Tentative Minutes of the WPAN SG Meeting

Wireless Personal Area Network Study Group
Interim Meeting

Westford Regency Inn
Westford, MA

14-17 September 1998

1.0 The meeting was called to order on September 14, 1998 at 1:35 p.m. in the Emerson Room by our Chairman Dick Braley.

1.1 Roll Call: There were about 25 people present. The people present in the Study Group were informed of their voting rights within the Study Group portion of the Interim meeting.

1.2 Secretary: The Chair recognized Tim Blaney (acting) as the Secretary for the Study Group Meeting.

1.3 Goals: Dick Braley discussed the goals of the SG for this interim meeting and listed the submissions that would be presented in response to the Study Group's Call For Applications (CFA) [Document -98/288, S. Shellhammer]. These submissions were:

1.3.1 -98/294 D. Braley (FedEx) CFA FedEx

1.3.2 -98/295 S. Shellhammer (Symbol) CFA Symbol

1.3.3 -98/296 T. Blakadar (PED) CFA PED

1.3.4 -98/297 H. Chhaya (Texas Instruments) CFA TI

1.3.5 -98/301 M. McInnis (Boeing) CFA Boeing

1.4 Officers: Dick Braley gave the floor to Bob Heile who introduced the Study Group officers.

1.5 Executive Update: Bob Heile discussed the opportunity the SG was going to have with the Full WG in presenting the SG's objectives and applications the following morning at the Full WG session. The group spent some time discussing the strategy for this presentation and the order of submissions. Bob Heile also suggested the SG consider an interim meeting in October because there was still a lot of work to accomplish on the PAR if we wanted to submit it to ExCom for acceptance in Albuqueque. Bruce Kraemer suggested that we postpone that decision until after the Full WG review and the SG agreed.

1.6 Agenda Approval: Bob Heile presented the following agenda for approval:

Monday September 14, 1998

1. Opening of session
   introductory comments, acting Secretary assignment
   roll call
   voting rights
   logistics (attendance list/ registration)
   other announcements
2. Approval of minutes from La Jolla meeting
3. Reviewed ExCom report from La Jolla & Call for Papers from La Jolla
4. Review of Submissions
5. Adoption of agenda
6. Unfinished business
   Summary of Call For Applications (CFAs)
   Determine key WPAN MAC/PHY Requirements
7. Review objectives of meeting
8. New Business

CFA Review
HomeRF Liaison report

Tuesday September 15, 1998

1. Review of CFA's with 802.11 WG
1. Liaison reports from HomeRF & Bluetooth
2. Engage 802.11 WG in continuation of MAC discussion from La Jolla meeting
   Present SG's summary of MAC layer discussion to WG [98/298]
3. Break into working groups for additional work on the MAC requirements
4. Create a WPAN comparison matrix

Wednesday September 16, 1998

1. New Business
   Create WPAN Compare & Contrast of 802.11 Annex
   Examine WPAN 2.4 GHz coexistence with 802.11
   Review SG Objectives
2. Determine SG Goals For Albuquerque

Thursday September 17, 1998

1. Review of CFA summary list
2. Review of FH PHY & MACS PICS
   Created highlighted versions for intermediate working sessions before Albuquerque mtg.
3. Prepare SG report for Friday's Full WG
4. Output Documents
5. Next meeting
   location/logistics
   - October Ad-hoc meeting concurrent with Bluetooth Developers Conference in Atlanta (Oct 26-29)
   objectives
6. Close

Note: The SG agreed to expand the original agenda to include full sessions on Thursday.

Hearing no objections Bob Heile moved to adopt the Agenda, Tim Blaney seconded, and the agenda passed by general consent.

3.0 Tim Blaney overviewed the May meeting minutes of the Study Group. The SG added the following documents during the Westford Meeting. Documents in red have not been officially submitted via softcopy to the official 802.11 WG:

