Chapel Hill

PHY Subgroup Activity Summary

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At the Interim meeting of IEEE 802.11 held in Chapel Hill during the week of January 13,1992 the PHY subgroup chartered at the Fort Lauderdale Plenary meeting had its first meeting.

The first order of business was to review the changes that had been made to the requirements document in the area of PHY characteristics and determine what if any action was required. In particular there were a number of "softening"/"hardening" statements that were added to various characteristics that attempted to state that although the particular characterisitcs could occur, that it did in fact not usually occur. In some instances there were numbers placed on the definition of usually. The discussion centered around the fact that while, in general, the group felt that the original statements could be softened, that the degree to which they could be softened could not be determined at this time. A decision was reached to ask that the original text be returned to those items with the possibility of more refined versions of those statements being added at a later date if they are found to be:

1) Necessary for the development of a MAC

2) Possible to generate with sufficent specification to make them useful.

The next order of business was to deal with the submittal that had come as a result of the committments made at the Ad-hoc meeting in Fort Lauderdale. Bruce Tuch had agreed to speak with Ted Rappaport regarding the use of his simulator. Bruce received a response from Dr. Rappaport that was basically a restatement of previous commercial presentations that said SIRCIM was available for a price of $1500 for individuals and companies and $400 for schools. The letter also noted that the use of simple two ray models was not recommended as had been done in committees dealing with digital cellular. The ensuing discussion centered around the adequacy of the SIRCIM model for the purposes of the group. The specific requirement that complex impulse response models are important and that arriving power profiles are only part of the problem was stated. Other requirements regarding channel coherence time and the impact of motion on the complex impulse response were also discussed. Finally, a discussion of various approaches such as using simulators such as EXTEND or BONES or SPW took place. This discussion also brought to light that simulation might also be performed using SPICE with analog behavorial models or math packages such as MATHEMATICA or MATHCAD. The conclusion was a decision to consult with the MAC group to see if a common approach was possible.

The next contribution was Document IEEE P802.11-92/4 Explanation of the PHY Layer Template Document. This document presents a methodology that requires the development of a standard MAC-PHY interface that will be used by all PHYs. This interface will export symbols in a specified manner. These symbols will be mapped using a Physical Layer Convergence Protocol to a set of symbols suitable for placing onto a medium using a Medium Dependent Interface. This medium will be tightly characterized in a Medium Definition section of the document. These medium sections will specify typical kinds of environments. Conformant Entities will need to operate when tested in a testbed that exhibits the behavior detailed in the Medium Definition sections. The ability of conformant entities to operate in the "real world" will be dependent on the degree to which the "real world" matches the typical characteristics listed in the standard document. In fact the definition of "coverage area" is that geographic area that does exhibit those charcteristics at a specific instance in time.

The basic approach was discussed by the group and it was agreed that either this or something similar to this should be adopted as a starting point for progress. With this in mind the discussion turned to how a medium could be characterized. This discussion included listing of possible parameters and an attempt to build illustrations that showed the characterization of interference and differences among possible media.

A preliminary list of parameters was begun with the understanding that terms listed would need to be defined and the list revised before a final set of parameters ~~could~~ be arrived at.

The terms proposed were:

1) RMS Delay Spread

2) Peak Delay Spread

3) Coherence Time - for single access point case, for multiple access point case, for moving station

