

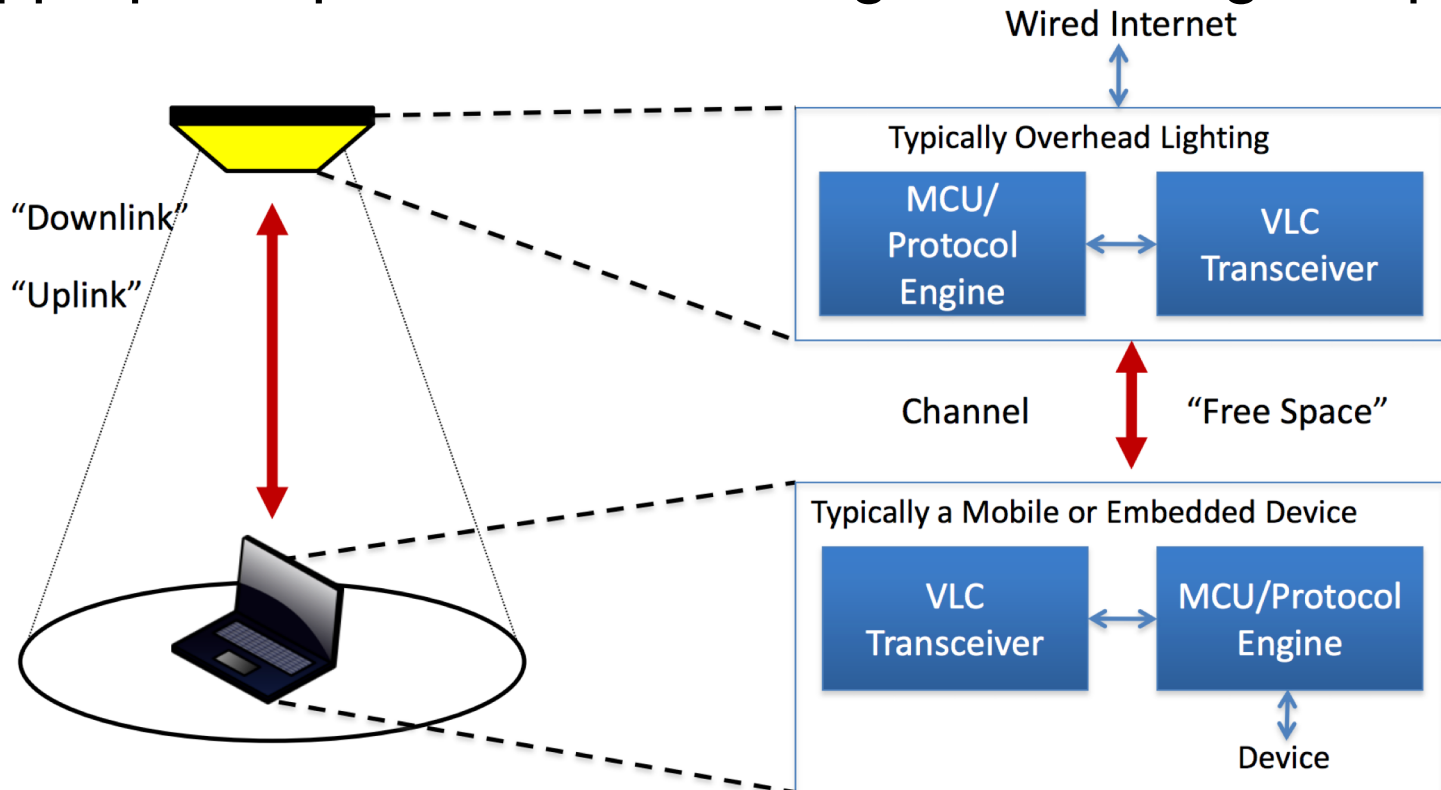
Visible Light Communication



COS 463: Wireless Networks
Lecture 23
Kyle Jamieson

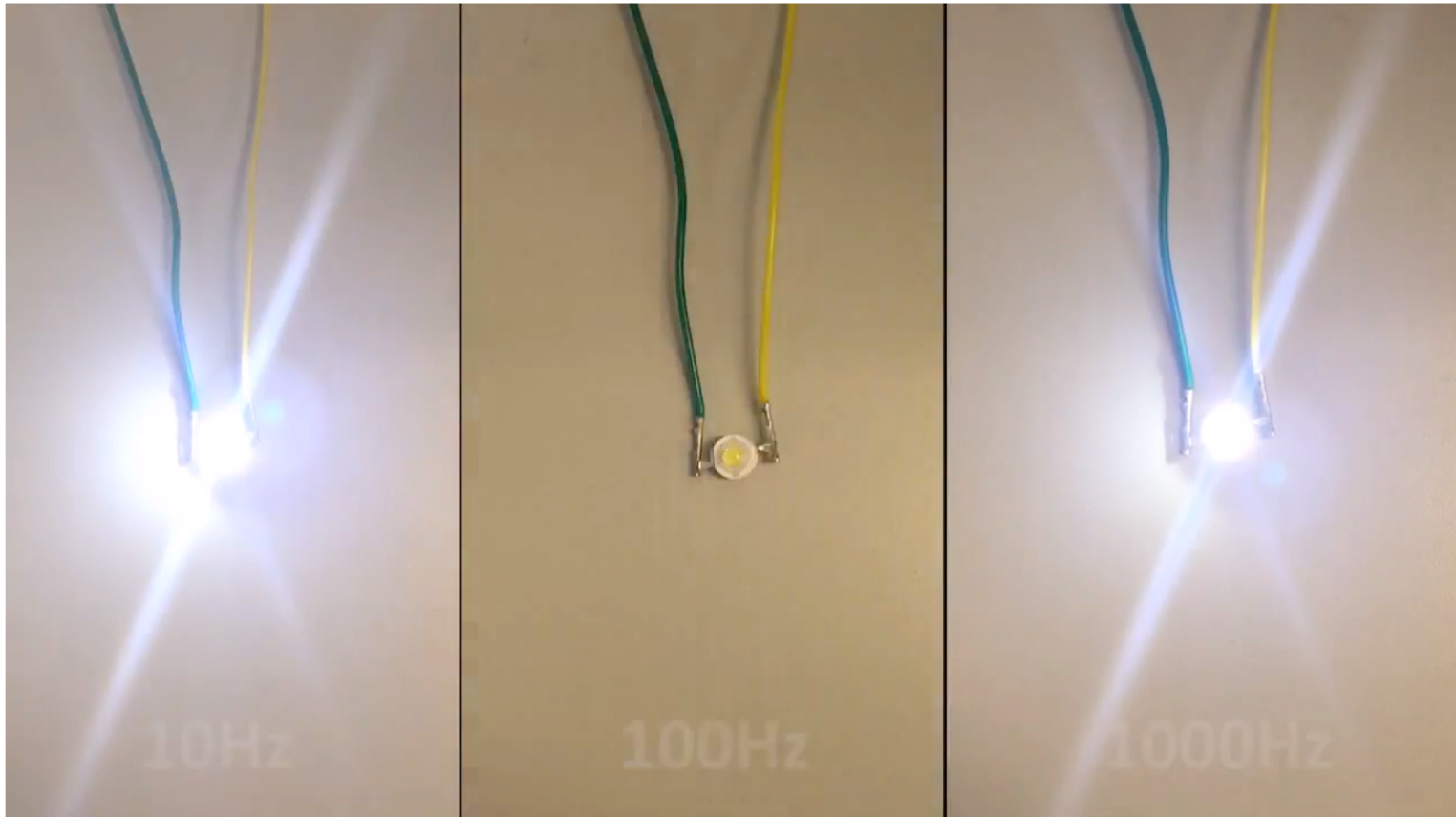
What is VLC

- **Visible light communication (VLC)**
 - visible light source as a signal transmitter
 - air as a transmission medium
 - appropriate photodiode as a signal receiving component



What is VLC

- **Key idea behind VLC**
 - **Eye cannot detect fast light switching but semiconductor- based photodetector can do**



What is VLC – Light source



Incandescent bulb

- First industrial light source
- 5% light, 95% heat
- Few thousand hours of life

Lumens/W: 10-18

Efficiency



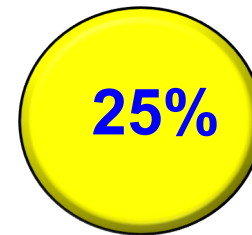
Power usage
> 40%



Fluorescent lamp

- White light
- 25% light
- Lifetime ~10,000s hours

Lumens/W: 35-100



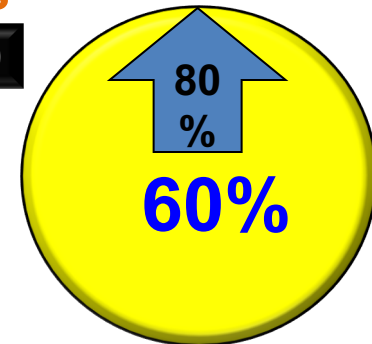
20%



Light emitting diode (LED) – since 1990s

- Compact and 50% light
- Uses 2-17 watts of electricity
- More than 100,000 hours lifespan

