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Abstract: [This document presents about Technical Requirements for VLC Applications]

Purpose: [To contribute the Technical Requirements Document of IEEE 802.15.7 VLC]

Technical Requirements
# for VLC Applications

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Contents

- ## Technical Requirements
  - – Topology
  - – Uni/Bi-Directional
  - – Data rate and Distance
  - – Inherent Function of lighting source
 - – Reliability
- ## Conclusions

Topology

- Network topology is the study of the arrangement or mapping of the elements (links, nodes, etc.) of a network, especially the physical (real) and logical (virtual) interconnections between nodes.

Physically Bus Topology

Token

Packet Transmission sequence

Logically Ring Topology
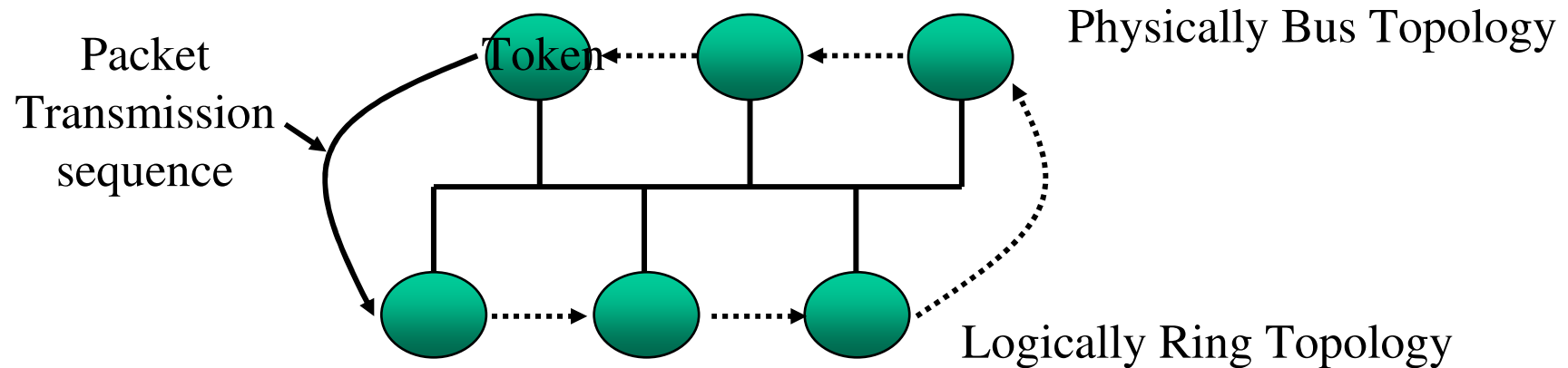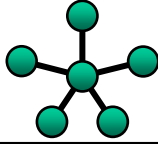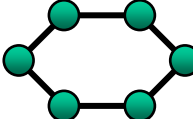
Physical Topology for VLC
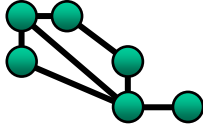
- ## Six basic types of physical topology
  - Point-to-point, Bus, Star, Ring, Mesh and Tree
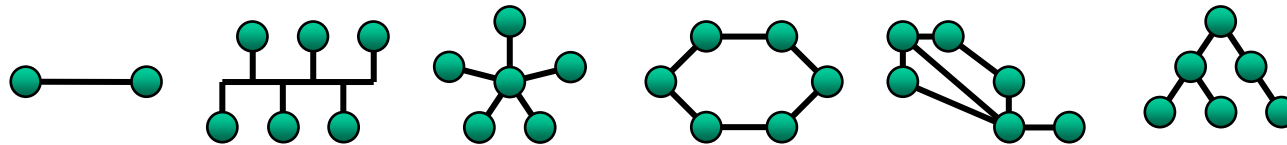
- ## Physical topology for VLC
  - Point-to-point and Star topology will be the physical topology which VLC can apply.
  - But we do not need to limit.

Logical topology for VLC

- ## Logical topology for VLC
  - Star, ring and mesh is possible and suitable.
  - But it also do not need to limit.