DOC No.	TITLE
-98/249r1	8249r16S-Kraemer-WPAN RF Comparison Matrix (Revised with new data)
-98/288	82886S-Shell-WPAN Call for Applications
-98/290	82907S -WPAN -Agenda-Westford-Sep-98 (Updated original agenda with adopted agenda - a softcopy was provided at meeting)
-98/291	82917S-WPAN-SG-Minutes-Westford-Sep-98
-98/292	82927S-WPAN-SG-Meeting-Report-Westford-Sep-98 (presented on Friday)
-98/293	82937S-Kraemer-Summary-La Jolla MAC Layer Discussion (Revised at meeting)
-98/294	Fedex CFA (D. Braley)
-98/295	82957S-Shell-WPAN Applications
-98/296	PED CFA (T. Blakadar)
-98/297	82977S-Chhaya-WPAN CFA TI
-98/298	82987S-Kraemer-CFA-Summary
-98/299	82997S-Blaney-HomeRF Liaison Report
-98/300	Bluetooth 2nd Liaison Report (S. Ellis) [note same as 7/98 LaJolla Liaison –98/253]
-98/301	83017S-McInnis-WPAN Applications Boeing

	New Numbers Added at Westford Meeting
-98/322	83226S-MAC PICS vs WPAN requirements
-98/323	83237S-802.11 Terminology related to WPAN
-98/324	FH PHY PICS review (was informally presented, will be officially presented at next meeting)
-98/325	SPARE
-98/326	SPARE

Source: Existing document list and meeting notes. Need to get soft copies of the following documents:

-98/291
-98/294
-98/296
-98/300
-98/324

3.0 Steve Shellhammer reviewed the criteria for the CFA papers for the SG. The criteria listed below should be included in any CFA to help the group categorize the application:

1. How many devices are in this personal area network (PAN)?
2. What are the types of devices in the network (e.g. PDA, bar code scanner, printer, etc.)?
3. Describe how the network is initiated.
4. How do devices attach and detach from the network. Is human intervention required?
5. Describe the traffic flow of the data.
6. Describe the type of data that flows in each branch of the network.
7. How much data is typically in each message?
8. How often are messages sent?
9. How much latency in the message transfer is acceptable?
10. Describe the network topology.
11. Is there a master node where are of the data flows into and out of, or do devices communicate peer to peer?
12. Does this PAN have to interface to a larger network (e.g. an 802.11 network)? If so, how should these two networks be connected?
13. If two PANs are in range of one another how should they interact?
14. Will there be a need to send data between two (or more) PANs? If so, how should they connect?
15. What is the type of data that would flow between two PANs? How often would they communicate?
16. How should these two PANs connect when they are within range? Should they configure themselves into one network or only communicate between master, for example?

These following criteria were added by the group during the discussion:
Range
Power requirements
Size requirement (Physical)
Physical mobility (10 mph)

14.0 PAR Discussion:

A discussion by the group ensued on whether we need to have two PARS if we determine that the WPAN requirements need to have two solutions to meet the criteria listed in the CFAs.
Vic Hayes was present and was consulted as to his opinion on this subject. Vic Hayes said the answer was yes because it may be simpler to get through the adoption process. Tim Blaney pointed out that the existing 802.11 PAR supports multiple PHYs and didn't feel the group needed two separate PARs to be successful.
Ken Clements made some points regarding his opinion that if we went after a new MAC that the 802.11 WG would not support that effort as willingly. He suggested that the SG needed to justify why the existing 802.11 MAC wouldn't work for the WPAN applications. In addition, he said that a lot of effort went into getting the 802.11 MAC to the point it is at today, and suggested there might be resistance at ExCom to change the SG into a Full WG.

14.0 CFA Review

Steve Shellhammer presented Symbol's perspective on bar code scanner & peripheral applications. A discussion ensued regarding what the19.2 kbps data rate referred to in his presentation. Is it raw? Or, delivered? For Symbol's application, it is mostly a raw data rate requirement.

Harshal Chhaya gave a presentation on an application for the classroom or education environment. Texas Instrument's application was centered on a non-PC-based network. Discussion on cost objectives for the device developed. It was centered on the cost the school pays versus what the individual would pay.
Bruce Kraemer asked about the aspect of roaming from classroom to classroom with re-association. He wanted to know how you would identify the contents of one classroom versus another. Is it manual? Automatic?
Harshal Chhaya suggested that you may type in a node address for the device, but noted that you can't expect people to type in a 48 bit ID. However, it will require some type of physical intervention.
Privacy is also an issue that needs to be addressed. The scenario presented was that a student could monitor a class from outside the classroom (i.e. could take a class without paying for it).
Steve Shellhammer asked how this device was used for education.
Harshal Chhaya responded that interactivity within the classroom is a key aspect. For example, multiple choice exams/quizzes, using the teacher's PC as a projector, letting the teacher individually monitor students from a single fixed location, record attendance automatically, would allow the teacher to distribute a common data set for analysis and gives the school direct access to the student.
Jacob Sharony asked if there was any need for interaction with outside networks?
Harshal Chhaya suggested that it could be used for WAN access around the campus or home use via a home network access point.
Ken Clements suggested that this application could be solved with existing 802.11 solutions. He said the issues are centered around cost & power consumption.
Harshal Chhaya said that TI was told by the current market place that their price goals could not be met.
Ken Clements states that there is nothing in the 802.11 specification that indicates that the power & cost requirements cannot be met.
Pat Kinney says that you need to throw money at it (i.e the turn-around times & adjacent channel requirements).
Ken Clements argues that it is because of PCMCIA implementations that the cost is high. He added that you could use the existing MAC with a different PHY to achieve the cost & power requirements, but that the solution should not interfere with the existing 802.11 installed base of devices.

