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

Submission Title: [Simulation results of VLC with actual traffic light regulations in Korea]
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Abstract: [This document presents Simulation results of VLC with actual traffic light regulations in Korea]

Purpose: [To prove the VLC with traffic lights to be capable]

Simulation results of VLC with actual Traffic Light regulations in Korea

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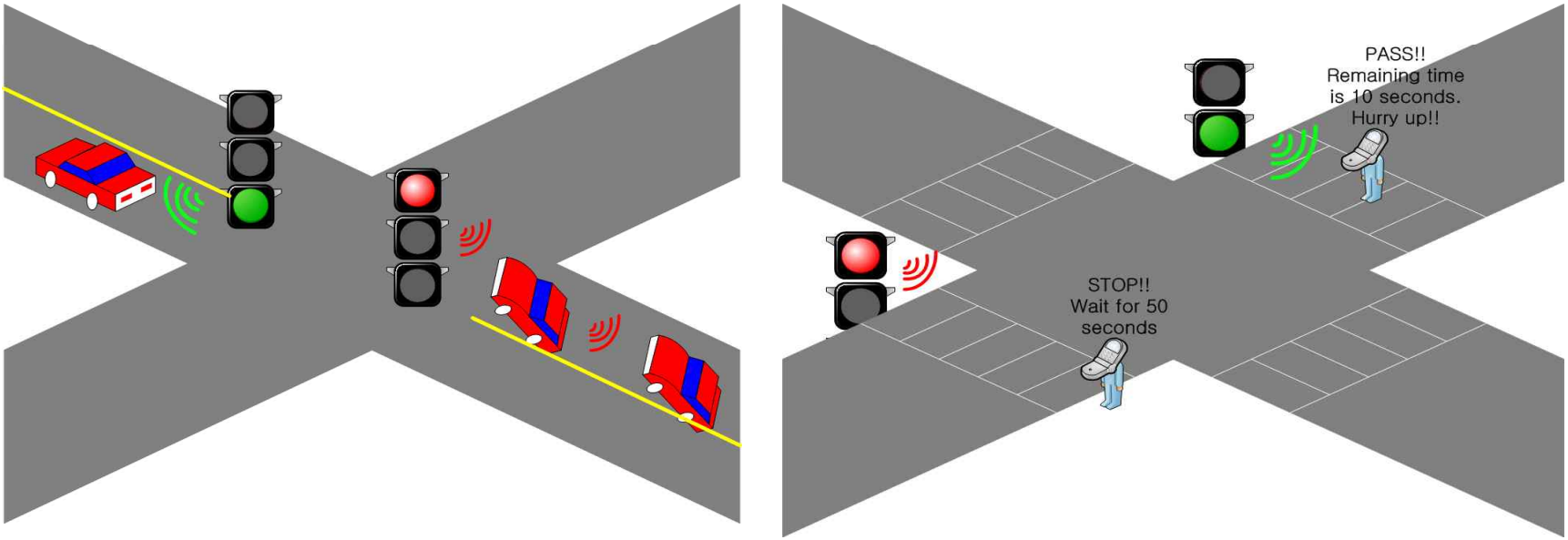
Motivation for doing simulation

- In January meeting this year, we introduced the result of simulation of the VLC between the Traffic Light and Vehicles [ref. IEEE 802.15-09-0052-01-0007]
  - Simulation results show that any receiver of all recommended positions in a vehicle can reliably communicate with 100kbps
  - But, we can not consider the background noise and not apply real traffic light regulations, for example transmitter power
- In this meeting, I'm showing the updated simulation result considering the maximum background noise and the actual transmitter power of a traffic light

