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

Submission Title: [VLC Application, evolution and consideration]
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Re: []

Abstract: [Some visible light communication (VLC) application is described in this document. Some consideration points and issues of that application are also presented.]

Purpose: [Contribution to IEEE 802.15 SG-VLC]

VLC Application, evolution and consideration

2008. 11

Samsung Electronics

Contents

VLC Applications

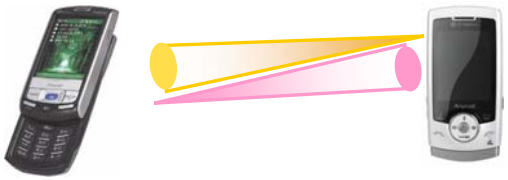
- Basic concept
- Specific use case
- Possible scenario
- Consideration

Mobile to Mobile Applications

Basic concept

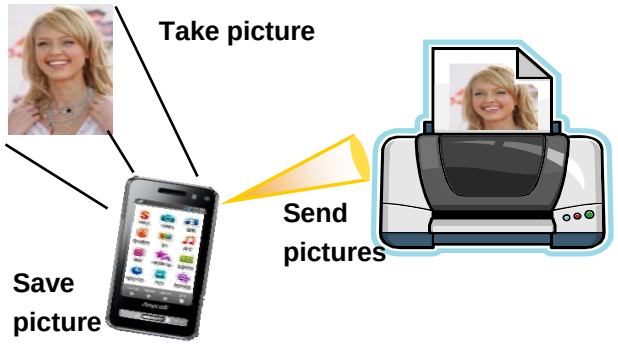
- Contents-sharing or data transferring between two handheld devices or portable device like cell phone

Mobile to Mobile Applications

	Link	Rate/distance	Infra / Mode	Mobile
		❖ Primary, Secondary: ~100Mbps ❖ 0.5~1m	❖ No Need ❖ Full duplex /Half duplex	❖ TX / RX
Possible Scenario / Consider-ation	❖ Contents-sharing or data transferring between two handheld devices or portable device like cell phone ❖ Can choose the light color for user's preference ❖ The transmitting signal, interrupted signal, completed signal can be verified by the visible light, or different color. ❖ High data rate ❖ FOV, divergence angle (Mobility) ❖ Visibility ❖ Power control ❖ Eye safety			

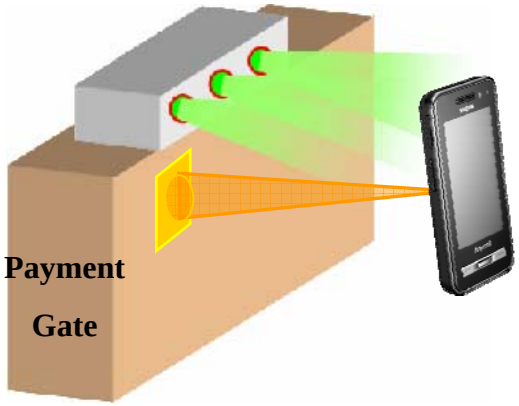
Mobile to Fixed Device Applications

- **Basic concept**
  - Relatively large file transmitting between one devices or portable device like cell phone and other fixed device like TV, printer, projector, computer and so on.
  - Ex) Video streaming

	Link	Rate/distance	Infra / Mode	Mobile
Data sharing		❖ Down: ~10Mbps ❖ ~1m	❖ No Need	❖ TX
Possible Scenario / Consider-ation	❖ Take a picture with user's portable device (camera, cell-phone) and send it to the fixed device like printer, TV or projector ❖ Power control ❖ Visibility (for aligning) ❖ FOV, divergence angle ❖ Eye safety			

	Link	Rate/distance	Infra / Mode	Mobile
Control CE device		❖ Up: ~10kbps ❖ 5m	❖ No Need ❖ Mode?	❖ TX / RX
Possible Scenario / Consider-ation	❖ Work as an Universal Remote ❖ Possibly works as an interactive mode. ❖ Intuitive control using visible light. ❖ easy to pick the device up. (No interference with other device) ❖ can choose the color ❖ Visibility / Distance ❖ TX / RX ❖ Divergence angel			

