Tentative Minutes: TGb meetings November 1997

TGb meeting at 5pm Monday November 10, 1997

John Fakatselis, chair, /Carl Andren secy
John gave a overview of the history of the group

Papers to propose new PHY layer
97/110 Golden Bridge Technologies, Method of achieving variable data rate
97/124 Siemens, Chirp modulation for high rate systems
97/112 Breezecom, High speed FH high speed PHY
97/124 Lucent, PPM technology for high speed PHY
97/xxx Harris, MOK 11 MBps PHY
97/128 Micrilor, Multisignal detection
97/129 Micrilor, 2.4 GHz proposal
97/xxx Harris, 11 MBps PHY performance comparison

Papers supporting the tradeoffs
97/78 Informed Technologies, Throughput discussion
97/136 Harris, Market analysis for interoperability with existing 802.11 PHY

John went over the instructions to the presenters.
Dean added to the criterion list: interference immunity and intellectual property

Presentations:
97/124 Hanspeter Kupfer, Siemens, Chirp modulation for high rate systems
High bandwidth is needed for multipath mitigation
Dean, what is the form of the DPSK modulation on the chirp? Chirp to chirp phase differences.
Naftali, how many bits are possible? 3 bits per chip and 4 MSps, gives 12 MBps. Not explained how to get to 16 MHz.
Carl; How do you preserve phase from pulse to pulse? Using differential PSK.
Carl; What is the cost of the SAW? Cell phones use SAWs of similar time BW product, so cost should be low.
Ron;, How many channels? By resolving to a fine pulse, they are pulse position differentiated and many channels can share the band.

Presentation of paper 97/112 by Naftali Chayat

- higher speed frequency hop proposal using 8mbps FM modulation
- uses an overall 9MHz bandwidth
- preference is to use multilevel modulation in order to use same symbol rate as current FH so that the use of current preamble and synchronization techniques
- proposes to use multicarrier system with each carrier being MSK modulation
- each carrier would be spaced 0.5MHz apart
- statement that there will be some ISI as result of the modulation but it can be overcome
- proposed simple error control mechanism to be used to overcome effects of fading
- proposal also suggests the use of an additional preamble segment in order to learn about the wider bandwidth channel
- suggests an alternative to use only the high speed preamble
- regulatory aspects may prohibit the use of frequencies near the band edges

questions:
- demodulator does not require coherent demodulation

- system becomes a baseband multicarrier detection after the discriminator detects a signal
- the 'carrier tone' is a byproduct of the low frequency FM modulation, this tone allows for fast roll-off property and allows for phase detection.
- this tone may also open the system to the effects of narrow band interference
- regarding the number of channels – propose to use 10MHz IF filter, which allows for 8 channels. Assuming perfect coordination, 8 systems could coexist, however, in January, Naftali will bring information regarding the statistical sense of overlapping systems.
- A warning (from John Cafarella) that 15.247 may be passable, however, 15.249 which specifies ??mW per MHz, may give trouble to this system. Naftali suggests that hopping may overcome this issue.
- Naftali feels that the sensitivity of this system will be similar scale to 2Mbps FH system
- The use of wide filter will have adverse effects when coexisting with current system, Naftali proposes the use additional filter (or digital equivalent) when operating in coexistence environment in order to allow less noise into the system

Presentation of paper 97/110 by Darrel Draper (Golden Bridge Technology)

- suggests looking for a low power (battery operated system), adaptable data rate system
- decision to select data rate can be accomplished on a packet by packet method (negotiation occurs on higher level)
- goal of interoperability with current 802.11 systems
- propose to keep current preamble and channelization of DS system

questions:

- the proposed modulation will be unveiled before the January 1998 meeting and posted on the reflector
- John Faketselis points out the rules of the game which stated that a skeleton proposal of the modulation was to be presented at this meeting and says that Golden Bridge will be given until Thursday to present additional details in order to be considered in January

presentation of document 97/124 by Jan Boer (Lucent)

- current DS system uses only one peak per symbol, this system proposes to multiple peaks in order to send more bits per symbol
- sequence estimation techniques must be used to overcome the symbol interference
- This system is scaleable, creating additional data rates of 8,10, and 11 Mbps
- points that this system overcomes a limitation of the Harris Walsh code proposal by not having an irreducible packet error rate when not using an equalizer

questions:

- level of complexity of the CMF depends on implementation and training requirements
- there will be a 6 - 12 dB loss of sensitivity due to 3 overlapping symbols at 10 and 11 Mbps rates
- there are Lucent IP issues with the both TX and RX. They have patents on the modulation method, rate change mechanisms and receiver structures
- this system meets both FCC tests for processing gain
- current FCC approval is based on simulation and theory only
- perfect coexistence with current systems is not possible when using energy detect CCA scheme

presentation of document 97/144 by Carl Andren (Harris)

- begins by summarizing the MOK modulation presented in earlier submissions
- possible to get 33Mbps aggregate throughput with 3 non-overlapping channels

- faster transmit has possibility of less interference (and susceptibility to interference) since on the air less amount of time
- equalization is a must for this system when operating in environments with greater than 50ns delay spread
- claims lower power amplifier backoff than is needed for PPM modulation
- claims better than -85dBm sensitivity at 11Mbps data rate
- claims the FCC will pass the modulation when Harris demonstrates a working system that passes the CW jamming margin test
- claims better than 100 feet indoor range with a throughput of 8Mbps (7Mbps with table rotation) while using antenna diversity
- claims similar multipath performance to other proposals using the same bandwidth
- first implementation uses coherent demodulation with a 25% gate count increase
- short range near 0 percent PER, 10% PER at about 75 feet
- Harris will look at additional codes in order to improve multipath performance
- suggest using longer codes (lower data rate) in order to overcome FCC 11 chip criteria

questions:
Q: What delay spreads can the system handle. The system without equalizer can handle 40-50 ns delay spread range, with a simple equalizer the system can handle up to 80ns. A system with sophisticated recovery has not been investigated.
Q: What happens if the correlation moves during a packet due to one path fading out and another taking over. Timing synchronization is established during the preamble and is tracked but not jumped during the packet. That is, it will stay with the signal it first began tracking unless the delay is short enough such that the correlation peak is blended into the new signal gradually.
- Jan Boer points out that with a 25ppm oscillator, that signal timing can drift greater than a symbol. Carl responds that this is no problem as the signal timing is tracked and the tracking can follow well over 50 PPM and can handle considerable FM modulation of the timing.
- Naftali asks why the PER analysis was performed over symbol bandwidth instead of spread bandwidth. Carl responds with “the time to perform the analysis is time consuming”

Presentation of document #97/128 by John Cafarella (Micrilor)

- title of paper is “Multi-signal clear channel assessment”
- how to decide when to defer without using energy detect only CCA mechanism
- using a 16 tap matched filter implementation (32MHz sample rate)- minimal additional gates required, negligible power consumption, only operated when CCA is desired
- easy to detect existing DS system, feature detection allows for detection of FH systems
- DSSS able to obtain -90dBm (-80dBm for FHSS) sensitivity for detection is possible within short time of 2usec
- adding this bit of hardware allows coexistence without incurring the penalty of the low rate preamble

presentation of document #97/129 by John Cafarella (Micrilor)

- document title is “Proposed 2.4GHz PAR”
- Walsh modulation uses 16 chips per symbol
- reference document 97/119 concerning wideband fading details
- reference document 97/116 concerning processing gain details
- reference document 97/117 lists the preferred 16 bit Walsh codes proposed
- reference document 97/120 compares Harris and Micrilor proposal
- propose using a 20usec header using a DBPSK portion to convey rate and length information
- 1 sample per chip matched filter is used to perform CCA and determine the required slot time

- reference document 97/118 describes the performance of a power amplifier using MSK signaling

questions:
- it is the opinion of the presenter that MSK performance is slightly better than OQPSK in regards to power amplifier performance

one additional paper (presented by Symbol) will occur tomorrow
adjourn at 13:00 for lunch then task group A

Wed, 11/12/97

Meeting 7:30 on selection criterion for the candidate waveforms.
Dean Kawaguchi, Symbol…DS/GFSK design. DS proposals do not address FH interoperability. Interference immunity is very needed in this band. High rate or no rate at all is not what the customer needs. Both low speed and high speed preambles possible. BGFSK with deviation of 0.7 and a small preemphasis. Chipping rates of 10 and 20 MCps with bandwidth to chip rate ratios of 1.1. Each DS channel has 20 FH channels. Synchronization is provided by the preamble that falls in the DS band. Two us rate switching time. HS header is 16 us,
While in wideband mode (short header), the receiver can see NB signal with right processor.

