**IEEE P802.15**

**Wireless Personal Area Networks**

|  |  |
| --- | --- |
| Project | IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs) |
| Title |  |
| Date Submitted | September 10, 2012 |
| Source | Jinyoung Chun, Suhwook Kim, Jin Sam Kwak*LG Electronics* | E-Mail: [jiny.chun@lge.com] |
| Re: | Comments on TG8 TGD r2 (15-12-0385-02-0008) |
| Abstract | This is comments on TG8 TGD r2 |
| Purpose | To provide the technical guidance including functional and technical requirements to the P802.15 Working Group. |
| Notice | This document does not represent the agreed views of the IEEE 802.15 Working Group or IEEE 802.15.8 Task Group. It represents only the views of the participants listed in the “Source(s)” field above. It is offered as a basis for discussion and is not binding on the contributing individual(s) or organization(s). The material in this document is subject to change in form and content after further study. The contributor(s) reserve(s) the right to add, amend or withdraw material contained herein. |
| Release | The contributor acknowledges and accepts that this contribution becomes the property of IEEE and may be made publicly available by P802.15. |
| Patent Policy | The contributor is familiar with the IEEE-SA Patent Policy and Procedures:<http://standards.ieee.org/guides/bylaws/sect6-7.html#6> and<http://standards.ieee.org/guides/opman/sect6.html#6.3>.Further information is located at <http://standards.ieee.org/board/pat/pat-material.html> and<http://standards.ieee.org/board/pat>. |

Table of Contents

[1. Overview 4](#_Toc334703565)

[2. Definitions 4](#_Toc334703566)

[2.1. General definitions 4](#_Toc334703567)

[2.2. Specific definitions to this standard 4](#_Toc334703568)

[3. Abbreviations and acronyms 4](#_Toc334703569)

[4. General descriptions 4](#_Toc334703570)

[4.1. Concepts and architecture 4](#_Toc334703571)

[4.2. Components 4](#_Toc334703572)

[4.3. Topology 4](#_Toc334703573)

[4.4. Services 4](#_Toc334703574)

[4.5. Reference model 5](#_Toc334703575)

[5. General requirements 5](#_Toc334703578)

[5.1. Operating frequencies 5](#_Toc334703579)

[5.2. Operating bandwidths 5](#_Toc334703580)

[5.3. Duplex 5](#_Toc334703581)

[5.4. Multiple access 6](#_Toc334703582)

[6. Functional requirements 6](#_Toc334703583)

[6.1. Synchronization 6](#_Toc334703584)

[6.2. Discovery (PD discovery or Peer discovery) 6](#_Toc334703585)

[6.3. Peering (Link establishment, or association) 6](#_Toc334703586)

[6.4. Scheduling 6](#_Toc334703587)

[6.5. QoS 6](#_Toc334703588)

[6.6. Interference management 6](#_Toc334703589)

[6.7. Multicast 6](#_Toc334703590)

[6.8. Broadcast 7](#_Toc334703591)

[6.9. Multi-hop support 7](#_Toc334703592)

[6.10. Relative positioning 7](#_Toc334703593)

[6.11. Power management 7](#_Toc334703594)

[6.12. Security 7](#_Toc334703595)

[6.13. Scalability 7](#_Toc334703596)

[6.14. Coexistence 7](#_Toc334703597)

[6.15. Requirements for high layer and infrastructure interaction 7](#_Toc334703598)

[7. Performance requirements 8](#_Toc334703599)

[7.1. Transmission range 8](#_Toc334703600)

[7.2. Peak spectral efficiency 8](#_Toc334703601)

[7.3. Areal spectral efficiency 8](#_Toc334703602)

[7.4. Dara rate 8](#_Toc334703603)

[7.5. Error rate 8](#_Toc334703604)

[7.5.1. Bit error rate (PHY) 8](#_Toc334703605)

[7.5.2. Packet error rate 8](#_Toc334703606)

[7.5.3. Frame error rate (MAC) 8](#_Toc334703607)

[7.6. Latency 8](#_Toc334703608)

[7.6.1. Discovery latency 8](#_Toc334703609)

[7.6.2. Data latency 8](#_Toc334703610)

[7.7. Fairness 8](#_Toc334703611)

[7.8. Mobility 8](#_Toc334703612)

[7.9. System overhead 9](#_Toc334703613)

[7.10. Complexity 9](#_Toc334703614)

[8. Regulations 9](#_Toc334703615)

[9. Evaluation methodology 9](#_Toc334703616)

[9.1. Channel models 9](#_Toc334703617)

[9.1.1. Large scale fading 9](#_Toc334703618)

[9.1.2. Small scale fading 9](#_Toc334703619)

[9.2. Simulation scenarios and parameters 9](#_Toc334703620)

[10. References 9](#_Toc334703621)

# Overview

The 802.15.8 specification shall be developed according to the P802.15.8 Peer Aware Communication (PAC) project authorization request (PAR), as approved on 30th March 2012 [1], and Five Criteria document [2].

