**IEEE P802.15**

**Wireless Personal Area Networks**

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| Re: | Technical Guidance for 802.15.8 Proposals | |
| Abstract | This is the draft baseline of 802.15.8 Technical Guidance Document | |
| Purpose | To provide the technical guidance including functional and technical requirements to the P802.15 Working Group. | |
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| 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>. | |

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# 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

# 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 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 composed of PAC devices or PDs.

Some of these devices may be able to connect on an opportunistic basis to infrastructure, which is out of scope for 802.15.8.

802.15.8-PAC shall support one-to-one and, one-to-many communications.

PAC shall support the scalable data rate to accomodate many applications such as listed in the Application Matrix (doc. #).

Possibly aided by higher layers, a PD shall support data transfers between itself and identified PDs or groups.

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

IEEE 802.15.8 PAC shall provide discovery for peer information without peering. Peering is a function to establish single link or multiple links. Peer discovery without peering is beneficial by reducing redundant procedures to setup links and to exchange data among non-peer PDs.



## States of the device (PD)

IEEE 802.15.8 consists of several components \*\*need to be revised\*\* that operate corresponding to each other to provide Peer Aware Communications that supports peer aware discovery and communications to connected PDPDs.

[Example] Move these to definition clause.

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

Connected PD (CPD) means a PD which is connected to another PD.

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

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

PeeredConnected PD (PPD~~CPD~~) means a PD which is peered~~connected~~ to another PD within a service [group ] .

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

PPD – Peered PD, a device which has been peered with another device.  
PSPD – Peer seeking PAC device, a device which is actively attempting to discover / be discovered by other devices in order to peer. (Note that this definition allows a PD to seek other devices while already being peered)

## 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

## 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 operations 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)

## 

Functional requirements

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

Multiple access schemes shall be supported.

## Synchronization \*\*TBD \*\*

## Discovery (PD discovery or Peer discovery)

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)

802.15.8 PAC shall support discovery latency to xxx ms

## Peering

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.

Only relay-enabled PD shall relay discovery messages and/or traffic data from PDs in the proximity.

## 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