Lumens/W: 35-150



10%

What is VLC – Light detector

- **PIN photodiode**

- low cost, large area
- limited sensitivity



- **Image sensors**

- **Charge-Coupled Device (CCD):** low cost, slow due to serial read-out



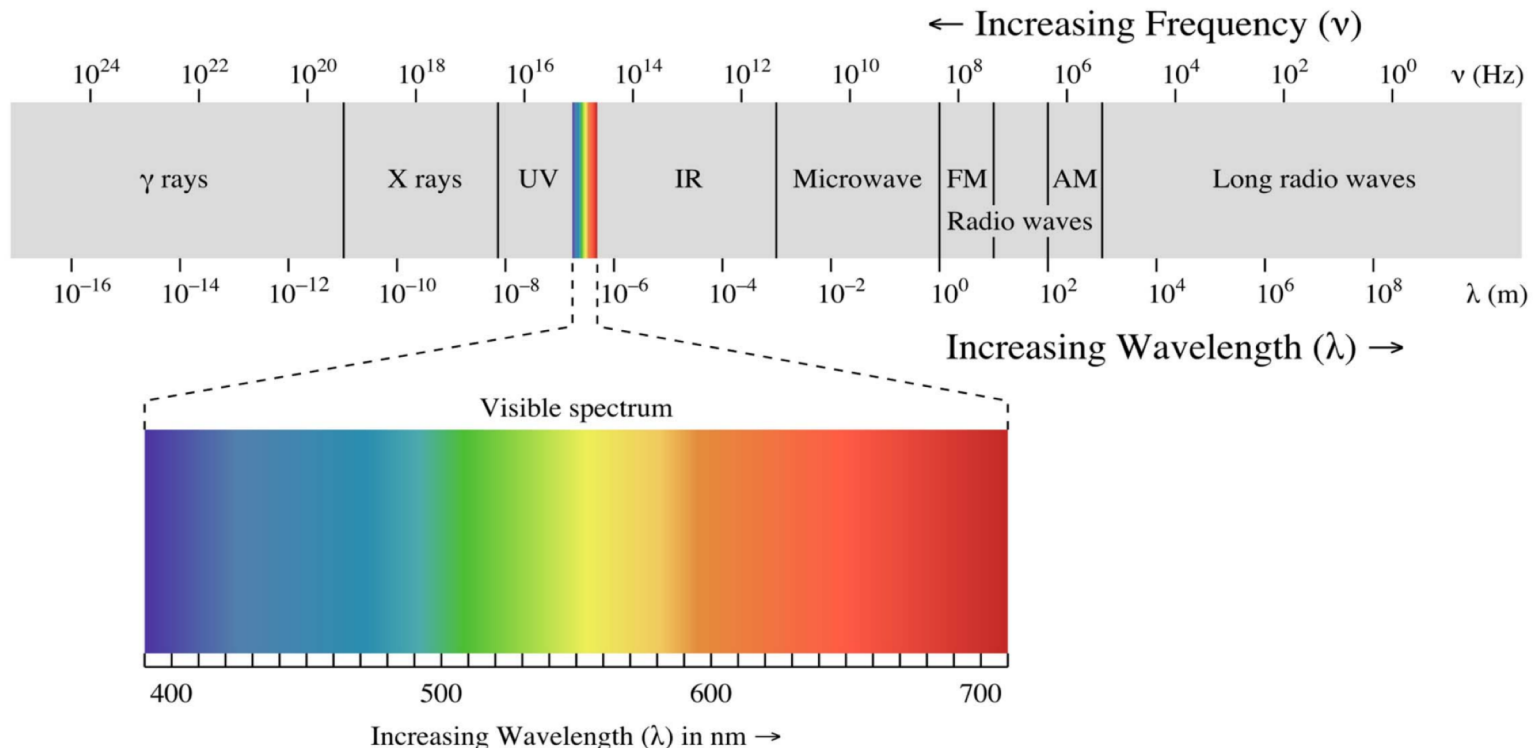
Motivation of VLC

- **Privacy-preserving**
- **Resilient to Interference**
- **Radio spectrum crunch**
 - Ever-growing user demands meet limited radio spectrum