# Definitions

## General definitions

## Specific definitions to this standard

Peering: To establish a link or multiple links between PDs or among PDs for the purpose of announcing information or exchanging traffic.

# Abbreviations and acronyms

PD :PAC Device

# General descriptions

This clause provides the basic framework of PDs and links. The framework serves as a prerequisite to supporting the functions of PDs and links and their interactions specified later in detail.

## Concepts and architecture

802.15.8 PAC shall support a fully distributed, decentralized, data scalable, and self organized system.

 PAC shall support both one-way and two-way communication.

## Components

IEEE 802.15.8 consists of several components that operate corresponding to each other to provide Peer Aware Communications that supports peer aware discovery and communications to connected PDs.

[Example]

Discovering PD (DPD) means a PD which is doing discovery function and is not peered yet.

Peered PD (PPD) means a PD which is peered to another PD within a service [group].

Service Group (SG) means a collection of PDs which are connected by the same service.

## Topology

Several topologies are considered to support various service interactions within PDs.

One-to-one, one-to-many topology shall be supported.

802.15.8 PAC shall support PD participation in at least two independent one-to-many peer to peer communications with different peers at the same time.

802.15.8 PAC shall support a PD having simultaneous communication links for different applications.

Mesh topology may be supported.

## Services

802.15.8 PAC shall support a PD ability to:

* Discover other PDs in proximity and be discoverable by them
* Discover other PDs in proximity but not be discoverable by them
* Be discoverable by other PDs but not discover them
* Neither discover nor be discoverable

## Reference model

All PDs are internally partitioned into a physical (PHY) layer and a medium access control (MAC) sublayer of the data link layer, in accordance with the ISO/OSI-IEEE Std 802-2001 reference model. Direct communications between PDs are to transpire at the PHY layer and MAC sublayer as specified in this standard; Message security services are to occur at the MAC sublayer, and security key generations are to take place inside and/or outside the MAC sublayer.

Within a PD, the MAC provides its service to the higher layer through the MAC service access point (SAP) located immediately above the MAC sublayer, while the PHY provides its service to the MAC through the PHY SAP located between them. On transmission, the higher layer passes MAC service data units (MSDUs) to the MAC sublayer via the MAC SAP, and the MAC sublayer passes MAC frames (also known as MAC protocol data units or MPDUs) to the PHY layer via the PHY SAP. On reception, the PHY layer passes MAC frames to the MAC sublayer via the PHY SAP, and the MAC sublayer passes MSDUs to the higher layer via the MAC SAP. Both MAC SAP and PHY SAP are not exposed and their specifications are beyond the scope of this standard.



There may be a logical PD management entity (PDME) that exchanges network management information with the PHY and MAC as well as with other layers.

# General requirements

## Operating frequencies

All PDs shall operate in selected globally available unlicensed/licensed bands, below 11 GHz.

There are 4 target bands;

* Unlicensed Sub 1 GHz band
* Unlicensed 2.4 GHz, 5 GHz ISM band
* Unlicensed 6 ~ 10 GHz UWB band
* Licensed bands

## Operating bandwidths

## Duplex

IEEE 802.15.8 may support the following types of duplex.

Time Division Duplex (TDD)

Frequency Division Duplex (FDD) (note: if one wants to support licensed band)

## Multiple access

The multiple access schemes shall be designed as follows: Contention-free access scheme, contention-based, or other access scheme may be considered for control and data transmission.

Functional requirements

The functional requirements described in this document shall be met with a system comprised solely of IEEE 802.15.8 compliant PDs.

[

## Synchronization

]

## Discovery (PD discovery or Peer discovery)

IEEE 802.15.8 shall support that PD finish the discovery of other PDs [within the same service] before peering.

The system shall provide discovery in [TBD] ms.

There are following requirements for discovery.

* Autonomous(should be edited) and continuous discovery(TBD)
* Energy-efficient discovery
* Support high PD density
* Efficient spectrum utilization
* Discovery without peering(association) (from PAR)

## Peering (Link establishment, or association)

IEEE 802.15.8 shall support a peering function to establish a link or multiple links between PDs or among PDs, respectively.

