IEEE p802.4L

Through-the-Air Physical Media, Radio

Positions and Arguments

First version

INTRODUCTION

This document represents the results of the discussions held in the Radio-LAN task-force. The way of representation is acording to the IBIS method.

OBJECTIVE

The objective of this document is to keep a record of the decisions taken on the many questions that had to be taken along with the arguments on which the task-group based its decision. This way, even rejected positions are kept on file so that when new ideas come up it is easy to recupe our thought process at the time the decision was taken.

Members of the taskgroup are encouraged to submit contributions in the same format.

ABOUT THIS ISSUE

This issue is based on a document prepared by Vic Hayes by regenerating the resukts from the some of the minutes of meeting and the Running Objectives and Directions document. It has partially been reviewed at the May 1990 (Atlanta) meeting. In addition the discussions held at that meeting have been added.

Future contributions are planned for capturing more results from prior meetings.

What is IBIS:

IBIS means Issue Based Information Systems, it presents a method of documenting discussions.

IBIS consists of 3 key elements (nodes): Issues, Positions and Arguments.

Issues :	An Issue articulates a key question.
Position :	A position makes a single point that directly addresses its parent issue.
Argument :	An argument supports or objects to a Position.

IBIS notation (text indentation method):

The textual format of IBIS uses indentation to represent the hierarchical relationship among nodes. The labels used for different types of nodes are:

Issues, Positions and Argument nodes are labeled:

I:	issues
P:	positions
A+:	supporting arguments
A-:	objecting arguments

Each node label is preceded by a status flag.

?	open node (no decision made)
*	Issue resolved, Position or Argument accepted.
-	rejected node.

Issues have been numbered for easy reference

The format is thus:

*I: What is the layout for text indentation IBIS?

*P: The base Issue at the left margin.

*P: The Position(s) 1 TAB indented under the Issue.

*P: The Argument(s) 1 TAB indented under the Position.

*I: Can a node have more than one line of text

*P: Yes. This position is an example of a position being printed on more than one line.

*I: Can a new issue be raised at all types of nodes.

*P: Yes it can.
*A+: Questions can raise everywhere.
?I: Is this a valid argument?

).0.1

1 *I: What are the Product Requirements of the Radio LAN PHY?

*P: Meet FCC part 15 rules for spreading, scrambling and Power
*A+: Permits non-licensed use
*A-: Spectrum has to be shared with other non-licensed users
*A-: danger of being forced to stop because Spread Spectrum has the lowest secondary user status.

*P: Economy

*P: Permit system diameter of 300 m
A+: Feasable under power level permitted by FCC Part 15 rules
?I: Is this only limited to Peer-to-Peer systems?

*P: Minimal acceptable diameter is 100 m

*P: Permit adjacent 802.4-conformant RadioLANs

*P: Support office, retail and industrial environments

*P: Robust with respect to multipath

*P: High data rate at required BER and outage

1.0.1 *I:What is the acceptable BER?

*P: The BER at the MAC/PHY interface shall be 10^{-8} or less achievable in al but 10^{-3}or less of the area of spatial coverage of the system in a minimally conformant system, and where additional antenna and receiver diversity can be used to reduce the area of outage as required

*P: Accommodate relative motion between Transmitter and Receiver

*P: Meet ISO IS 8802-4, sections 1-10
A+: a requirement for the IEEE p802.4 group

*I: What is the definition of the transmitted signal?

*I: What type of modulation (Carrier) should be used?

-P: Coherent Phase Modulation
*A-: the anticipated coherence time of the channel is insufficient
*A-: the acquisition time is too long compared to the anticipated packet length

*P: Differential (Phase shift) keying
*A+: fast acquisition
*A+ robust for the time varying channel
*A+ simplifies receiver
*A-: theoretical loss in S/N of 2.3 dB

?I: What type of DPSK?