Break at 3:30 p.m.

Re-adjourned at 3:50 p.m.

Dick Braley gave a presentation on the multiple devices that a FedEx courier needs to use in his daily routine. Communications between courier tools & base stations/dispatch are common scenarios. Connectivity at a customer's site with the office and connectivity with the van are necessary in a daily routine. Voice calls may be needed as well. The OBJECTIVE is to get the information into the FedEx system as close to real-time as possible because this saves the company money.
Steve Shellhammer wanted to know what information is passed to/from the courier?
Dick Braley says that it varies but is within the data rate parameter of the CFA.
Steve Shellhammer wanted to know how much time the courier is away from the truck?
Dick Braley said maybe a minute or two per residence, and up to 2 hrs at some business parks. Foot couriers can be away from the van all day. FedEx guarantees knowledge of a packet within 1/2 hour, so couriers need to hustle from site to site.

Bob O'Hara told a story about a day in the life of a WPAN (Verbal presentation). His typical application scenario was where the PAN works at home, in the car, when he gets to the office, interaction at meetings/lunch. The devices must support transient network membership. Access & startup happens when power is applied with very little user interaction. Flow of data is conceptually peer-to-peer, but it doesn't have to be implemented that way. He sees voice as a very important part of PANs. However, 802.11 does not support voice well because of the lack of QoS and the heavy CSMA/CA architecture. He doesn't see the need for PANs to merge, but the transient aspect is important. The question of how you keep the Pans separate was raised, and he suggested that most capabilities of the PAN are performed at a higher

network/application level than the MAC.

Bob Heile asked if the SG should present a summary of the CFA's to the Full WG tomorrow?
Mike McInnis suggested we pick a packet structure.
Dick Braley suggested that it may be too low in the details at this point in time.
Bob Heile wants to do a summary of the MAC discussion the SG had in La Jolla.
Tim Blaney suggested that we could ask for a time slot later in the week to do this.
Dick Braley wants to see the HomeRF & BT presentations drive the requirements portion of the discussion.

Bruce Kraemer then presented a CFA spreadsheet comparing WPAN, 802.11, Bluetooth and HomeRF parameters at the MAC layer. This could be used as a guide to help the WPAN SG define its set of requirements. We need to do this in order to show why the 802.11 MAC can or cannot be used for the WPAN applications.
Steve Shellhammer suggested that we need to assign a priority to each of the spreadsheet's line items.

Tim Blaney then gave the SG his 3rd liaison report from the HomeRF SIG.

The group then set the agenda for the Full WG review the following morning:
1) Presentations from Bluetooth & HomeRF liaisons
2) CFA summaries
3) Discussion of CFA spreadsheet

The group adjourned at 6:05 p.m.

14.0 Full WG CFA and Liaison Review

Tuesday September 15, 1998 at 8:30 a.m.
The meeting was called to order with 55 people present.
Dick Braley addressed the Full WG with some comments regarding the agenda and order of presentations.

Order of CFA & liaison presentations:
Mike McInnis spoke about Boeing's WLAN & WPAN connections to factory machinery (tools, trucks, fork lifts).
Simon Ellis asked what are the required data rates?
Mike McInnis answered that for the PCS phone it was 14.4 kbps up to 384 kbps & possibly 1 Mbps.

Dick Braley presented his applications on courier tools and their connectivity. It was a repeat of the presentation to the SG on 9/14. There are about 50-150 messages sent on the delivery cycle in the morning and a similar number on the pick-up schedule in the afternoon.

Steve Shellhammer gave Symbol's & TI's presentations because Harshal Chhaya was not present.
Simon Ellis asked why telephony was not important to the TI application? No answer was given because Harshal Chhaya was not available at the time of the question.