Some selectivity is lost for the 1 and 2 Mbps mode. System does maintain interoperability. Saw filters (IF?) are selectable. DS chipsets would work fairly well for this type of modulation. Same front end could provide both DS and FH capability. Dean's approach is probably not patentable.

Q: How many cells with this approach? In 10 Mbps mode, with four channels, similar cell arrangement as DS
Q: Can cells be collocated? Yes, but at some loss of throughput.
Q: Rx signal is FM demodulated. Does this require higher SNR? FSK requires 12.5 dB, FM needs about 10 dB.
Q: What about multipath performance compared to DS? Not enough simulation data available at this time to draw conclusion.

John F: We will make a final call at end of the day for High Rate proposals to let Golden Bridge provide more details on their approach. Time can be allotted on Thurs. for a presentation.

Naftali: we need discussion to define full proposal for 5 GHz PARs in January. J.F. This is an agenda item for discussion tomorrow.

Interoperability Discussion (9:15 am)

Bob O'Hara Presentation: Analysis of 802.11 Multi Rate Throughput

Analysis assumes fixed 10 Mbps rate, independent of modulation and spreading. Paper focuses on MAC throughput. Frame length, header length, etc are traded off. Interframe space is fixed at 20 microsec.

The presentation assumes 1 Mbps ACK rate. Throughput tops out at 8.5 MBps. ACK causes 2mbps loss of throughput. In second case, ACK is at 10 MBps. Increase in throughput is only slightly increased.

Single Frame Efficient yields significantly increased throughput.

Effects of Contention: ACK'ed transmissions are reduced as a function of probability of contention, but efficient method is still best.

Real World effects of varying frame size: Packet size distribution in corporate environment is Bi-modal. Mean frame size is 607 bytes. Using this assumption, probability of contention was computed. Curves for Throughput of a BSS were also computed. Efficient Method is about 2X better for up to five stations.

Conclusion: Current 802.11 method is bandwidth inefficient. High rate PHY should use only high rate method. A modal PHY with stand-alone capability where no legacy equipment exists, AND compatibility mode for systems which must be backward compatible.

Q: Dean said he saw rate peaking as nodes are added.
Q: Keith said that total throughput showed a flattening with more nodes.
Q: Ron Brockman, How would mixing low and high speed nodes effect overall throughput? The analysis can be expanded to cover this case. Guess is a lower overall throughput.
Q: What is the performance with non 802.11 traffic?

97/136..Al Petrick, Market analysis of interoperability.
Used focus groups consisting of SOHO MIS managers familiar with LANs and Wireless. Gave them15 questions on what were top concerns. Top 5 were E-mail Intranet access, Interoperability and compatibility with 802.11, File printing, range, and cost.
Q: Naftali, what percentage of responses were discarded?
Conclusion…. consider backwards compatibility as important, along with gear shifting to lower rates.
Q: Dave Fisher Did the survey questions bias the results on interoperability and compatibility?
Q: Dean Nothing here is suprising. Did the survey group know the difference between 9 and 10 MBps?
Answer:
Q: John C. Did you reconsider your proposal to reconsider compatibility for FH?
Q: Jeff. Was the survey group representative of the customer group we need to target? MIS managers are conservative and like standards.
Q: Dave Bagby. Was the focus group informed as to what an AD hoc network and an infrastructure LAN were?
Q: ….., What is your opinion on a dual mode design. We support it.

Interoperable discussion. Is it FH and DS or only one or the other? The options are:
1. 802.11 low rate interoperable
2. no low rate interoperability or coexist.
3. low rate coexist., no interoperability.
4. dual (LR interoperability and fast preamble)
5. other

Dave Bagby: Definition may be emotionally biased towards antenna to antenna rather than data passing. He feels that we should not do antenna-antenna interoperability.

Dave's trades	Migration, data interoperable	antenna-antenna, PHY interoperable
Infrastructure	via AP	long header
IBSS	bi-modal (tri)	long header/performance

Dave Fisher. 3-Comm. History has a habit of repeating. So do MIS managers. The people who where successful in 10/100 switchover had auto sensing capability. Ease of migration was key to them. But these did not share the same domain. From the standpoint of the 10/100 story it is more like the 2.4 to 5 GHz argument. Suggests having two PHY headers. Users like to have a migration path.