Type	Diagram	Special feature	VLC applications
Star		Master and slave	Infrastructure to any, mobile to fixed
Ring		Token control	Fixed to fixed
Mesh		Number of connection	Fixed to fixed, Vehicle to vehicle

Definition of Uni/Bi-directional

- Uni-directional: A VLC device that processes data flowing only in one physical direction (TX or RX)
- Bi-directional: A VLC device that processes data flowing in two physical directions (TX and RX)*

Direction	Transmission mode	VLC Applications
Uni-directional	Simplex	Information Broadcast, Image sensor with LED tag, Visible remote control
Bi-directional	Half-duplex	Most of applications
	Full-duplex	

The Necessity of Uni-directional
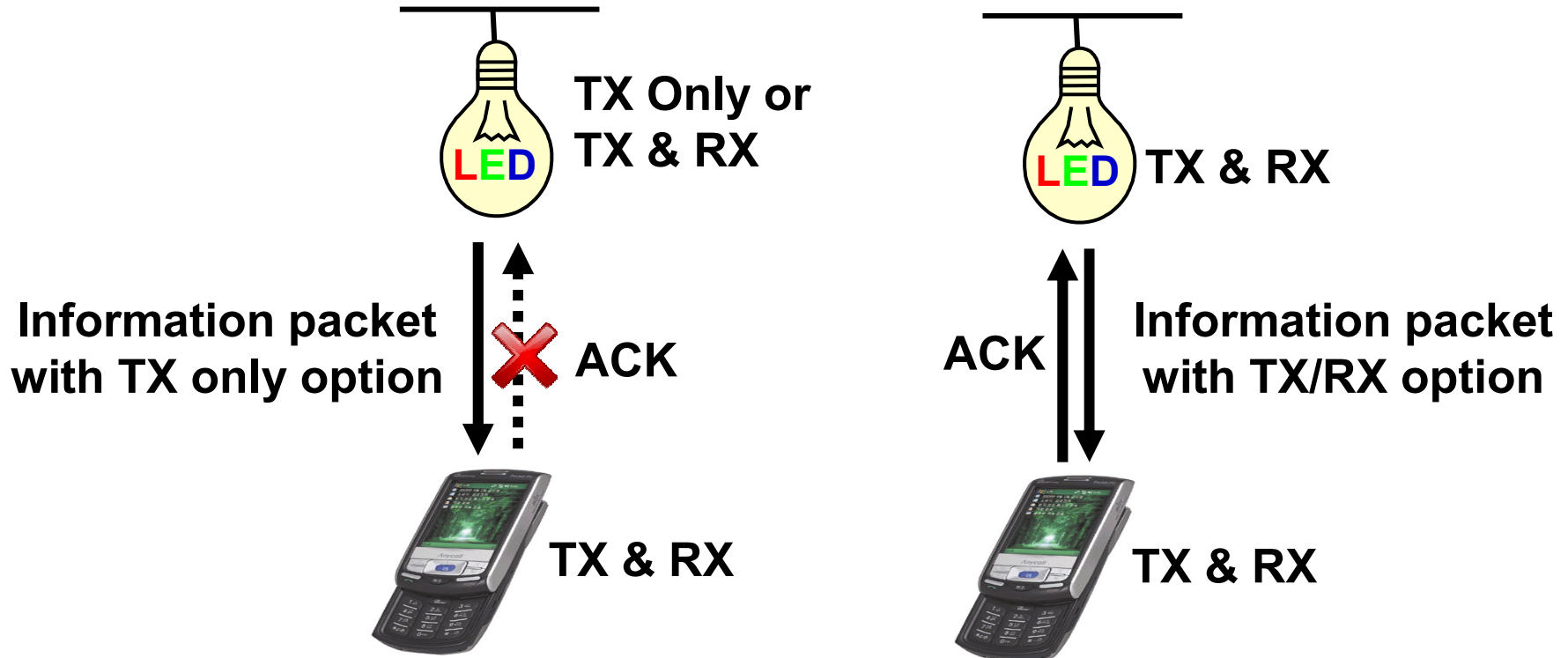
- ## At TRD
  - Do we need to consider uni-directional case (no acknowledgements)? Yes
  - Information broadcast is uni-directional case and one of important applications for VLC
    - Indoor navigation, visible remote control*
  - If bi-directional communication is possible, uni-directional case can be covered by MAC or PHY layer.

