!! PHY SUBGROUP !!
!! WORKING DRAFT ONLY !!

8.4.2 Medium Dependent Sublayer for 2.4 GHz Frequency Hopped Physical Layer Entity

The functional, electrical, and mechanical characteristics of one specific form of Medium Dependent Sub-Layer of the standard is specified in this section. This standard specifies the Physical Layer Entity (PLE) only in so far as necessary to ensure:

(1) The interoperability of implementations conforming to this specification

(2) The protection of the local area network and those using it.

The relationship of this section to other sections of this standard and to the reference model in use for this standard is illustrated in Figure 1.

EDITORS NOTE:

INSERT THE CURRENT ARCHITECTURAL MODEL WITH PMD SUBLAYER HIGHLIGHTED

Figure 1

8.4.2.1 Nomenclature. Terms used in this section that have a specific definition within the context of this section of the requirements document.

signal. A detectable disturbance.

medium. Anything upon which a signal is impressed or from which a signal is received. The term media is used only as the plural of medium.

conformant medium. A medium that exhibits the characteristics detailed in one of the Medium Definition sections of the IEEE 802.11 standard.

station. Any entity that imposes signals that conform to the IEEE 802.11 PHY specification on a medium in a manner that conforms to the IEEE 802.11 MAC specification and receives signals that conform to the IEEE 802.11 PHY and MAC specifications from a medium is considered a station whether or not it has any functionality beyond the reception and transmission of signals.

channel. An instance of medium use that can coexist with other instances of medium use with each instance of medium use providing service to a separate set of stations.

Euclidean distance. The classical measure of spatial separation that is calculated as $\mathrm{Sqrt}[x^2+y^2+z^2]$ and is denominated in meters.

attenuation distance. The path loss between stations experienced by a signal that conforms to the IEEE 802.11 PHY specification as it propagates between a transmitter and a receiver. This distance is measured in dB and it is typically a time varying quantity.

coverage area. The physical geography over which an instance of medium exhibits the characteritics defined in the Medium Definition Section of this document for that particular class of medium.

8.4.2.2 Object. The object of this specification is to:

(1) Provide the physical means necessary for communication between native stations employing the IEEE P802.11 media access control method defined in this standard and one of the media defined in this standard,

(2) Define a physical interface that can be implemented independently among different manufacturers of hardware and achieve the intended level of interoperability when connected of a common medium,

(3) Provide a communication channel capable of high bandwidth and low error rate over a usable coverage area,

(4) Provide for ease of installation and service in a wide range of environments,

(5) Provide for a low level of outage over a usable coverage area,

6) Use a medium that can be shared by totally unrelated applications and conserve the capacity of that medium.

8.4.2.3 Compatibility Considerations. This standard applies to Physical Layer Entities that can be broken down into a Medium Independent Sublayer, a Convergence Sublayer and a Medium Dependent Sublayer.

This combined Physical Layer Entity will impose conformant signals onto an instance of a medium. If this instance of a medium is a conformant medium as defined in the Medium Entity Definition section of this standard for the particular medium required by the Medium Dependent Sublayer Entity, communciation service with the minimum quality specified for conformance to this standard shall be achieved between combinations of like entities. The physical geography over which the medium exhibits the characteristics detailed in the Medium Entity Defintions Section fo this document is the defined coverage area of that medium.

The Physical Layer Entity defined will provide this communications service to an IEEE 802.11 conformant Media Access Control Entity at the Ph-Service Interface. This communications service will be provide in a manner that conforms to the MAC-PhL Interface Specification Section of this document.