	Link	Rate/distance	Infra / Mode	Mobile
E-contents Vending Machine		❖ Up: ~10kbps ❖ Down: 1Gbps ❖ ~0.5m	❖ Possibly need (easy to update) ❖ Mode:	❖ TX / RX
Possible Scenario / Consider-ation	❖ Work as e-contents vending machine ❖ Download, music, movie, book, information and so on. ❖ Preview, highlight preview, payment, download ❖ High speed ❖ Payment, authentication, security ❖ FOV			

	Link	Rate/distance	Infra / Mode	Mobile
E-commerce		❖ Up: ~10kbps ❖ Down:~10kbps ❖ ~1m	❖ network - authentication system	❖ TX / RX
Possible Scenario / Consider-ation	❖ e-payment ❖ pass the gate with the mobile device ❖ Fast initialization ❖ High security, authentication ❖ Mobility			

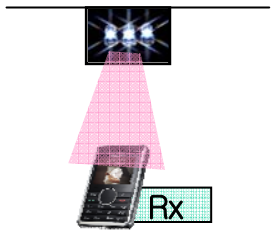
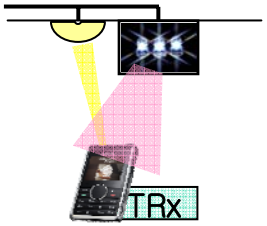
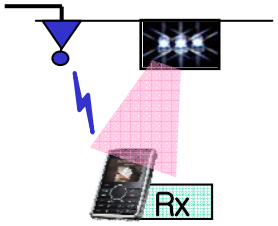
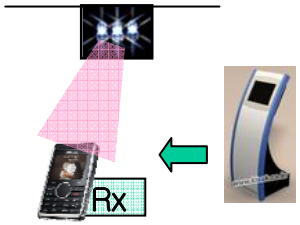
	Link	Rate	Infra / Mode	Mobile
Light Info-shower (Broadcast)	**Information Gate** 	❖ Down: 1Gbps ❖ ~3m	❖ Network	❖ RX
Possible Scenario / Consider-ation	❖ Just pass through the gate with VLC handheld ❖ Download information ❖ Public information and other kind of information can be offered with different color ❖ High speed ❖ Fast initialization ❖ Mobility			

Mobile to Infrastructure Applications

- **Basic concept**
  - Light can be used not only for the lighting system but also for the optical light source.
  - Light is modulated by a unique lamp ID and other information

CE, Signboard, Traffic Signal, Illuminator

Indoor Navigation

	Uni	Bi	Hybrid	Hot spot
Type				
Possible Scenario / Consider-ation	❖ Down: ~10kbps ❖ Lighting w/ optical ID ❖ RX	❖ Down: ~10Mbps ❖ Up: ~100Mbps ❖ Lighting w/ optical ID ❖ In-building network	❖ Down: ~10kbps ❖ Up: ~10Mbps ❖ RF AP/ Connectivity ❖ In-building network	❖ Down (light):~10kbps ❖ Down (HS):~100Mbps ❖ Lighting w/ optical ID ❖ Hot spot
	❖ Download the whole map data at the entrance of the building or Depends on scenarios, user can request and download using hot-spot, RF or other existing comm. method. ❖ Each LED light has own ID that can give a location information or Depends on scenarios, the location server and LED network infrastructure is necessary ❖ LED lighting layout (distance between lightings, the overlapped lighting area.) ❖ Illumination (Lighting) ❖ Safety			