Tom Blackadar gave a presentation from PED on an application for medical monitoring in the armed services and the need for multiple sensors collocated in very close proximity.
Pat Kinney asked about military applications and their applicability to the standards process.

Bob O'Hara gave his verbal presentation on the Day in the Life of a PAN which was a recant of the previous day's story. The point was to establish the need for standardization in other areas than just the MAC & PHY as we know it in the 802.11 world.

Simon Ellis gave a Bluetooth liaison report. He indicated that samples are due out in 6-9 months. The SIG has two working prototypes from two different companies today, Ericsson & Nokia. He believes there is a major market opportunity for the 10 m bubble.
Pat Kinney asked what the channel switch times are? And, wondered how you can achieve 800 kbps with 220 usec switch times and a hopping rate of 1600 hops/sec.
Simon stated that the technical experts felt this was achievable.

Daniel McGlynn asked how they get to 2 Mbps?
Simon Ellis replied that it requires a 4FSK mode that is higher cost.
A member of the group asked how much of the protocol is in the radio?
Simon Ellis replied that the security & MAC functions are done within the module. Since it acts as a cable replacement, the intelligence is not offloaded to the host.
Steve Shellhammer asked if the group planned on building modules that are master modules?
Simon Ellis said that initially they were going to develop a one module fits all that is around $20.
Daniel McGlynn asked how does this relate to HomeRF?
Simon Ellis said that HomeRF is truly a networking topology with applications for extending computing around the home.
Daniel McGlynn asked how does it relate to higher level protocols like JetSend from HP?
Simon Ellis was not familiar with this particular protocol, but said it would interconnect through standard API's up to the application layer.
Naftali Chayat commented that the preamble structure disturbs him He said there is no provision for diversity or timing resolution. This will add complexity and make the product more expensive
Simon Ellis answered that a lengthy preamble discussion ensued within the SIG for about 3 months. He added that Ericsson, one of the leaders of the SIG, has been doing this design for years and knows how to do it. He said the cost is related to silicon size & pin counts.
Naftali Chayat asked if the MAC implementation could be simplified because it would not be simple to implement due to the requirements placed on it by the PHY and system architecture?
Simon Ellis responded that the chips are designed for implementation on CMOS and should be cheap.
Tom Tsoulogiannis asked about interoperability with 802.11?
Simon Ellis answered that it should coexist but doesn't have to interoperate. It would be very difficult to create a bridge device.

Tim Blaney presented the 3rd HomeRF liaison report. He discussed the possibility of a creating a bimodal AP to talk 802.11 on one side and TDMA on the other for WPAN applications. He noted that to date, most of the WPAN presentations were TDMA-based for power saving capabilities. He pointed out that SWAP has four modes of operation that can be used to support a wide range of applications. He discussed the possibility of using SWAP Lite as a solution. He said that it differs by a PA only for cost & current consumption. This gives lower range & lower power solutions, with a lower cost due to the reduced chip architecture.
A member asked if there was any SWAP Lite commonality for WPAN or Bluetooth?
Tim Blaney said there was dialog underway but time lines for deployment were tight. Convergence of standards may occur later.
A member asked what the 1 & 2 Mbps data rates used?
Tim Blaney responded that they use 2 FSK & 4 FSK.
The member asked if 4 FSK was feasible?
Tim Blaney said it was deemed feasible by the HomeRF WG.

Break at 10:30 am
Reconvened at 10:45 am

Bruce Kraemer then led the Full WG in a discussion with Steve Shellhammer's help on the PHY comparison chart between 802.11, HomeRF and Bluetooth. Steve Shellhammer pointed out that there are a lot of commonalties in the PHY implementations. But the MACs differ drastically between HomeRF & Bluetooth.

Bruce Kraemer then briefed the Full WG on the spreadsheet of the WPAN MAC requirements as compared to the HomeRF, Bluetooth and 802.11 MACs. He informed the Full WG that this Wireless Communications Protocol Comparison document would be the guideline for the WPAN SG to determine what technical direction they should take on the PHY & MAC implementations. The SG is soliciting the WG for inputs to help them fill out the spreadsheet comparison.