Dean Kawaguchi: In addition to the cost of installing the stations, the bulk of the cost in the access point in sparse networks. There is also the cost of more collisions. There are two cases of deferral low-high and visa versa. Dean recommends a dual mode header. Lower rate is also good for improved connectivity. They see a different migration problem. Customers want to use the old equipment for some applications that do not need the higher rate capability.
Dave Bagby: How do you see the upgrade path? Dean: The access point will need to be replaced first.

John Cafarella: There seems to be an assumption that the range of the high rate system will be less. There is a 5 dB difference in Eb/N0 between the DPSK Vs the Microlor system and the rate is only 5 dB more. The hardware cost of the dual mode has to be considered when interoperability Vs coexistence is considered. MSK saves 200 mA in the PA. It is not necessarily true or false that the range will be less. Interoperable modes can't save this power. Also there is a cost of processing a neighbors frames. Dick: We want to provide Boeing a radio infrastructure on PC cards, so the power is important. ….. We already have a standard for minimum RX sensitivity and there can be a 15 dB difference in sensitivity. Dean: Shorter range is not that desired by customers. Dave: The reason we did not try to do two standards is the work involved. Bruce: It is important to show a migration path to customers.
Colin: With regards to corporate desires on migration. Will there be a big enough base to worry about.
Jeff: There is another PAR for high speed at 5 GHz. This one is an improved PHY. What is this group trying to do? People always want more speed. Perceived speed is more important than actual performance. If you tell the customer that the new standard will not be backwards compatible, you will stall adoption of the current standard.
Victoria: Boeing says that the existing systems are throw away components when the newer units are available. Jeff: There are far more companies that hand down the old stuff.
Victoria: The 2.4 GHz band is very important to Boeing worldwide, so trying to put the highest rate stuff in 5 GHz only is not good.
Horush: We have seen both types of customers. The reason to use wireless is mobility. Therefore the ½ MB network will survive for some time. Customers will change out the AP, but will be unwilling to throw out the existing station hardware. Coexistence is most important, and interoperability is less. The organizations that will need the higher speed will buy the new system and sell their old stuff on the secondary market. The mobile professional will not buy a modem without the backwards capability.
Dave: We need a common vocabulary. That will give us a better capability to make the choices.
John: This is indeed needed in order to come to a conclusion next time. By the way, as a committee we can cut and paste from the proposed techniques.

There will be a 6:00 Ad-Hoc meeting to discuss selection criterion.

Phy group b meeting 6:30 PM

John started with Naftali's 5 GHz criterion. Comments on performance with and without equalization in multipath simulations.
Struck the paragraph on data rates since the proposals will be for 8 to 11 MBps.
Add implementation complexity criterion.

- RF/IF compared to ½ MBps PHYs
- Baseband processor complexity (relative) provide gate counts if possible
- Equalizer complexity if applicable
- Diversity implementation

How does the system tolerate interference of 802.11 widgets and non 802.11.

- Applicable patent numbers
- contact point to get licensing info
- has IEEE letter been submitted?

Critical issues and technologies

- Extreme sensitivity to phase noise

- power consumption relative to existing PHYs
- excessive complexity
- RF PA backoff
- unusual enabling technologies
- dependence on antenna diversity/directivity

Low speed PHY interaction

- Elaborate on Migration path assumptions and include any multirate schemes
- coexistence
    - ignore
    - defer one way
    - defer two way
        - which PHY defers
- antenna to antenna connectivity
- compatibility at the data level
- what does it cost to achieve this

Thursday, 11/13/97

John began the meeting with a review of the agenda and gave a suggestion for the evaluation of the presentations. He suggested a vote on the various proposals one by one to determine the degree of completeness.
Review of the FCC teleconference by Dean: They had no problem with the current draft whereas several certifications already approved. At 5 GHz, the had no problems yet. At 2.4 GHz, they weren't so sure that with chipping rates under 8 chips per bit, that the CW jammer test be used. Some justification should be included with the certification process. Keith had a different take on the FCC's comment was that they wanted to be assured that the 10 dB was proved by the test. A lot of discussion on the problem was done. Dean said that the FCC wanted the group to discuss the issue of how to test the 10 dB processing gain to reflect the real life processing gain. Naftali feels that it is a very positive that we have the charter to make sure the user community gets what they need. Dean: The FCC does not want each company to come to them separately. They would like us to combine our comments and not take up their time. Michael (Breezecom) suggests that a common position be established at the beginning so that company maneuvering does not put the FCC in the middle of a competitive situation.