*P: DQPSK
*A+: information is vested in phase change
*A+: allows wave shape form that tolerates non-linear amplifiers
+A+: allows coherent demodulation
*A+: decreases signalling rate (increases symbol time) without excessively compromising S/N (see QPSK)

*P: Quaternary Phase Shift Keying
*A+: decreases signalling rate (increases symbol time) without excessively compromising S/N

?P: π/4QPSK
*A+: is almost constant envelope
*A+: allows an FM discriminator to be used as demodulator
*A+: decreases signalling rate (increases symbol time) without excessively compromising S/N (see QPSK)
*A-: does not allow Direct sequence spread spectrum before the non-linear elements of the transmitter
*A-: the constant envelope property is lost when the signal is Nyquist filtered
*A+: does not increase cost in complexity compared with other QPSK type modulation techniques

-P: Frequency Modulation
*A+: is 100 % constant envelope
*A+: demodulation is simple
*A-: is not spectrum efficient except for M-ary FSK with M>2
*A-: can not be passed through a filter and maintain constant envelope
*A-: has a clicking phenomena below 10 dB S/N ratio

-P: Amplitude Modulation
*A+: works with minimal channel coherence time
*A-: requires linear amplifiers (expensive)
*A+: economy
*A-: technical risk
*A-: spectrum efficiency
*A-: not robust against fading environments

*I: What power should be transmitted

*P: less than one Watt

*A+: Required by FCC

2.2.1 *I: Should the transmitter power level be adjustable?

?P: Yes
*A+: permits adjustment to prevent interference with an adjacent LANs
*A-: higher cost
?I: how should the adjustment be controlled?
?I: is this a managed object?

*P: NO
*A+: cost
*A-: may prevent operation with an adjacent LAN

2.3 *I: What type of modulation (spreading) should be used?

*P: Direct Sequence Spread Spectrum (DSSS)
*A+: allows use of FCC 15.126
*A+: limits the effect of interferers
*A+: increases the symboltime to a value beyond multipath
*A+: reuse of code and frequency possible in head-end systems where antennae are separated more than one chiptime

2.3.0.0.1 ?I: does not interchip interference due to multipath increase the necessary separation?

2.3.0.0.2 ?I: would not a fraction of the symboltime offset reuse of the code render unnecessary antenna-space time separation?

*A-: loss of bandwidth

2.3.0.1 *I: What is the best spreading size?
*P: Minimal within FCC rules
*A+: most efficient use of bandwidth

2.3.0.2 *I: How to use the spreading?

*P: Encode the data on a single code
*A+: simple and satisfies the requirement
*A+: allows for the use of short codes
*A+: short codes allow efficient use of bandwidth

?P: Use a long code for the clock and use CDMA with shorter codes to encode data; e.g. 3 data symbols per clock symbol, 8 bits per data symbol 89-
*A+: single complex correlator for clock recovery, data recovery with simple correlators
*A+: allows clock recovery as delay spread approaches or exceeds data code length
*A-: reduces power devoted to data
*A-: requires a linear amplifier over a wide range because it is a high peak-to-rms wave shape

2.3.0.2.0.1 ?I: Is this method feasible in the light of cross correlation components?

2.3.0.2.0.2 ?I: What is the transmitted spectrum?

*I: What spreading code to use?

*P: Use the Barker 11 code: +-++-+++---
*A+: it has bounded auto-correlation
*A+: It has bounded periodic auto-correlation
*A+: It has bounded odd periodic auto-correlation
*A+: It has good spectral properties

-P: Frequency Hopping
*A+: allows use of FCC 15.126
*A+: limits the effect of interferers
*A-: Can not meet data rate requirement because current regulation limits bandwidth to 25 kHz/hop

?I: Has the FCC changed the rule yet?

*A-: loss of bandwidth

*I: Should Forward Error Correction (FEC) be used?