Bruce Kraemer then recapped the discussion that took place in La Jolla regarding the applicability of the 802.11 MAC to WPAN requirements. The onus is on the SG to show the WG why we can't use the existing 802.11 MAC. The commentary on the MAC focused on what could be trashed/removed, what could be extended and what could be added/changed. The discussion was a sfollows:

What option set of the 802.11 MAC would be appropriate for WPAN?

Keep:

- Single BSS
- Peer-to-peer data frame type
- IBSS Beacon/join

Extend:

- Add a new power management protocol

Trash or Optional:

- MIB
- PCF
- RTS/CTS
- Fragmentation
- NAV
- WEP
- Association/authentication
- TIM/DTIM
- Multiple rates
- ESSID
- To DS / from DS
- Wireless DS

A member of the group commented that a master/slave implementation is the lowest power management arrangement. In the remove list, the SG suggests removing the PCF/AP, which makes it a pure CSMA architecture, and this seems counter intuitive and doesn't follow the MAC directions
Tom Tsoulogiannis asked if we should keep an AP in the system? He said that is the question that seems to be confusing everyone. He said that in 802.11, an AP needs to be on all of the time, so it cannot power save. However, it contains the information for the various power saving modes. It controls association & authentication. The PCF adds a lot of complexity to any application. For WPAN he feels that it can be removed.
Tim Godfrey asked if it is possible to have a PCF function but not have a fixed AP. The PCF function could migrate to the available unit with the most available power or battery capacity. An AP & the PCF are not necessarily the same, except in 802.11.
Anil Sanwalka said he sees two contrary requirements 1) very strong power savings vs. 2) simple complexity. Upon activation, he suggests that a node is selected as the AP. He does not believe Ad-hoc will give the best power savings mode.
A member of the group asked if an AP adds cost to everybody in the network?
Anil Sanwalka said that rather than having a PCF that would migrate to the most battery capable unit. He believes the function should be user selectable.
Tom Tsouligiannis suggests there could be different classes of devices, with some being AP only.

A member of the group asked if WPAN would be offering a different QoS? An example would be video (TI).
Bruce Kraemer stated that the SG was told that QoS was talked about in 802.11 and thrown out. So, it may not be something that WPAN wants to tackle at this time. WPAN has not officially stated that we need a QoS function.

Chandos Rypinski spoke about the tradeoff between simplicity in the user station and the complexity of the infrastructure required to implement this. He stated that he has been arguing this for years in the 802.11 committee. It isn't QoS that we want, but rather a reservation for video. He suggests that we consider the U-NII bands & the 5 GHz spectrum. We should bring the case to another 802 medium. The PHY becomes a detail after the MAC and we should consider a new MAC because the 802.11 MAC will not work. You cannot get the simplified user station with the 802.11 MAC. For example: WPAN vs existing 802.11: The receiver is always on and assumes that it can hear everyone. To save battery you may want to remove this requirement.
Greg Ennis suggests that 802.11 power management mode will handle this function.
Tom Tsouligiannis states that QoS & Isochronous services have been in and out of the standard for years.

He feels adding this feature would require different extensions to the MAC.
Bruce Kraemer wants to know why Chandos associates the 5 GHz band and the QoS functions?
Chandos Rypinski states that spectrum at 5 GHz gives more BW (i.e. compressed video). In the long term, he is concerned with overlapping coverage and insists this will become a big problem between WPAN & WLAN. However, at 5 GHz, you will be able to contain your coverage with small antennas. He states that 5 GHz solutions will become commercially feasible and we shouldn't ignore them as an option.

Steve Shellhammer pointed out that there appears to be a number of competing solutions, Bluetooth & HomeRF, so he wants to know what the 802.11 MAC experts think about the feasibility of WPAN being met by a subset of the existing 802.11 MAC?
Straw Pole: about 6-7 people think it can be done, 1 doesn't think it can be done. Most didn't vote.
Pat Kinney states that it isn't a question of can it be done, but how efficiently & quickly can it be done. His company believes that expediency is key.
Ken Clements doesn't think that the 802.11 MAC is broken. He believes that it can be improved. He feels that Bluetooth & HomeRF work just fine for WPAN. He feels that the 802.11 cost curve will come down. He feels that Bluetooth & HomeRF will drop as well and may always be cheaper, but he feels that the gap with 802.11 will narrow, and that Bluetooth & HomeRF will not be able to expand to higher performance solutions as well as 802.11 can today. Bottom line is that he feels that it is a design issue and not a standards issue.