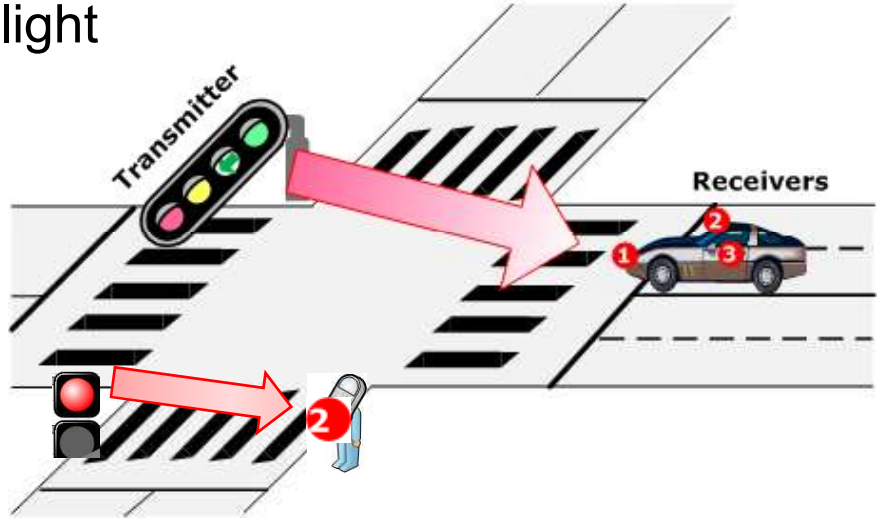
VLC application for ITS

- Traffic lights control competing flows of traffic at intersection and pedestrian crossings as shown in following figures



Simulation Setup

- At the intersection(Communication Range: 35m)
  - Transmitter : LEDs in the traffic light
  - Receiver(PD) positions
    1. Center of front bumper
    2. Top of windshield
    3. Both side mirrors (left, right)



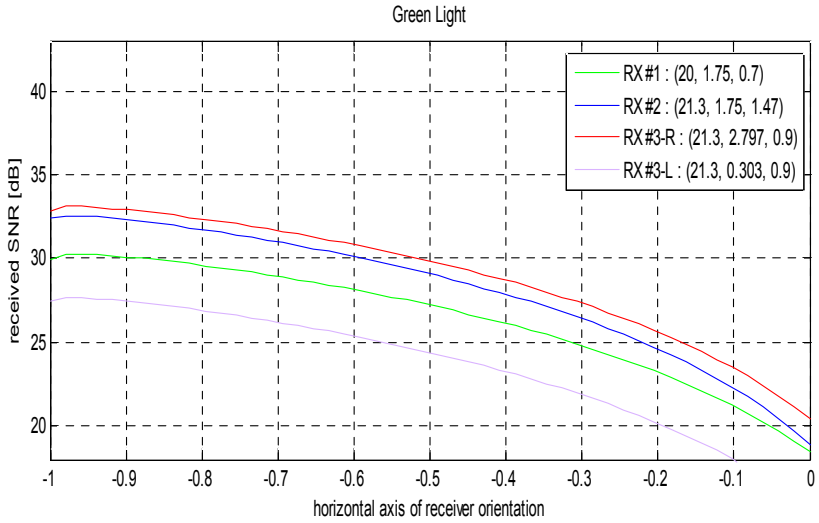
- At a pedestrian crossing(Communication Range: 29m)
  - Receiver positions
    2. 1.47m