This particular Section of the standard defines the Medium Depend Sublayer of the PLE

8.4.2.4 Specification of Transmit and Receive Functions

8.4.2.4.1 General Description of Functions. In general, The Medium Dependent Sublayer Entity accepts Convergence Layer-service primitives and provides the actual means by which the signals required by these primitives are imposed onto the medium. In the Medium Dependent Sublayer at the receiver the process is reversed. The combined function of the transmitting and receiving Medium Dependent Sublayers results in a data stream, timing information, and receive parameter information being delivered to the receiving Convergence Sublayer. Unless otherwise stated, all voltages are in rms and dBmV, based on transmission of random data patterns. Unless otherwise stated all power levels are rms and dBmW as measured by the locally applicable regulations for measurement of such signals while transmitting any data pattern. (EDITOR'S NOTE: THIS NEEDS A MORE WORK SINCE IT DOESN"T MAKE SENSE WHEN THE APPLCIABLE REGULATION DOES NOT SPECIFY MEASUREMENT IN RMS)

8.4.2.4.2 Symbol Transmission Functions. The Medium Dependent Sublayer will accept symbols from the set {{1},{0},{no_modulation},{silence}}from the Convergence Sublayer.

8.4.2.4.2.1 Signal Representation. The symbol {1} is encoded with a peak deviation of (+f), giving a peak transmit frequency of (Fc+f), which is greater than the carrier (Fc). The symbol {0} is encoded with a peak frequency deviation of (-f), giving a peak transmit frequency of (Fc-f). The nominal peak deviation (f) shall be 160 KHz. The symbol {no_modulation} shall be encoded as the frequency (Fc) within the tolerance specifications detailed below. The symbol {silence} is encoded as a transmit power level below TBD dBmw.

A conformant implementation shall be able to select the carrier frequency (Fc) from the full country-specific set of available set of carrier frequencies. The set of carrier frequencies support by an implementation is contained in the managed object detailing the available values of Fc. Table 1 summarizes these frequencies for a number of different geographic locations.

Country	Number of Frequencies	Frequency Range	Total Frequency Range
USA	81	2.402-2.482 GHz	2.400-2.483 GHz
Europe	97	2.402-2.498 GHz	2.400-2.499 GHz
Japan	17	2.471-2.497 GHz	2.470-2.499 GHz

Table 1

The available carrier frequencies are located on integral MHz boundaries inclusive of the first and last values in the listed frequency range. A conformant implementation shall maintain the stability of the chosen carrier frequencies to within ±25 ppm when the symbol {no_modulation} has been presented to the Medium Dependent Sublayer for a minimum period of TBD μs. This center frequency stability specification shall be met within TBD μs of time that the managed object governing the currently active center frequency is set to a new value by the action of the Convergence Sublayer.

The process of moving from the frequency representing one medium symbol to the frequency representing another shall be implemented as a continuous phase frequency modulation in a manner that results in the signal on the medium being that which would have

been genereated by modulating an ideal voltage controlled oscillator with a baseband control signal the falls within the mask detailed in Figure 2. Alternatively, the time domain mask detailed in Figure 2. could be interpreted as the range of permissable baseband waveforms that could emerge from an ideal limiter-discriminator demodulator with the transmitter and reciever coupled together through a perfect channel exhibitina a VSWR of 1. The signal shall be such that the boundaries of the mask detailed in Figure 2. are not violated by any transmit symbol pattern.

EDITORS NOTE:

AS A SUGGESTION
INSERT AN EYE-DIAGRAM MASK THAT IS BOUNDED BY GAUSSIAN FILTER IMPULSE RESPONSE OF BT=.5 and BT=.4 USING THE MAXIMUM PEAK DEVIATION THAT IS EXPECTED TO MEET THE FCC EMISSION MASK REQUIREMENTS. THIS TEMPLATE CAN ALSO BE USED TO SPECIFY ALLOWABLE BIT TIMING VARIATIONS BY LABELING NOMINAL ZERO CROSSING COORDINATES

Figure 2.

8.4.2.4.2.2 Output Level. In addition to the requirements imposed on the transmit signal be the baseband waveshape detailed above the signal shall also exhibit the characteristic that the maximum Equivalent Radiated Power (EIRP) of the implementation as measured in accordance with the locally applilcable regulations shall not exceed that listed in Table 2. Conformant implementations shall be capable of transmitting a minimum of 0 dBmw. Implementations that are not in the conformance class "battery operated equipment" (EDITOR'S NOTE: WE WILL NEED TO ESTABLISH A MORE DETAILED DEFINTION OF CONFORMANCE CLASSES) must transmit a minimum of 10 dBmw.