Bruce Kraemer asked how many people feel that the HomeRF protocol will work?
Straw Pole: (1)
Bruce Kraemer asked how many feel that Bluetooth will work?
Straw Pole: (3)
Pat Kinney feels that we do not have enough data at this time to answer that question.

Mike McInnis asked if it was possible to add a second MAC to the 802.11 Standard?
Vic Hayes said that 802.11 is currently implemented with multiple PHYs and a single MAC. We should stay consistent with this approach.
Bob O'Hara suggests that it would turn the existing model of 802.11 on its head.
A discussion about the fact that other 802 committees have multiple MACs ensued between members of the Full WG.
Chandos Rypinski gave the group a multiple MACs history lesson. He felt that we shouldn't bind ourselves by what exists today or by how we have done it in the past.
Vic Hayes said that they tried in 802.4 to make a PHY work over an existing MAC. When they realized it couldn't be done, they decided they needed a special MAC to work over the PHY. The MAC needs to be tuned to the wireless medium.
Mike McInnis feels this limits the applicability of technologies such as LMDS over the existing MAC.
Vic Hayes informed the group that at the next plenary in Albuquerque there will be a presentation from an MMDS company.

Bob Heile wrapped up the discussion with a statement of the WPAN SG goal of having our PAR ready by the Albuquerque meeting. In addition, he asked the WG for those that are MAC experts to help us understand the spreadsheet and trade-offs as the SG moves forward. There were no immediate volunteers.

Adjourned at 12:00 p.m.

14.0 SG reconvened at 1:15 p.m. in the Emerson Room to review the Bluetooth SIG with Simon Ellis and to discuss applicability to WPAN

Steve Shellhammer asks how we can adopt a standard, such as Bluetooth, and move forward with developing the standard?
Tim Blaney states that this action would potentially put us out of the 802.11 WG.
Mike McInnis states that it appears that Bluetooth is more in line with the WPAN direction. He doesn't feel that there are any companies developing HomeRF solutions for PCS phones.

Motion: To adopt Bluetooth as the WPAN standard. Steve Shellhammer/No second. The motion was non-existent.

Dick Braley asked the group to discuss openly with Simon Ellis what can Bluetooth bring to the WPAN standardization process to see if there can be convergence.

Mike McInnis asked if Bluetooth would be open to being adopted by IEEE?
Simon Ellis said that the launch schedule is driving the SIG. However, they may be open to feature enhancements as long as it doesn't impact the schedule.
Mike McInnis asked if the SIG would let IEEE critique the specification?
Simon Ellis stated that since membership is covered by an NDA, he needs to figure out how to open the IP pool to the IEEE standards body.
Jon Rasmussen asked if you join Bluetooth, can you leave if it doesn't do what you want?
Simon Ellis said that the agreement is in place to cover the IP and make a commitment not to disclose it publicly. The reciprocal IP that is written into the specification says that by signing the contract, you are giving that up to the group. The naming and branding is important for interoperability testing. An early adopter agreement gives you a 4 week period under which you can exit the program. If you contribute IP during that time, then it belongs to the group.
Rudiger Rabe said that the applications that were presented show connecting to a LAN or WAN. If we end up with a third standard, then IS departments will have to come up with solutions that cover all three technologies.
Simon Ellis said the market will decide on what it uses. Need commitment to build it in. Solution to getting to the Internet is that they are the wire replacement.
Tim Blaney said that HomeRF has a bimodal solution to talk CSMA & TDMA. It uses the IP of 802.11 & DECT rather than recreating a new protocol. Options utilizing SWAP-Lite could address the WPAN requirements quite well and coexist with existing 802.11 solutions.
Steve Shellhammer said you could make a dual mode SWAP radio easier than a dual mode Bluetooth radio.
Jon Rasmussen said that you do not want a common PHY because it will make it difficult.
Mike McInnis said the basic radio functions are the same.
Anil Sanwalka said that the power outputs are different between HomeRF and Bluetooth.
Simon Ellis restated that the Bluetooth strategy is coexistence with other networks.
Anil Sanwalka wanted clarification of coexistence of WPAN within an 802.11 network.
Tom Blackadar observed that it appears that HomeRF and Bluetooth are looking at solving different applications as cable replacements.
A discussion ensued on how to make HomeRF a WPAN, it seems that it is not geared to that.
Tim Blaney discussed how this can happen. (Missed most of this follow-up discussion)
Simon Ellis asked rhetorically how do we get a mechanism in place to review the Bluetooth & HomeRF specifications.
Pat Kinney asked how the SG can make changes to either HomeRF or Bluetooth?
Simon Ellis said that changes may get into the 0.8 & 0.9 specification in the mid-January time frame.
Bruce Kraemer stated that some of the WPAN requirements may be trivial & some may be impossible, and wanted to know how we can open this discussion up into a forum?
Dick Braley asked if it is reasonable to assume that Bluetooth will listen to changes?
Simon Ellis said it is unlikely that changes will be listened to because that process has already happened within the SIG.
Jim Zyren asked if the specification can be opened up to the IEEE? And if so, how is IP handled relative to the IEEE?
Dan McGlynn asked how much is in silicon?
Simon Ellis said some of the baseband functionality is in silicon.
Bruce Kraemer asked if this should be an implementation issue, not a standards issue. WPAN would also need to show why we need the changes we do. (Refers to Jim Zyren's question).
Tim Blaney said that IP needs to be disclosed at time of presentation with fair & reasonable licensing policies given to all parties.
Simon Ellis asked the group how the IP is protected that is in the public domain. Patents don't necessarily cover it.
Pat Kinney said full disclosure would be the best. Speed is the issue in deployment of these systems.
Jerry O'Brien suggested that the SIG schedule the IEEE to review a rev 2 of the specification.
Simon Ellis agreed this may be a better route to take. No formal plan beyond rev. 1 has been established by the SIG.
Pat Kinney asked if it is important for the SIGs to have IEEE approval?
Simon Ellis said it hasn't been a priority, however, there are benefits. Maintenance of program, insuring