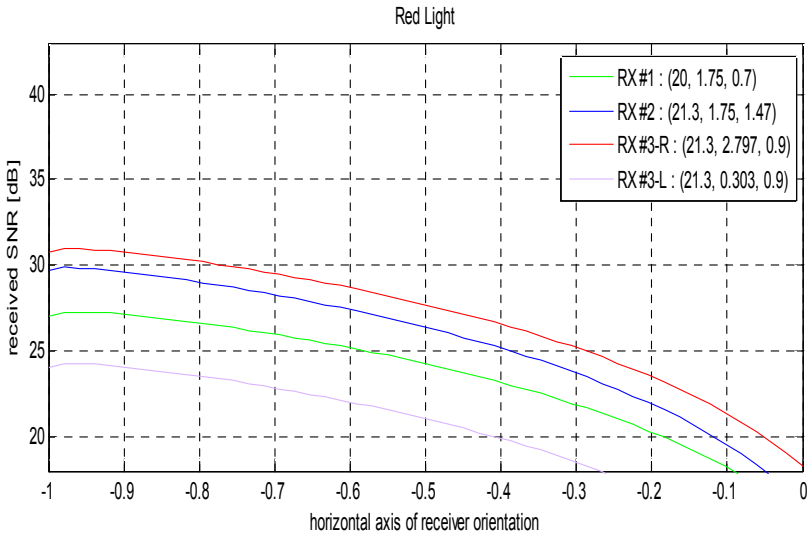
Simulation Parameters

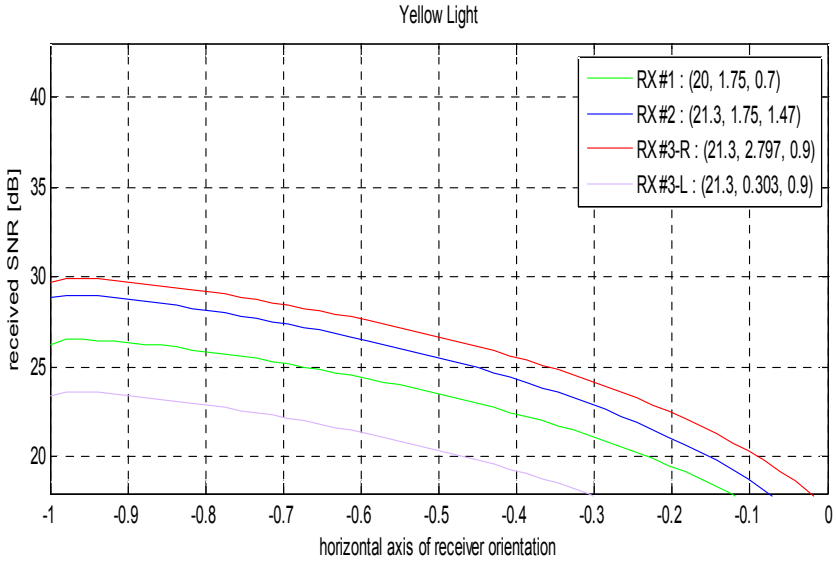
	Traffic Lights				Pedestrian Lights	
	Data rate	Modulation	min. SNR for OOK	BER	FOV	max. Background noise
	1Mbps	OOK	13.6dB	10^{-6}	60°	16dBm[1]
Color	Red	Yellow	Green	Green Arrow	Red	Green
Wavelength	625±5	530±5	505±5	505±5	625±5	505±5
Size	200mm (8″)	200mm (8″)	200mm (8″)	200mm (8″)	300mm (12″)	300mm (12″)
P_{tx}	7W	5.8W	7.8W	4.3W	6.5W	5.4W
Brightness	300cd	300cd	300cd	5000cd	1800cd/m^2	1800cd/m^2

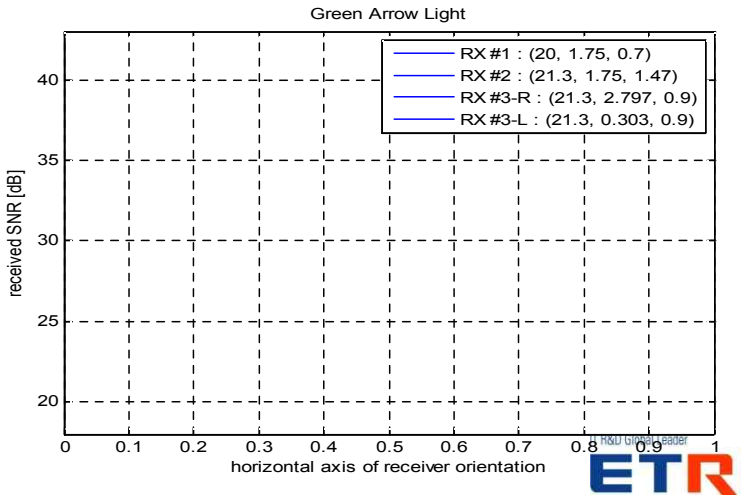
[1] I.E. Lee, M.L. Sim, and F.W.L. Kung, "A Dual-Receiving Visible-Light Communication System for Intelligent Transportation System," in Proc. IEEE ICCSC 2008, pp. 698-702, May 2008.

