

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

Submission Title: [MAC requirements for visible light communication systems]

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Abstract: [Discussion of some important MAC requirements derived from VLC link characteristics .]

Purpose: [Contribution to technical MAC requirements definition and discussion for 802.15.vlc.]

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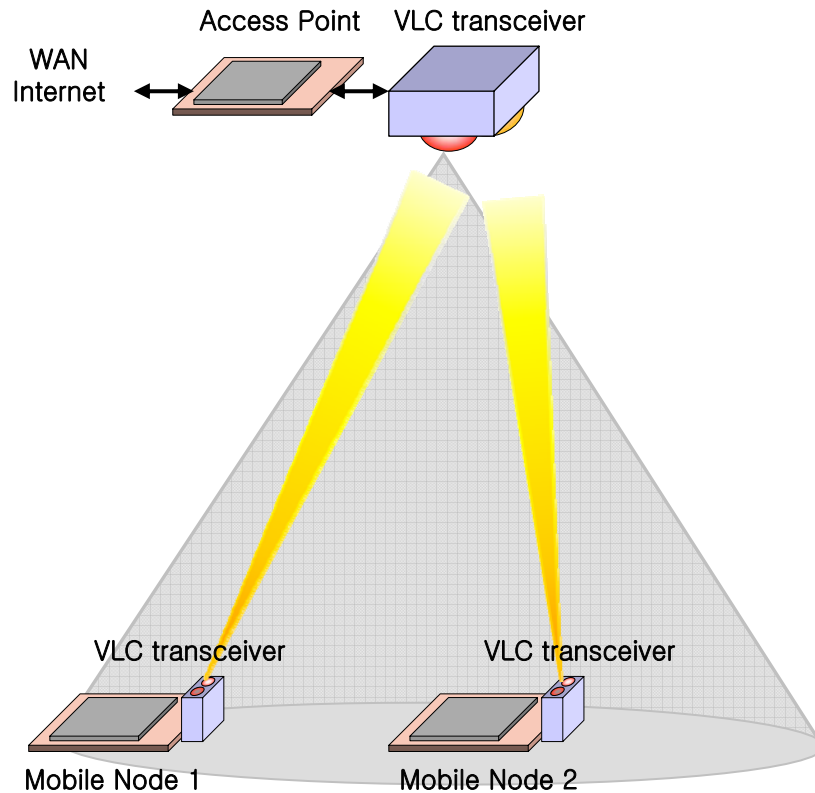
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MAC requirements for visible light communication systems

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VLC system overview



- Bidirectional & Full duplex communication system
- Support point-to-multi points topology
- Broadcast downlink
 - Downlink: wide light directivity for lighting

Conventional 802.15 MAC

	802.15.3 (MB-OFDM or DS- CDMA)	802.15.4	VLC
Topology	P2P	Ad-hoc	P2MP
Data rate	Very high	Very low	High
Service range	Short	Short	Short
Power consumption	Low	Very Low	Low
Quality of service	High	No or Low	High
Target service	High speed p2p service	Low power & low rate sensing service	High speed LAN service

MAC requirements for visible light link (1/2)

- VLC link characteristics
 - Independent up/down communication medium
 - Light reflection interference
 - Asymmetric up/down communication link
 - Down: Broadcast channel (LED arrays, wide directivity)
 - Up : Point to point channel (Single LED, narrow directivity)



- VLC MAC features
 - Support bi-directional and full duplex communication
 - Support half-duplex in critical reflection environments
 - Support independent up/down link speed negotiation and resource management
 - Down: resource allocation algorithm
 - Up: resource allocation and collision avoidance algorithms

MAC requirements for visible light link (2/2)

- VLC link characteristics
 - Lights intensity(RSSI) depends on the location of mobile node (MN)
 - Temporary link failure due to obstacles (burst frame or packet errors)
 - User assisted uplink setup (not always connected such as RF links)



- VLC MAC features
 - Support adaptive rate control or duplex mode change schemes
 - Link failure or packet error detection mechanism
 - Link failure: fast link recovery
 - Packet error: fast retransmission
 - Initial link setup procedure and link status display scheme

MAC requirements for higher throughput

- Legacy WPAN MAC limitations
 - Inefficient multiple access and resource managements to support Ad-hoc or mesh topology (distributed algorithm)
 - Low or no QoS supports due to simple implementation
 - Limited parallel transmission due to PHY complexity
- VLC MAC features
 - Centralized multiple access and resource management algorithm in intelligent access points
 - Enhances parallel transmission using RGB color
 - Efficient frame structure for variable data rates
 - Low speed in long range
 - Very high speed in short range

MAC requirements for visibility

- Lightening pattern(light intensity, blink) and color can be used for additional information such as
 - Link connectivity
 - Data rate
 - Duplex mode
 - MAC status (active mode, listening mode, power saving mode ...)
- VLC MAC features
 - Lightening pattern(light intensity, blink) control scheme based on VLC PHY or MAC status

MAC requirements for parallel communication

- Parallel communication in VLC
 - Light color (R,G,B) communication
 - Multiple beam communication

- VLC MAC features
 - MAC frame structure for parallel communication
 - Links status based multiple stream control mechanism
 - Lights color (R,G,B) allocation algorithms for VLC downlink

Conclusions

- Optimized MAC in VLC link characteristics
 - Asymmetric up/down link
 - Full/Half duplex
 - Burst error
- Efficient MAC for 1-to-N topology
- Visibility support
- Support for high order parallel transmission

- For optimizing system performance and supporting requirements, 802.15.VLC should design a new MAC for VLC system