4) Spatial Fading- small scale, large scale

5) Temporal Fading

6) Interference Profile

7) Doppler Effect

8) Attenuation

9) Waveguiding

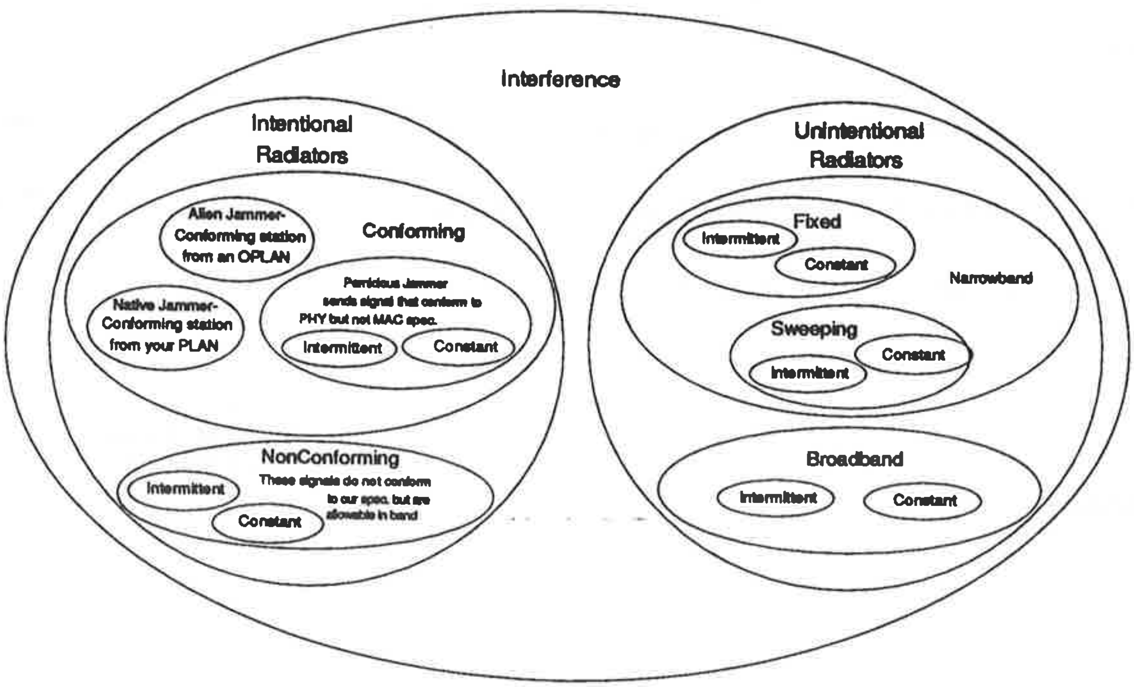
With respect to interference we attempted to come up with a set of definitions to describe the universe of interferers. We started with the definition:

Interference - any signal that degrades communications

Jammer - an intentional radiator that causes interference

Our discussion of channnel parameters brought to the surface the concept that if there are more than one access point transmitting at the same time, for instance in an effort to increase coverage effectiveness that the parameters used to characterize the channel will change. This would complicate our analysis. A decision was reached to point this out to the MAC group during our liason session.

We decided that we needed a much more comprehensive approach to interference definitions and generated the following drawing.



This drawing was latter discussed in a larger ad-hoc group consisting of many members of the MAC subgroup and was agreed to be a reasonable picture of the universe of interferers from which to work.

An attempt was made to make progress on the medium characterization problem by making a chart with various mediums and possible characterization options. This work was very preliminary and the basic outline of the discussion is detailed below

	Conventional Digital Modulation "Narrowband"	RF Direct Sequence Spread Spectrum	RF Frequency Hopped Spread Spectrum	Infrared PPM "Baseband"	RF below limits of FCC part 15.209
Available Bandwidth	<5GHz | >5GHz none | 20MHz	<1GHz | >1GHz 26MHz | 83MHz |150MHz	<1GHz | >1GHz .5MHz | 1MHz	1-10 MHz	
Frequency Allocation					
Usable Range	|15 m	100 m	100 m	25 m	<10 m
Delay Spread RMS		100 ns 300ns	100 ns 300 ns	10 ns 30 ns	
Delay Spread Peak					
Coherence Bandwidth	Description	of Channel	Models		
Coherence Time	Based on	Complex	Impulse		
Temporal Variance	Response	to be	provided		
Interference Profile				IBM Photonics and NASA studies	
Inpulse Noise Sources					
Unintentional Radiators					
Jamming Profile					
MultiPointTX Complexity					

Having begun to explore the requirements for specifying the medium that exists below the PHY the next activity was to look at the MAC-PHY interface and to attempt to list the symbols that might need to be passed across that boundary. There was some discussion regarding whether this should be a parallel or serial interface. There was considerable discussion regarding the need to have a path between PHY and MAC that was available regardless of whether data was being transmitted or received to pass management information. There was consensus among the group that a path capable of operating logically in parallel with the data transmission path is required.