?P: Should be avoided if possible 89-15

?P: No
*A+: does not help against narrow band interferers 90-13 /11
*A+: Higher effective data rate
*A+: better delay spread tolerance
*A-: should be avoided if possible

?P: Yes
*A+: provides protection against impulse noise
*A+: provides protection against white Gaussian noise
*A-: Lowers the effective data rate because it takes part of the bits transferred unless the bitrate is increased
*A+: improves performance of inexpensive receivers in time variant channels
*A-: increases slot time
*A+: if used correctly there is a net gain against impulse noise and white Gaussian noise
*A+: allows operation in high impulse noise (energy/impulse/symboltime >> -24 dB of E_B) (puncture) environments

?P: FEC support is required in Distribution system and an installation option for the DTEs (mobile stations)
*A+: Higher data rates in benign environments
*A+: fall back available
*A+: application is possible in all bands

?I: At what level is interoperability required?

P: Make FEC transparent to Distribution system, i.e. Header and trailer have a separate FEC in all cases, MAC PDU part has another FEC if used.
A+: single distribution system for all markets
A+: Header and trailer are longer for market not using FEC.

2.4.0.2 ?I: Should the header encoding be the same or nearly the same for 802.3 and 802.4?

2.4.0.3 ?I: Should the information bits in the header and trailer be "in the clear", i.e. systematic code?

2.4.0.4 ?I: What is a suitable coding rate and type?

2.5 *I: Is scrambling required?

*P: Yes
*A+: to smooth the output spectrum

2.5.1 *I: What size polynomial should be used?
*P: 7-bit polynomial (length 127) when the adopted spreading code is < 127 chips 89-11
*A+: to suit FCC requirements

2.5.1.0.1 *I: What polynomial is to be used?

*P $1+X^{-4}+X^{-7}$ 89-11
*A+: to suit FCC requirements
*A+ Economy

2.6 *I: How should the MAC symbols be encoded?

*P: Preamble and frame delimiters should be encoded without increasing the signal constellation 89-15

*P: The non-data symbol in the frame delimiter should be encoded by a different chip sequence: e.g. Barker-11 backwards
*A-: no need to be encoded

2.7 *I: What data rate?

*P: Between 1 Mbit/s and 20 Mbit/s
*A+: Is within the charter of IEEE p802

2.8 *I: How is the requirement for limiting phase noise specified?

*I: What should be specified for the receiver?

*I: What Network Management objects are to be defined?

5 *I: What are the characteristics of the medium?

5.1 *I: What is the characteristic of the RF Propagation?

5.1.1 ?I: What is the coherence time?
?P: the reciprocal of the Doppler frequency spread (effectively the maximum Doppler frequency componant in the channel)
?P: the Doppler spread is proportianal to the square root of the amplitude-Doppler frequency function
A-: is not consistent with textbook
?P: Doppler spread is reciprocal of the Δt span for the non-zero values of the spaced-frequency spaced-time correlation function defined in previous minutes

5.1.2 ?I: What is the importance of coherence time to our subject?
?P: If coherence time is not significantly longer than the symbol time, then a coherent QPSK detection will be difficult
?P: It would be nice if coherence time was >300 symbol times for coherent QPSK. However, it may be possible to work with 50.
?P: It would be nice if coherence time was > 50 symbol times for differential QPSK. However, it may be possible to work with 5.
?P: It would be nice if coherence time was > 5 symbol times for on/off keying. However, it may be possible to work with 2.
?I: Are these figures correct?

5.1.3 ?I: Do we have to decide on a coherent or a differential demodulator?
?P: No, provided the transmitter provides information for differential and coherent demodulators

5.1.3.0.1 ?I: How long preamble is needed for coherent demodulators?
?P: 300 symbols would be really nice, but at least 50 symbols

5.2 *I: What can be done to control the RF propagation?

*I: What is the definition of the Distribution System?

*I: How are the forward and reverse channels separated?

-P: Frequency division

*P: Time division

?P: Code division

*I: What is the format of the PHY PDU?