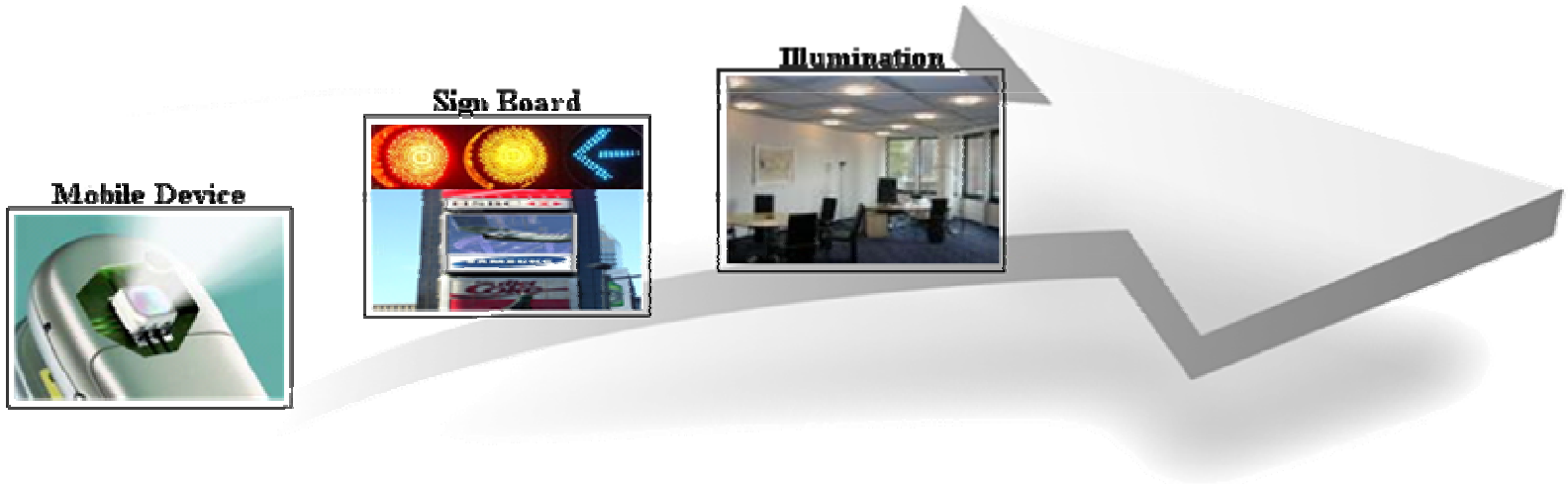
	Link	Rate	Infra / Mode	Mobile
Transmit Additional Information		❖ Down: 10kbps ~10Mbps	❖ Not essential	❖ RX
Possible Scenario / Consider-ation	❖ The lighting for the art can work as a transmitter. ❖ User can download a detail information about the exhibit using handheld device. Download just a lighting ID, URL and so on. ❖ Store, Museum, Mall, Audio guide and etc. ❖ LBS can be possible. ❖ Lighting system. ❖ FOV, divergence angle ❖ Eye safety			

	Link	Rate	Infra / Mode	Mobile
Transmit Additional Information	 	❖ Down: ~100Mbps	❖ in-building network	❖ RX/ TX
Possible Scenario / Consider-ation	❖ RF restricted area, like hospital ❖ Data transfer between Infrastructure and mobile machine, or machine and machine. ❖ for the patient information, large size medical record and images like x-rays and etc ❖ QoS ❖ Security (privacy) ❖ Eye safety ❖ High speed ❖ Network connection method			

Issues

- **Current connectivity trend**
  - **Wireless connectivity**
    - wired->wireless
      - Home Network
        - A/V system cable (connection between CEs)
        - Contents share (control, low data rate -> ?)
      - Not just wireless –> Good quality
        - Ex) Earphone, keyboard, mouse, etc
        - Low Quality, lost, power, cost, design, durability
      - Possibly complicated connectivity technology

Issues



- **VLC application evolution**
  - Depends on LED proliferation
- **Advantageous feature of VLC**
  - Visibility:
    - intuitive communication
    - Fun & Aesthetics
  - LED infrastructure
    - Indispensable element for the VLC

Issues

- **Expect new role**
  - Not just connection but also new function
    - Easy to use
    - Interference free
    - Reliability / durability
    - Proper data rate
- **How about future?**
  - Do we need to think more for the near future?

Summary

- **Various application was described.**
  - Mobile to mobile
  - Mobile to fixed device
  - Mobile to infrastructure
  - Basic Concept / Use case / Possible scenario / Consideration
- **Issues**
- **Expectation**