Carl/John: moves that we send a copy to the FCC, of each of the presentations received so that they can look over them and make comments.
Naftali: Doesn't think that the papers are in a state that properly represents the techniques and should not be sent.
7/6/11 Passes

Revised Presentation by Golden Bridge, 97/151
Augmented Barker code by adding a -1 to the end. This, with all cyclic shifts
Stacked carrier (OCDM) with CCSK Barker codes augmented with a -1 at the end. Rate adapted by how many sequences are chosen. You can use up to 11 codes on each of I and Q channels. They use a 4K cover code . on all sequences. The codes are summed on I nd Q independently. This gives rtes of 1.83 to 20.16 MBps. The technique uses the existing 802.11 header. They claim 12:1 processing gain and data rates of 11/12*N. The constellation is not QAM and has a binomial distribution in amplitude. Thus, the outer ring of points can be discarded without causing symbol errors.
They will have silicon in Q1, 98.
They can use a short preambles or long. Their system chooses the best signal like a RAKE receiver.
They say that while people may throw away hardware while upgrading, they are reluctant to throw away training, so it is important that the channeling structure be retained.

Dean: How fast is their fast Acq? Header can be different rate than preamble or PDU. Can change rate packet to packet.
Naftali: 12 chip sequence is balanced. Do they use EDAC? No. The system is an ortho-normal transform and takes the regulation to new and unforseen degrees of abuse. The maximum rate of this technique is the same as PSK.
….. What is the PN cover? It is a garden variety PN.
…… What is the form and effectiveness of the RAKE receiver. It chooses the strongest path
Isao: What receiver linearity is needed. The constellation has a binomial distribution of amplitudes on I and Q and no harm comes from clipping the outer ring which has low probability.
….. What is the peak to average ratio after discarding the tails? Thre are 3 amplitude levels left, so the power amplifier has power saving by spending most of its time at low levels???
Hanspeter: What is the processing gain? 12:1
Dean: What is the effect of discarding the tails on the cross correlation performance? No data.
….. In multipath simulation, were code sidelobes considered. Yes.
Isao: What was the conditions on the multipath simulations. /two ray model (single reflector at worst point) was used. Raleigh faded.

Motion to approve all 7 proposals Keith/John.
21/0/1

Break

Comparison paper presentation by John F. 97/157
Final decision to be made in March, 1998. Naftali feels that having all the information in January is too aggressive. Dean/Carl says that we need to have all the information before the march meeting if the decision is to be done then. Dave: The information needs to be in before the March meeting. Keith: suggests we remove words in the beginning in conflict with the letter ballot that was taken on the schedule. Michael: the situation was different at the beginning of 802.11. Then, there were too few experts to make fast progress. Now there is a lot. By running too fast this time, we may lose valuable ideas. There was much heated discussion of whether or not John could put conditions on the presenters that conflicted with what was approved on a letter ballot. Tabled until Plenary

Dave Bagby: suggests a change that the presenter insure that the proposed PER will not cause the MAC to not met the error rate of the MAC performance requirements. .

Motion to accept the criterion for comparing modulation methods. 97/157r1.
John Cafarella/Naftali 17/0/3

Jeff: Offer to supply data from WLANA. The Next meeting is Jan 16, 1998. Propose that if this group wants answers, we can put it to this group. The membership is mostly marketing from 13 companies. The group welcomed this information. We need feedback on:
Data rate
cost premium
range
throughput
channelization
(missed one)

Agenda for Jan meeting
- Technical submissions
- Decision process discussion

- TGb schedule

Naftali: Full text proposal for the section in the standard will be brought in January for 5 GHz. It is suggested that you do the same for this group.
Dean: does text mean all the criterion filled out or does it mean the standard sections.
Straw vote: do both.

Adjourned.