?I: What is to be conveyed in the header of the PHY chunk?
*P: the NWID
*A+: to be able to reject PDUs of other LANs
.0.1 ?I: how long?
*P: 5 octets
*A+: to prevent the commitment to a registration authority for NWID by adopting the p(international) telephone number
*A-: this is longer than necessary for an administrative mapping
*P: string length of user data field in octets (1 octet long)
*A+: to identify the MAC End delimeter
.0.0.1 ?I: should this parameter refer to clear stringlength?
*P: Yes
*P: last chunk indication (1 bit)
*A+ to set AGC in strategic position
*P: NAK (3 bits)
*A+: allows management of ditribution system respond to NAK from stations
*P: FEC applied (1 bit)
*A+: to signal the receiver to apply FEC decoding or not
*P: Start delimeter (1 octet)
*A+: to mark the beginning of the header fields
*P: Slice number (4 bits)
*A+: to identify the channel (or channel type) or slot
*P: FEC Parity bits
*A+: to carry FEC information

?I: What is to be conveyed in the trailer of the PHY chunk?
*P: End delimeter (1 octet)
*A-: chunk length is not variable
.1 ?I: why is it needed?
*P: CRC
*A+: to support the distributed assessment algorithm
*A+: to support the MAC protocol

6.3 *I: How is the best reverse radio access point selected?

6.4 *I: What is to be specified for the antennae deployment?

6.5 *I: What is the transmitted Power?

6.6 *I: How is the RF frequency of the forward radio access points controlled?

6.6.1 *I: How is the coherence time controlled?

6.6.2 *I: How is the emission pattern controlled?

6.6.3 *I: How is the requirement for limiting phase noise specified?

*I: What should be defined in environmental Specifications?

*I: What are the characteristics of noise and likely interferers?

?I: How can Field Disturbance Devices (FD devices), in particular shoplifting devcies, co-exist with IEEE p802.4L (RLAN) systems?

?P: FD restricts to 902-905 MHz, RLAN restricts to 905-928 MHz
A+: Allows mutual co-existance
A+: is consistent with Sensormatic's positon relative to consumer devices
A+: installed base of FD to be equipped with new crystal
A-: RLAN has to give-up 3 MHz
A-: the remainder of the users of the band still utilize 902 - 928 MHz

?P: FD use the RLAN RF signal
A+: RLAN has an additional radiator
A+: is a synergistic solution
A-: FD has to swap pedestals of installed base
A-: logistically unmanageable

?P: FD restricts to 902-905 MHz, RLAN uses 902-928 MHz
A+: RLAN keeps full bandwidth
A+: In the 4 kHz band of the FD, RLAN merely transmits 0.16 mW(/4 kHz). This may even be lower due to the spectral curve
1 ?I: What is the saturation power level for the FD device?
2 ?I: What is the bandwidth of the front-end stage of the FD device?
3 ?I: If RLAN saturates the FD device, what is the duty cycle / rest-time required from RLAN to co-exist?

?P: Use FD device in the notch at Carrier frequency
A+: Allows co-existance
A-: RLAN has to commit to the notch at Carrier frequency, i.e. at 915 MHz
0.1 ?I: Does the carrier frequency move?
?P: Carrier of the distribution system will not move
A+: it is a broadcast internal to the system
?P: Carrier of the remote stations will move
?I: Does the moving carrier hurt the performance?
A+: High-pass filter in the receiver is required anyway

?P: FD restricts to 902-905 MHz, RLAN filters the 902-928 MHz asymetrically such that the cut-off at the lower side is less steep and starts higher than required (Vestigial sideband)
A-: the correlator needs some or extensive equalization
A-: extensive filtering required at RF

*I: What is required on labelling?

10 *I: What is to be specified about Coverage Area?

11 *I: What guidelines should be given in the standard?

*I: What steps are required to obtain a frequency band allocation dedicated to RLAN?

*I: What features are required of p802.4 RLAN to work together with other p802.x RLANs?