* 15-09-0173-00-0007-consideration-on-vlc-application

Uni-directional within bi-directional

Information broadcasting

TX Only or TX & RX

LED

TX & RX

Information packet with TX only option

ACK

ACK

Information packet with TX/RX option

TX & RX

TX & RX

Data Rate vs. Distance

- At application definition and summary document (15-09-0125-03-0007)
  - Data rate: min 100kbps to max 1Gbps
  - Distance: min 50cm to max 100m
- Data rate is related to light source.*
  - Phosphor LED: <10Mbps
  - Phosphorless LED: <100Mbps
  - RCLED: <500Mbps
  - LD: 1Gbps
- Real data coverage at max data rate of each lighting source

* 15-08-0468-00-0vlc-vlc-wavelength-range

Classification of Data rate

- We need to define data rate requirement according to distance and light source
  - Because we can not increase transmission power (source intensity) for increasing distance at our pleasure.
  - Because we can not use LD or RCLED at illumination for high data rate.
- Summary of Application definition and summary document (15-09-0125-03-0007)

Application	Distance	Data Rate	Expected Source
M-to-X	1~10m	100Mbps	**RCLED**
Illumination	3~10m	10Mbps	**Phosphor or less**
V-to-X	100m	100kbps	**Phosphor or less**

Suggestion of Data rate classification

- Define range*
  - Very short range : < 0.5m,   Short range : < 3m
  - Middle range : 3m ~ 10m,   Long range : >10m
- Determine data rate depending on distance and available light source at each device

Application	Distance	Data Rate	
M-to-M, P-to-P	Very Short	?	High
M/P-to-F, illumination	Short	?	
Illumination M-to-Infra	Middle	?	
V-to-X	Long	?	Low

Inherent Function of lighting source

- The inherent function and quality of the equipment should be maintained although VLC technology is applied.
  - Brightness of illumination
  - Dimming control of illumination
  - Color of illumination
  - Brightness control of Stop lamp of vehicle
  - Brightness of Head lamp of vehicle

Reliability of VLC

- Reliability : Link packet loss rate*
  - 802.15.4: less than 1%
  - 802.15.3: less than 8%
  - 802.15.5: consider related standard
  - Critical factor to some application
    - Emergency, Blind navigation, L-commerce**

Walk ← Salk - - Stok - - Stop
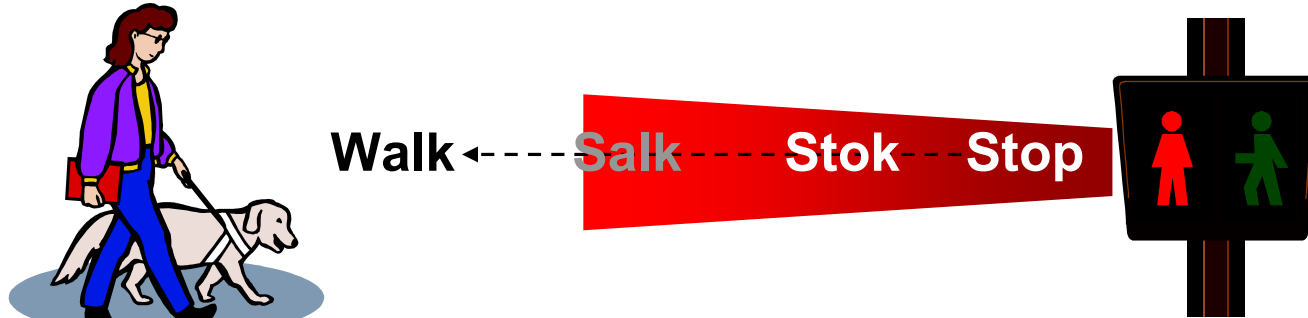
* 15-04-0655-00-0005-tg5-technical-requirements
**15-09-0117-01-0007-vlc-potential-use-cases-and-techniqual-requirement

Conclusions (1/2)

- ## Topology
  - – Point-to-point and star for physical topology
  - – Ring, star and mesh for logical topology
  - – VLC can support all types of physical and logical topologies.

- ## Directionality
  - – Bi-directional and Uni-directional (optional)

- ## Transmission mode
  - – Half-duplex mode or Full-duplex mode

Conclusions (2/2)

- ## Data rate
  - – VLC need to classify of data rate related to the transmission distance and lighting device

- ## Inherency
  - – VLC should maintain the inherency of lighting source during communication.
  - – Add to TRD

- ## Reliability
  - – Add to TRD