Simulation Results – at the intersection

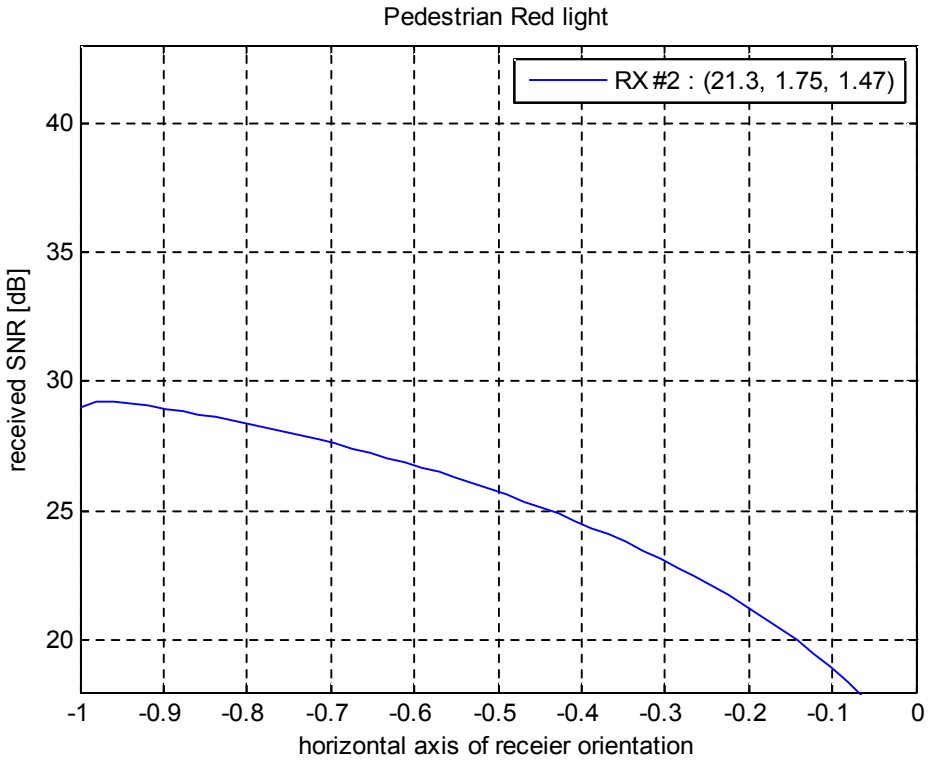


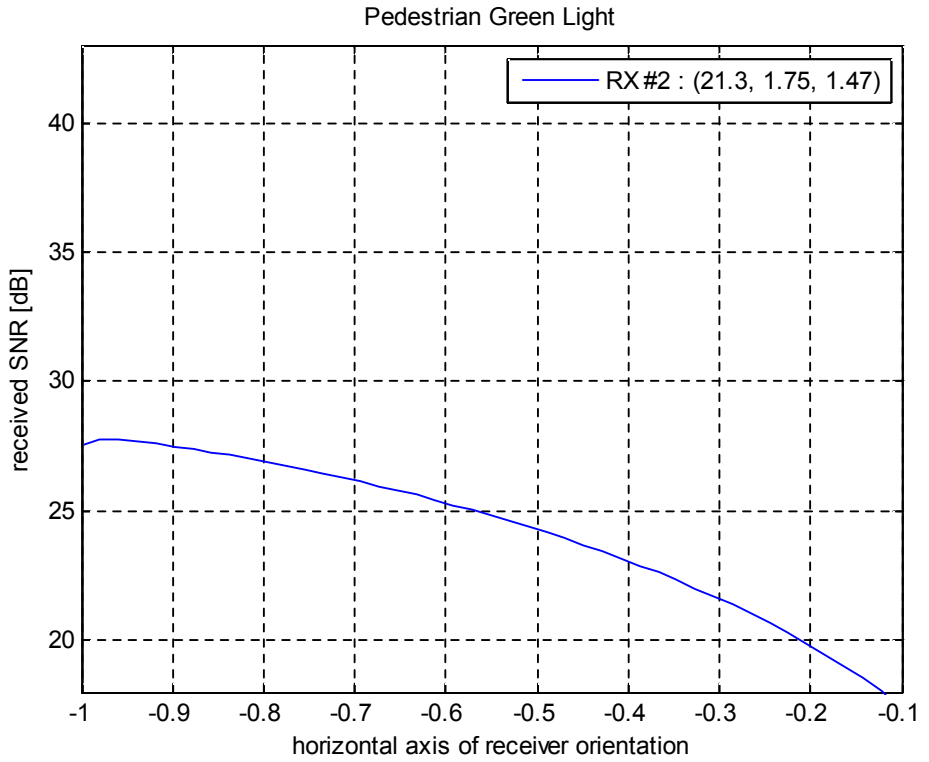






Simulation Results – at a pedestrian crossing





Conclusion

- VLC capability depends on the transmitter's power and communication range
- The Green Arrow among traffic lights is not suitable for VLC because of lower transmitter power in Korea

- It is required to modify the regulation of traffic lights in Korea

Reference

[1] I.E. Lee, M.L. Sim, and F.W.L. Kung, “A Dual-Receiving Visible-Light Communication System for Intelligent Transportation System,” in Proc. IEEE ICCSC 2008, pp. 698-702, May 2008

[2] IEEE 802.15-09-0052-01-0007