## Scheduling

The system shall provide the fully distributed scheduling mechanism.

## QoS

IEEE 802.15.8 shall support prioritized services, various QoS classes, enabling an optimal matching of service, application and protocol requirements (including higher layer signalling) to resources and radio characteristics.

## Interference management

IEEE 802.15.8 shall provide the functionality to mitigate interference.

## Multicast

IEEE 802.15.8 shall support a multicast transmission.

## Broadcast

IEEE 802.15.8 shall support a broadcast transmission.

## Multi-hop support

IEEE 802.15.8 shall provide at least 2-hop relaying function.

## Relative positioning

IEEE 802.15.8 shall support relative positioning for proximate PD.

## Power management

IEEE 802.15.8 shall support a power management functionality to reduce power consumption in PDs for all services and applications.

802.15.8 PAC discovery shall minimize impact on battery consumption without affecting user experience.

## Security

IEEE 802.15.8 should include a security function which provides the necessary means to achieve:

* protection of the integrity of the system (e.g., stability and availability)
* protection and confidentiality of user-generated traffic and user-related data (e.g. location privacy, user identity)

The impact of security procedures on the performance of other system procedures, such as discovery and pairing procedures shall be minimized.

Possibly aided by higher layers, 802.15.8 PAC shall support the authenticity and privacy of the identity of a PD.

Possibly aided by higher layers, 802.15.8 PAC shall support the privacy and confidentiality of communication.

## Scalability

IEEE 802.15.8 shall support scalability according to the number of PDs or data rates.

802.15.8 PAC discovery and communications shall take place in mass deployment of PDs.

## Coexistence

IEEE 802.15.8 shall coexist with other specifications or systems (radio interface technology)at the same frequency band.

802.15.8 PAC system shall support the coexistence of PDs used for different applications as well as non-PDs in the same spectrum.

## Requirements for high layer and infrastructure interaction

802.15.8 PAC shall be able to interact with higher layers to access suitable infrastructure, if it exists, e.g. to facilitate the set up and maintenance of communication.

802.15.8 PAC shall support the report to higher layers with updated discovery and association info.

802.15.8 PAC shall perform measurements at the request of and report results to higher layers. These measurements include received signal strength and interference levels.

# Performance requirements

## Transmission range

IEEE 802.15.8 shall provide sufficient one-hop transmission range to meet nominal service requirements. Transmission range may be extended by multi-hop.

|  |  |
| --- | --- |
| shorter than 200 m | Best performance |
| 200 to 500 m | Graceful degradation |
| longer than 500 m | Best effort |

## Peak spectral efficiency

The system shall support the peak spectral efficiency up to [TBD] bps/Hz with single antenna in a PD.

## Areal spectral efficiency

The areal spectral efficiency means that the summation of link spectral efficiency in the certain dimension. The system shall maximize the areal spectral efficiency without sacrificing other requirements.

*Example: The areal spectral efficiency in 1 km2 dimension is at least x [bps/Hz] when the number of links is y.*

*(PD distribution model should be considered.)*

## Dara rate

802.15.8 PAC shall support data rate up to typically 10 Mbps.

## Error rate

### Bit error rate (PHY)

### Packet error rate

The system shall provide the packet error rate smaller than or equal to [TBD] without retransmission.

### Frame error rate (MAC)

## Latency

The system shall support the data latency requirement of the different QoS of class.

802.15.8 PAC shall support low data latency (to 5-15ms per hop) communication (Note: requirement needed)

### Discovery latency

### Data latency

## Fairness

The system shall meet fairness constraints..

Example: Max-min fairness, proportional fairness, 5%-tile user throughput, 5%-tile user latency

## Mobility

IEEE 802.15.8 shall support PDs with various mobility scenarios.

|  |  |
| --- | --- |
| Walking speed (up to 3km/h) | Best performance |
| Running speed (up to 10 km/h) | Graceful degradation |
| Vehicular (up to 60 km/h) | Best effort |

802.15.8 PAC shall be optimized for pedestrian speeds 0-10 km/h

802.15.8 PAC shall support (relative / absolute) mobility of up to 100 km/h.

## System overhead

Overhead, including overhead for control signalling as well as overhead related to data communications shall be reduced as far as feasible without compromising overall performance and ensuring proper support of systems features.

## Complexity

Complexity should be minimal to enable mass commercial adoption for a variety of cost sensitive products.

# Regulations

# Evaluation methodology

## Channel models

### Large scale fading

#### Outdoor path loss

#### Indoor path loss

### Small scale fading

## Simulation scenarios and parameters

# References