The symbols that we discussed as potentially needing to pass across the MAC-PHY boundary are as follows:

{Pad_Idle} - a symbol indicating that preamble should be sent

$\{a_1,\ldots,a_n\}$ - an n symbol alphabet of data symbols ($n\geq2$)

$\{p_1,\ldots,p_n\}$ - an n level indication/request of signal power level

$\{sq_1,\ldots,sq_n\}$ - an n level indication/request of squelch level

$\{si_1,\ldots,si_n\}$ - an n level indication of signal to interference level

$\{c_1,\ldots,c_n\}$ - an n level request for channel select

$\{d_1,\ldots,d_n\}$ - an n level request for diversity select

$\{ap_1,\ldots,ap_n\}$ - an n level indication/request for aperture direction

We closed the meeting with a discussion of what would be done at the next meeting. This included the following work items:

1) Work on Channel Characterization

2) Work on possible "Hardening/Softening" statements for PHY requirements section

3) Accept Proposals and contributions if offered

4) Work on the MAC-PHY interface specification

It is our desire to be assigned 3 half day sessions and 1 MAC liason half day session.

We had voluteers to do work between meetings.

1) Orest Storoshchuk - will start to work on characterization of IR environment if he can solicit assistance in defining what needs to be done. Orest will also solicit input from Hughes on IR channel characterization.

2) Larry Van Der Jagt - will do a "white paper" on channel characterization templates.

3) Rich Lee - will collect data from the literature on specific channel and in particular IR channel information

The meeting was adjourned until Monday AM at Irvine. The appendix that follows are the revisions and additions to the requirements definitions that I volunteered to do as a result of our work in Chapel Hill

interference. Any signal that is not intended to assist in transmission of information to a specific instance of a **PLAN** user.

jammer. An entity that intentionally places signals that are observable by entities implementing an IEEE 802.11 PHY Layer Entity without the specific intention of communicating with the specific instance of a **PLAN** user that is observing the signals.

pernicious jammer. An entity that places signals that conform to the IEEE 802.11 PHY Layer Specification but do not conform to the IEEE 802.11 MAC Layer Specification on the medium.

native jammer. A station within the **PLAN** that is a jammer from the point of view of a specifc instance of a **PLAN** user.

alien jammer. A station within an **OPLAN** that is a jammer from the point of view of a specifc instance of a **PLAN** user.

non-conforming jammer. An entity intentionally that places signals that do not conform to either the IEEE 802.11 MAC specification or PHY specifiaction but are allowable uses of the medium and are observable by an IEEE 802.11 PHY layer entity.

narrowband interferer. A source of interfence that occupies a portion of the bandwidth of the medium.

wideband interferer. A source of interference that occupies the entire bandwidth of the medium.

intermittant.. A source of interfernce that is present some of the time that a **PLAN** is in operation.

constant. A source of interfernce that is presnt all of the time that a **PLAN** is in operation.

fixed. An adjective describing a narrowband interferer that occupies the same portion of the bandwidth of the medium all of the time.

sweeping. An adjective describing a narrowband interferer that changes the portion of the bandwidth of the medium that it occupies with time.

interference level. A weighted sum of the individual signals that are observed as interference at a given instance in time from the perspective of a specific instance of a **PLAN** user. The wieghting function used to obtain the interference level is described in the Medium Dependent Interface section of a specifc PHY layer specification.

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

attenuation distance. The path loss 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 distance. The maximum attenuation distance separating a tranmsitter and a receiver at which a communication service of sufficent quality of service to meet the requirements of the IEEE 802.11 PAR is possible. This distance is a function of the interference level at the receiver.

interference distance. The maximum attenuation distance separating a transmitter and a receiver at which a transmitted good signal can be detected as a good signal regardless of whether a sufficent quality of service to meet the IEEE 802.11 PAR could be provided by that signal. This distance is a function of the interference level at the receiver.