Looking into VLC spectrum

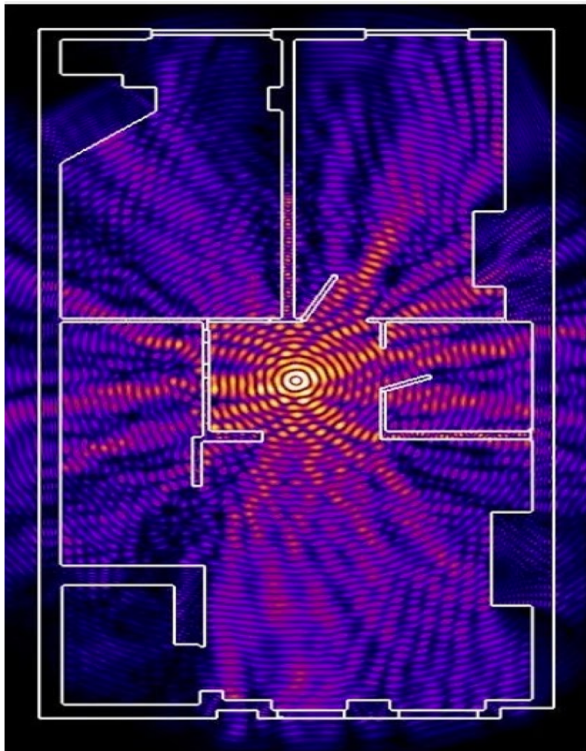
- VLC has a large frequency band
 - 390 nm – 700 nm in wavelengths
 - 430 – 770 THz in frequency



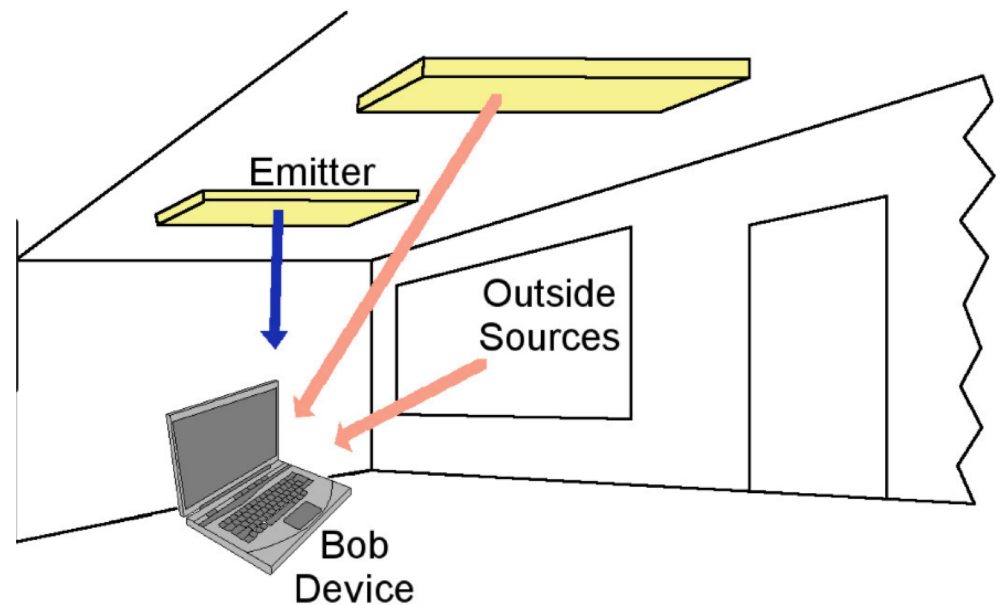
Key difference from RF

- **RF communication** works in a Non-line-of-sight environment
- **VLC** requires Line-of-sight between the transmitter and the receiver

RF signals



VLC



VLC Modulation Schemes

- **Many conventional schemes can be applied:**
 - On-off keying (OOK)
 - Frequency-shift keying (FSK)
 - Pulse amplitude modulation (PAM)
 - Pulse width modulation (PWM)

Current VLC Systems

	Range (m)	Data rate	Modulation	Year
Langer <i>et.al.</i>	1.5	230Mb/s	OOK	2010
Khalid <i>et.al.</i>	0.5	1Gb/s	OFDM	2012
Kottke <i>et.al.</i>	0.3	1.25Gb/s	OFDM	2012
Sewaiwar <i>et.al.</i>	0.85	3Gb/s	OFDM+RGB	2015