Country	Maximium EIRP	Applicable Regulation
USA	30 dBmw	FCC 15.247,15.205,15.209
Europe	20 dBmw	ETSI RES 02-09
Japan	10 dBmw	TBD

Table 2

If an implementation has the ability to transmit in a manner that results in the EIRP of the transmit signal exceeding the level of 20 dBmw (as measured by the locally applicable regulations) at least one level of transmit power control shall be implemented. This transmit power control shall be such that the level of emissions is reduced to a level below 20 dBmw under the influence of this power contro.

Conformant implementations of this standard shall confine their emissions while transmitting any symbol pattern to be such that when measured by "the filter method" (EDITORS NOTE: WE WILL NEED TO DEFINE WHAT THIS IS) they will not exceed -20 dBc in any range outside of Fc±.5 MHz, not exceed -45 dBc in the any range outside of Fc±2 MHz, not exceed -60 dBc in the any range outside of Fc±3 MHz and not exceed -45 dBc in the any range outside of Fc±4 MHz.

Conformant implementations shall confine their emission outside of the total frequency range band detailed in Table 1 above shall be such that the out-of-band emissions limits detailed in Table 3 as measured by the locally applicable regulations are met.

EDITOR'S NOTE:

PLACE A TABLE OF APPLICABLE OUT OF BAND EMISSION LIMITS HERE
Table 3

Note: All emission limits detailed in the above paragraphs shall be met at all times including during the period of time in which the transmitter is becoming active after a period of being presented with {silence} by the Convergence Layer and during the period of time in which it is modifying Fc in response to a modification of of the managed object controlling that parameter of operation.

8.4.2.4.2.3 Transition Times. Conformant implementations shall be available to impose signals onto the medium within TBD μs of a modification of the managed object controlling the current center frequency. Conformant implementations shall be available to impose signals into the medium within TBD μs of the time that the symbol {silence} is detected by the receiving portion of the Medium Dependent Sublayer. (EDITOR'S NOTE:WE MIGHT WANT TO ELABLRATE ON THIS WITH SOME MORE ELABORATE DESCRIPTION OF WHEN WE SHOULD INITIATE TURNAROUND).

8.4.2.4.2.4 Jitter. A conformant implementation that is imposing signals onto a medium shall provide those signals to the medium in a fashion that the actual rate of zero crossings of the theortical eye diagram detailed in Figure 2 will be will be within TBD ppm of that required by the current operating data rate when being supplied with symbols from the Convergence layer at a rate within TBD ppm of the current operating data rate.

8.4.2.4.2.5Jabber Inhibit. Each Medium Dependent Sublayer shall have a self-interrupt capability to inhibit modulation from reaching the medium. Hardware within the PMD(with no external message other than the prolonged detection of an output-on condition within the transmitter) shall provide a nominal window of one-half second ±25% during which normal data link transmission may occur. If a transmission is in excess of this duration, the jabber-inhibit function shall operate to inhibit any further output from reaching the medium. Reset of this jabber-inhibit function is implementation dependent but in no case should transmission be resumed prior to the completion of the interrupted transmission.

8.4.2.4.3 Symbol Reception Functions. The Medium Dependent Sublayer monitors signals on the medium and will return symbols from the set {{1},{0},{no_modulation},{silence}} to the Convergence Sublayer.

8.4.2.4.3.1 Receiver Sensitivity and Selectivity. The Medium Dependent Sublayer shall provide a BER of 10-5 or better when receiving signals with an input power between -80 dBmw and -20 dBmw with characteristics specified in the Medium Definition Section of this document associated with that medium. This performance shall be achieved in the presence of gaussian white noise of a level to provide and Eb/No value of 16 dB. It shall also be achieved in the

presence of a signal with a center frequency 2 MHz or more from the current center frequency of desired signal and a power 45 dB higher than that of the desired signal.

