PHY Ad Hoc Group Activity Summary

Fort Lauderdale, FA
November 12-13, 1991

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At the Plenary meeting of IEEE 802.11 held in Fort Lauderdale during the Week of November 11, 1991 an Ad Hoc Group was created with the charter to perform 1.5 days of work related specifically to making progress on a PHY layer specification.

The first order of business was to elect a chairman. Peter Cripps and Larry Van Der Jagt were nominated and Larry Van Der Jagt accepted the chair when Peter Cripps declined to accept the nomination.

The first item of action was to attempt to get a preliminary list of the proposals that either had been presented or were anticipated.

The following potential candidates were identified:

1) Frequency Hopped Spread Spectrum PHY that at a minimum meets the requirements of FCC Part 15.247.

A) Texas Microsystems Proposal

Data Rate - 1 Mbit/s
Hop Dwell Time - 256 ms
Channelization
Multiple channel by time shifted versions of the code
Modulation - Binary BPSK .175/t peak deviation
Filtering - Linear Phase Prefilter .75/t

2) Direct Sequence Spread Spectrum system at a minimum meeting FCC Part 15.247

3) Diffuse Infrared system

A) Spectrix Proposal

Data Rate - Up to 10 Mbit/s

4) Private Radio Channel at a minimum meeting FCC Part 90 requirements at around 18 GHz. (10 MHz channels, 1 watt EIRP, No video)

5) Possible non-spread spectrum systems in a future regulatory environment

6) Possible other spread spectrum systems in a future regulatory environment

Note: There is also a proposal on the table for a baseband waveshape that could be applicable to many of the above system that has been present by Mr. Chan Rypinski at Palo Alto.

Having identified the current perceived scope of possibilities, the group proceeded to address the issue of what information would need to be obtained through negotiations with the MAC group. A list of questions intended to solicit the "wants" of the MAC group was generated. The questions are as follows:

1) Does the MAC want the PHY to take action to improve quality of service at the expense of data rate?

2) What level of BER performance does the MAC require to achieve the performance specified in the PAR (packet loss rate performance)

3) What indications of quality of service does the MAC want (signal power? signal goodness? signal source? etc.) and does it want these indication on a per signal burst basis?

4) Does the MAC want the PHY to support multichannel operation?

5) Does the MAC want the PHY to achieve specific targets with respect to delay imposed by the PHY?

Next a set of statements was developed that expressed the "wants" of the PHY group of any MAC that might be developed. The PHY group wants the MAC...

1) **To support single channel operation with any requirement for multichannel operation being optional.**

This position was "straw balloted" with a result of 14 for, 1 against, 0 abstain.

2) To support a half duplex system

3) To support a simple PHY - i.e. we want the MAC to deal with high BERs and outages.

4) To support various PHYS

The next order of business was to review the section of the Requirements Document dealing with PHY and we came up with certain shortfalls in the area of definitions that needed to be generated. Specifically definitions dealing with "conformant signals", "channels", "service distance", "outage" and "interference distance" were identified as lacking.

The definition of "channel" was deemed to be worth spending the time of the group to generate. After lengthy discussion the following definition was agreed upon:

Channel:

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

For example,

2 sets of stations using 2 frequency BERs form 2 channels

2 sets of stations using different FHSS codes form 2 channels

2 sets of stations using different DSSS codes form 2 channels

2 sets of stations using a time synchronized system form 2 channels

The final activity of the group was to document the steps that needed to be taken to reach the end of the process. These steps are as follows:

1) Agree on a small subset of BERs models against which to benchmark proposals. These models would form a starting point for work on conformance testing. These models should also include interference profiles.

2) Get proposals in a format in which they can be evaluated and get MAC requirements against which the proposals need to be evaluated.

3) Run benchmark tests and evaluate the ability of proposals to meet MAC requirements under test BERs and interference conditions.

4) Decide of final approach/approaches

5) Prepare document

6) Prepare conformance document

The immediate **actions** agreed to were:

Larry Van Der Jagt to dig out some relevant IEEE802.4.L information and resubmit it.

Bruce Tuch to speak to Ted Rappaport about use of BERs models.

NTIA to evaluate if they have information that can be submitted with respect to channel tests.

Larry Van Der Jagt to submit a BERs boilerplate document in soft format to smooth the transition from proposals to working documents.

There were few issues of concern of individuals in the group that are reported here but that were not addressed in the subgroup meeting.

1) There is a question of how big is a local area. Some individuals are concerned about the premises of an electric utility that might cover an entire city.

2) Individuals interested in large physical sizes also expressed a desire for low cost PHY repeaters

3) There may be a requirement for a simplex service

Also there were some station BERs issues that were brought forward. These were:

1) The MAC or Station Management might want or need to control transmit power if power control exists

2) The MAC or Station Management might want or need to supervise antennae diversity if it exists

3) The MAC or Station Management might want or need to supervise channel diversity if it exists

One half day of the 1.5 day BERs of this subgroup was spent in joint meeting with the MAC subgroup. During this meeting the progress of the individual groups was reviewed and three of the questions that the PHY group had for the MAC group were addressed.

The discussion was basically free-flowing and the following notes represent the points that were made during the discussion but should not be construed to be conclusions.

Question: Does the MAC want the PHY to take action to improve quality of service at the expense of Data Rate?

1) ARQ is properly a MAC Function

2) Power Control, Antennae Diversity and Channel Diversity may be possibilities

3) Some of these things are global and require centralized management

4) MAC has the means to measure things the PHY typically cannot measure. If the PHY needs to measure these things (CRC etc.) it will need to be smart

5) No ARQ or FEC should be done at the PHY

6) Some say perhaps ARQ or FEC should be done at the PHY

Question: What level of BER or Outage does the MAC require to meet the performance specified in the Par?

1) At the edge of the service area performance may be very bad at the center it may be very good (10-6 or 10-7)

2) The difference between 10-3 and 10-6 is not very much in terms of service area because the edge is a cliff.

3) BER impacts maximum packet length

4) Bellcore narrowband tests seem to not be able to get better than 10-3 typically.

5) Most reports say you are either in or out of service

6) If the error rate is 10-3 we need to do something to make it better

7) The length of an error burst may be long or a total dropout

8) Dependence of BER on time and space is important to MAC designers

9) The size of a service area might need to be smaller

10) Outage or sync loss BERs is important

11) A price list is needed to make tradeoffs.

Question: What indications of quality of service does the MAC want and does it need this information on a per signal burst basis?

1) The MAC will require the PHY to have almost BERs synchronization

2) Instantaneous is probably about 2 octets at the data rate

3) There will be a specification on the turn around time of a half duplex PHY

4) Maybe quality of service is meaningless maybe it should be BERs or no service

5) Lock indicators and receive level indicators may be useful

6) CRC gives protection for 3 consecutive bit errors if you don't report losing more that 3 bits the CRC check is not effective (Note: this statement was contentious) .

This concludes this report of the Fort Lauderdale activities. During subsequent plenary session a vote was taken to continue the activities of the group in BERs. It is my hope that at that meeting we will be able to address BERs models for use as benchmarks and concrete proposals. Our ability to do this will depend largely on the submission that are presented to that meeting. Please bring submissions.