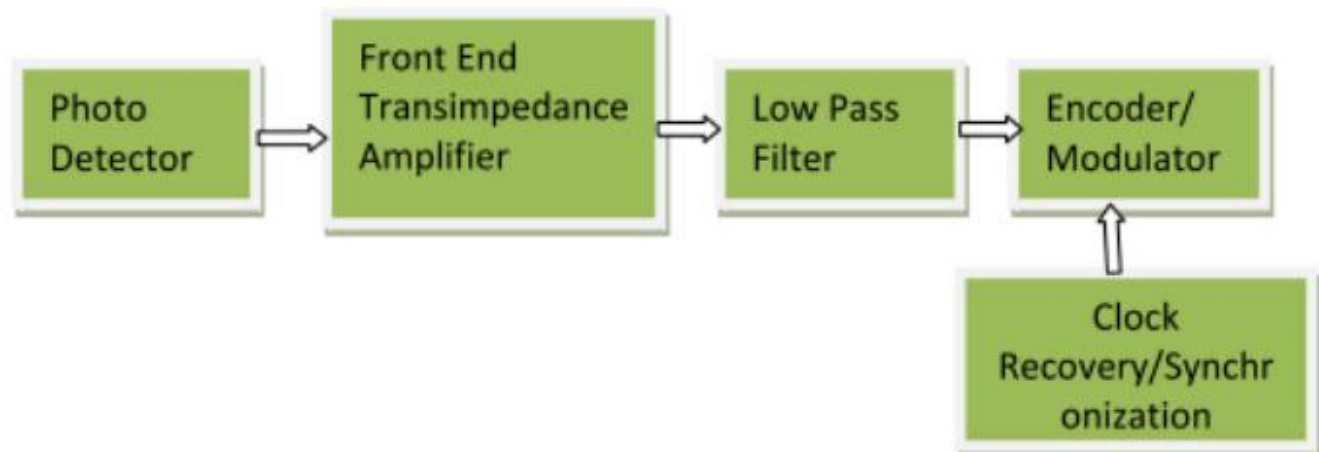


Fig.: Simplified Block Diagram of VLC Receiver

VLC System Architecture

Tugas

Jelaskan Blok Sistem Pengirim dan Penerima pada VLC!



ANY QUESTION?



Thank You!
😊