8.4.2.4.3.2 Transition Times. Conformant implementations shall be available to detect signals on the medium within TBD μs of a modification of the managed object controlling the current center frequency. Conformant implementations shall be available to detect signals on the medium within TBD μs of the time that the symbol (silence) is presented at the Convergence Sublayer interface. (EDITOR'S NOTE:WE MIGHT WANT TO ELABLRATE ON THIS WITH SOME MORE ELABORATE DESCRIPTION OF WHEN WE SHOULD INITIATE TURNAROUND).

8.4.2.4.3.3 Jitter. A conformant implementation that is receiving signals from a conformant medium shall provide the symbols associated with the arriving signal to the Convergence Sublayer in a fashion that the actual rate of delivery will be will be within TBD ppm of that required by the current operating data rate.

8.4.2.4.3.4 Receive Parameter Information. A conformant implementation that is receiving signals from a conformant medium shall provide an indication of the Recieved Signal Strength of the arriving signal to the Convergence Sublayer. This information is contained in a managed object that is made avialbe to the Convergence Sublayer.

8.4.2.5 Application of Management. The following managed object heirarchy is made available to the Convergence Sublayer. EDITORS NOTE: THIS INFORMATION IS EXTRACTED FROM DOCUMENT 93/173 AND IS INTENDED TO BE ONLY A PLACE HOLDER FOR NOW AND AN INDICATION TO THOSE WHO MAY READ THIS DOCUMENT BUT NOT 93/173 OF HOW A FORMAL DESCRIPTION OF OBJECTS THAT MUST BE PRESENT IN CONFORMANT IMPLEMENTATIONS MIGHT BE DONE WITHOUT REFERENCE TO PHYSICAL INTERFACE SIGNALS.

```
TransmitEntity MANAGED OBJECT CLASS
    DERIVED FROM                    PH-Entity;
    CHARACTERIZED BY                transmitPackage;
    CONDITIONAL PACKAGES
         adjustPower
          PRESENT IF                !Multiple Transmit Power Level Support is
                                    implemented in this instance!;
         adjustDataRate
          PRESENT IF                !Multiple Data Rate Support is implemented in
                                    this instance!;
         adjustDiversity
          PRESENT IF                !Diversity Support is implemented in this
                                    instance!;
REGISTERED AS {TBD};

transmitPackage PACKAGE
    BEHAVIOUR                   adjustableParameters;
    ATTRIBUTES                  transmitPower GET, transmitDataRate GET
                                transmitDiversityOption GET;
    ATTRIBUTES GROUPS           capabilitiesGroup, operationalStateGroup,
                                initializationGroup;
    NOTIFICATIONS               None;

adjustPower PACKAGE
    BEHAVIOUR                   adjustableParameters;
    ATTRIBUTES                  transmitPower REPLACE;
    ATTRIBUTES GROUPS           capabilitiesGroup, operationalStateGroup,
                                initializationGroup;
    NOTIFICATIONS               None;

adjustDatRate PACKAGE
```

```
    BEHAVIOUR                   adjustableParameters;
    ATTRIBUTES                  transmitDataRate REPLACE;
    ATTRIBUTES   GROUPS         capabilitiesGroup, operationalStateGroup,
                                initializationGroup;
    NOTIFICATIONS               None;

adjustDiversity PACKAGE
    BEHAVIOUR                   adjustableParameters;
    ATTRIBUTES                  transmitDiversityOption REPLACE;
    ATTRIBUTES   GROUPS         capabilitiesGroup, operationalStateGroup,
                                initializationGroup;
    NOTIFICATIONS               None;

ReceiveEntity MANAGED OBJECT CLASS
    DERIVED FROM                      Ph-Entity;
    CHARACTERIZED BY                  receivePackage;
    CONDITIONAL   PACKAGES
         adjustThreshold
          PRESENT IF                  !Multiple Receive Level Threshold Support is
                                      implemented in this instance!;
         adjustDiversity
          PRESENT IF                  !Diversity Support is implemented in this
                                      instance!;
REGISTERED AS {TBD};

receivePackage PACKAGE
