**IEEE P802.15**

**Wireless Personal Area Networks**

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| Project | IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs) |
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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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# 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 xx March 2012 [1], and Five Criteria document [2].

# Definitions

## General definitions

## Specific definitions to this standard

# Abbreviations and acronyms

# General descriptions

This clause provides the basic framework of nodes and links. The framework serves as a prerequisite to supporting the functions of nodes and links and their interactions specified later in detail. It covers the following aspects — the architecture, components, services, the network topology used for medium access, the transmission range, the reference model used for functional partitioning, and the time base used for access scheduling, and the security paradigm used for message protection.

## Architecture

This subclause presents the concepts of IEEE 802.15.8 and how the architectural components are related to the overall procedure.

## 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 nodes.

Discovering Node (DN) means a node which is doing discovery function and is not connected yet.

Connected Node (CN) means a node which is connected to another node.

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

## Services

## Reference model

All nodes 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 nodes 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 node, 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 node management entity (NME) that exchanges network management information with the PHY and MAC as well as with other layers.

## Time base

A node is to establish a time reference base where the time axis is divided into superframes of equal length and each superframe is composed of TU (Time Unit) of equal length and numbered from 0, 1, ..., m, where m ≤ [TBD]. A specific interval may be referenced in terms of the numbered TUs comprising it, and a point of time may be referenced in terms of the numbered TU preceding or following it as appropriate.

## Topology

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

One-to-one, star (one-to-multiple or multiple-to-one) topology shall be supported. Mesh topology may be supportable for the specific service.

## 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 to cover additional service requirements.

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

## Overall procedure

This subclause describes the overall procedure from discovering state to connected state. DN starts from discovery phase after synchronized. When DN finds a peer discovery message from another DN, which is matched to the discovering service set, it requests pairing to another DN. After pairing phase, DN is connected to another DN.

## Operating frequencies

All nodes 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 band

A node may operate in multiple bands simultaneously (ex. Unlicensed 2.4 GHz and Licensed band).

## Operating bandwidths

Scalable bandwidth is the ability to operate with different bandwidth allocations. IEEE 802.15.8 shall support scalable bandwidth from x to y MHz. This bandwidth may be supported by single or multiple RF carriers.

## Duplex

IEEE 802.15.8 may support the following types of duplex.

Time Division Duplex (TDD)

Frequency Division Duplex (FDD)

## Multiple access

The multiple access schemes shall be designed in accordance with the characteristics of each operation step. Contention-free access scheme or contention-based access scheme may be considered for control and data transmission.

Functional requirements

This cause contains system level functional requirements targeting peak spectral efficiency, latency, synchronization time, discovery capacity, scheduling, QoS, interference management, power management, system complexity, security. The functional requirements described in this document shall be met with a system comprised solely of IEEE 802.15.8 compliant nodes.

## Peak spectral efficiency

The system shall support the peak spectral efficiency up to [TBD] bps/Hz with single antenna in a node. The peak spectral efficiency may be increased through multiple antenna gain.

## Packet error rate (PER)

The system shall provide the packet error rate smaller than or equal to 10-2 without retransmission. The packet error rate may be reduced through retransmission.

## Latency

IEEE 802.15.8 categories several latency types to represent different requirements.

## Synchronization

A node and the nearby nodes shall be synchronized to the same time base in [TBD] ms from asynchrony condition. Synchronization mechanism shall be robust to dynamic condition.

## Discovery

The system shall provide x number of discovery trials in y discovery time bound.

There are following requirements for discovery.

* Autonomous and continuous discovery
* Energy-efficient discovery
* Supportable for high node density
* Efficient resource utilization

## Pairing

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

## Scheduling

The system shall provide the fully distributed scheduling mechanism. It means that resource assignment is decided by each node, not by a central coordinator. The scheduling policies such as round-robin, proportional fairness may be supported.

## QoS

IEEE 802.15.8 shall support various QoS classes, enabling an optimal matching of service, application and protocol requirements (including higher layer signalling) to resources and radio characteristics. The system may support high priority services for some use cases such as emergency.

## Interference management

IEEE 802.15.8 shall provide the functionality to mitigate interference considering spatial reuse.

## Multicast

IEEE 802.15.8 shall support a multicast transmission.

## Broadcast

IEEE 802.15.8 shall support a broadcast transmission.

## Relative positioning

IEEE 802.15.8 may support relative positioning for proximate service by providing the functionality which can measure the distance or the angle of link. The system may support very high resolution for the specific use-cases.

## System overhead

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

## Power management

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

## Complexity

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

## 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. system access, 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.

# Performance requirements

## 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.

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

## Packet error rate

## Latency

## Fairness

The system shall provide a fairness mechanism.

## Mobility

IEEE 802.15.8 shall support nodes with various mobility scenarios such as pedestrian A, pedestrian B, or vehicular.

|  |  |
| --- | --- |
| Pedestrian AWalking speed (up to 3km/h) | Best performance |
| Pedestrian BRunning speed (up to 10 km/h) | Best effort |
| Vehicular (up to 60 km/h) | Support |

# Operational requirements

## Multi-hop support

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

IEEE 802.15.8 may provide over 2-hop relaying function for the specific services or applications.

## Coexistence

IEEE 802.15.8 shall coexist with other specifications at the same frequency band.

# Regulations

# Evaluation methodology

## Channel models

## Simulation parameters

# References