**IEEE P802.15**

**Wireless Personal Area Networks**

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| Project | IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs) | |
| Title | **TG8 Technical Guidance Document - additional requirements** | |
| Date Submitted | Oct. 22’nd, 2012 | |
| Source | Eldad Zeira (InterDigital) | E-Mail: [eldad.zeira@interdigital.com] |
| Re: | Technical Guidance for 802.15.8 Proposals | |
| Abstract | A few suggested additional requirements | |
| Purpose | To provide the technical guidance including functional and technical requirements to the P802.15 Working Group. | |
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Introduction

This modified draft contains the requirements presented in the last CC in DCN 0557-00.

Proposed text is highlighted in green

# 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. The framework serves as a guideline in developing the functions of PDs and their interactions specified later in detail.

## Concepts and architecture

IEEE 802.15.8 shall support a fully distributed, decentralized, and self organized system composed of 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.

IEEE 802.15.8 shall support one-to-one and one-to-many communications.

IEEE 802.15.8 shall support scalable data rate to accommodate many applications such as listed in the Application Matrix (doc. #350r4 or the latest revision).

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

IEEE 802.15.8 PAC shall support both one-way and two-way communications.

## States of the PD

## Topology

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

One-to-one and one-to-many topologies shall be supported.

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

802.15.8 shall support a PD having simultaneous communication sessions for same or different applications.

Mesh topology may be supported.



Replace “one-to-one connection” and “one-to-many connection” with “one-to-one communication” and “one-to-many communication” respectively.

## 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.



\*\*Add a convergence sublayer (SSCS?) and LLC right above MAC sublayer.

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 candidate 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)

## Operating modes

All PDs shall support at least one common communication mode.

## 

Functional requirements

The functional requirements described in this document shall be met by IEEE 802.15.8 compliant PDs.

Multiple access schemes shall be supported.

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

## Discovery

An IEEE 802.15.8 device shall support peer discovery, service discovery, and group discovery.

Peer discovery includes device discovery.

The following properties are desirable for discovery process.

* Expedited discovery
* Energy-efficient discovery
* Support high PD density
* Efficient spectrum utilization

A PD may use multiple discovery identities at the same time.

## Peering

IEEE 802.15.8 shall support peering. . Peering is equivalent to link establishment; link establishment is the process at the end of which two or multiple PDs are ready to exchange data.

## Scheduling

The system shall provide a 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 PDs.

~~IEEE 802.15.8 shall support relative positioning for proximate PD.~~

802.15.8-PAC shall support range or range difference measurements between proximate PDs.

## 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 shall include a security function which provides the necessary means to achieve:

* authenticity and privacy of the identity of a PD possibly aided by higher layers
* privacy and confidentiality of communication possibly aided by higher layers.

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

## 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.

A discovery identity of a PD is derived from higher layers. Discovery identity may be pre-configured e.g. for the purpose of relaying.

How to handle discovery and peering in the absence of higher layers, infrastructure access or sufficient pre-configuration information is out of scope for 802.15.8-PAC.

# Performance requirements

The performance requirements described in this document shall be met by IEEE 802.15.8 compliant PDs.

## Transmission range

IEEE 802.15.8 shall provide sufficient one-hop transmission range to meet nominal service requirements.

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

~~Transmission range may be extended by multi-~~

## Peak spectral efficiency

The system shall support a 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 (TBD)

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

*[Eldad] Not sure what it means? Any packet error rate can be achieved if the SNR is high enough… suggest remove this requirement.*

### Frame error rate (MAC)

## Latency

### Discovery latency

The system shall provide discovery in [TBD] ms.

### Data latency

differentiatedssupported es

TBD

## Fairness (TBD)

[Eldad] Note as it is phrased it is a performance requirement not a functional one

The system shall meet fairness constraints.

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

*[Eldad] is there a requirement here? Any system will meet SOME fairness constraint; on the other hand specifying the right constraint dictates a solution*

## Mobility

IEEE 802.15.8 shall support PDs with various mobility scenarios.

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| 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 |

## 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

9.1 Antenna Configuration

PDs shall be equipped with antenna array configurations from one to four antennas.

## Channel models (Refer to Doc. #459r2 or the latest)

### Large scale fading

#### Outdoor path loss

#### Indoor path loss

### Small scale fading

## Simulation scenarios and parameters

# References