    BEHAVIOUR                   adjustableParameters;
    ATTRIBUTES                  receiveThreshold GET, receiveDataRate GET,
                                receiveLevel GET, receiveDiversityOption GET;
    ATTRIBUTES   GROUPS         capabilitiesGroup,operationalStateGroup,
                                initializationGroup;
    NOTIFICATIONS               receiveThresholdCrossed;


adjustThreshold PACKAGE
    BEHAVIOUR                   adjustableParameters
    ATTRIBUTES                  receiveThreshold REPLACE;
    ATTRIBUTES   GROUPS         capabilitiesGroup,operationalStateGroup,
                                initializationGroup;
    NOTIFICATIONS               None

adjustDiversity PACKAGE
    BEHAVIOUR                   adjustableParameters
    ATTRIBUTES                  receiveDiversity REPLACE;
    ATTRIBUTES   GROUPS         capabilitiesGroup,operationalStateGroup,
                                initializationGroup;
    NOTIFICATIONS               None

capabilitiesGroup ATTRIBUTE GROUP
  GROUP  ELEMENTS               transmitPower, transmitDataRate,
                                transmitDiversityOption, receiveLevel,
                                receiveThreshold, receiveDiversityOption,
                                receiveDataRate;
  DESCRIPTION                   !Attribute Group that includes all capabitity options
                                associated with Ph-Entity Class;
REGISTERED AS {TBD};
```

```
operationalStateGroup  ATTRIBUTE  GROUP
  GROUP   ELEMENTS              transmitPower, transmitDataRate, transmitDiversityOption,
                                receiveLevel, receiveThreshold, receiveDiversityOption,
                                receiveDataRate;
  DESCRIPTION                   !Attribute Group that includes operational state options
                                associated with Ph-Entity Class;
   REGISTERED AS {TBD};

initializationGroup  ATTRIBUTE  GROUP
  GROUP   ELEMENTS              transmitPower, transmitDataRate, transmitDiversityOption,
                                receiveLevel, receiveThreshold, receiveDiversityOption,
                                receiveDataRate;
  DESCRIPTION                   !Attribute Group that includes initialization state options
                                associated with Ph-Entity Class;
   REGISTERED AS {TBD};

adjustableParameters  BEHAVIOUR
   DEFINED  AS       !Elements of managed classes exhibiting this behaviour obtain their
                     initial values from the value of the appropriate initializationGroup
                     element with the object name, report their possible values with the
                     capabilities Group Element of the object name and report their current
                     value with the operationStateGroup element of the object name!;

receiveThresholdCrossed NOTIFICATION
    BEHAVIOUR
       !Generated when receiveLevel traverses the receiveThreshold    Level!;
    WITH INFORMATION SYNTAX  NotificationModule.ReceiveRange;

    ASN.1 Modules

    NotificationModule {TBD}
    DEFINITIONS ::=BEGIN
    ReceiveRange ::= SET{[0]BelowThreshold,[1]AboveThreshold}
    END
```

8.4.2.6 Coupling to the Medium. EDITOR'S NOTE: THE DETAILS OF THE ANTENNA AND OR ANTENNA PATTERN THAT ARE REQUIRED TO INSURE INTEROPERABLITY WILL BE PLACE HERE

8.4.2.7 Protection Against Device Failure. The PLE should be designed such that a single failure in the PLE should not cause more than a transient failure of the network as a whole (except as related to the failed device). The loss of power to any data device should not cause more than a transient failure of the network as a whole. For the purposes of this document, "transient" is defined as an event that has a duration on the order of one second.

8.4.2.8 Environmental Specifications

8.4.2.8.1 Electromagnetic Emanation. Equipment shall comply with local and national requirements for electromagnetic emanations.

8.4.2.8.2 Safety Requirements. All equipment meeting this standard shall comply with relevant local, national, and international safety codes and standards such as IEC Publication 950 (1986).