interoperability/coexistence are a few. The benefit to IEEE is to have a standard quicker.
Tim Blaney said the HomeRF WG is motivated to expanding its support. Originally, they didn't want to be slowed down by a standards body. However, now that the specification is far enough along, the WPAN SG could standardize the SWAP-Lite portion.
Harshal Chhaya asked if there is a fee to join HomeRF?
Simon Ellis said that HomeRF is self-funding, whereas, Bluetooth is funded by certain companies business units with a business objective in mind. He asked how many people in the room are Bluetooth members. At the time of the question, the majority of the room responded affirmatively.
Dick Braley stated that neither Bluetooth nor HomeRF are 802.11, so we need to solicit ExCom if we decide to adopt either one. One option if for Bluetooth and HomeRF to make submissions to 802.11 and ask that it be adopted unchanged.
Simon Ellis: Assuming you approve the technology, how does it get approved through 802.11 or 802?
Dick Braley states that he is very clear on where Bluetooth and HomeRF fit into the 802.11 picture. His main objective is to find out what this group wants to do moving forward.
Chandos Rypinski said that the SG needs to have an organized constituency with a goal in mind to have a successful PAR. The next requirement is to show that the work you want to do is not duplicated anywhere. Chandos feels we have met these requirements. The advantage of being under 802 is that you will always be Layer 2 compatible. The SG can take this work directly to ExCom. It can also go directly to the IEEE standards boards (1394, FDDI are examples).

- 802 restrictions like 1 -100 Mbps need to be addressed
- Below 1 Mbps it is EIA and above 100 Mbps it is ANSI

Simon Ellis said he will figure out if there is a mechanism for our SG to review the specification.
Bruce Kraemer stated that the HomeRF WG has held open forums to a broad audience. Their next meeting is on September 22, 1998 in Portland, OR.
Jerry O'Brien asked if the SG could review the Bluetooth specification initially and then form an 802.X group based on the outcome?
Bob O'Hara said that we need to have a decision on the direction of WPAN by Albuquerque so that we know whether we are an 802.11 SG or an 802.x group.

Break at 2:35 p.m.
Reconvened 3:00 p.m.

A straw pole was taken to determine how many people present were either Bluetooth and/or HomeRF members:

8 BT members present

Bruce Kraemer, Harris Semiconductor
Jerry O'Brien, Silicon Systems Ltd
John Priestly, Symbionics
Harshal Chhaya, TI
Bob O'Hara, Informed Technology
Jacob Sharony, Daniel McGlynn & Steve Shellhammer, Symbol Technologies
Tim Blaney, Commcepts

7 HomeRF members present

Same people as above except Bob O'Hara

Tim Blaney asked how many members were planning on attending the HomeRF developer's conference next week in Portland. None.

14.0 Dick Braley suggests the SG may want to adjourn for the afternoon to prepare for the MAC & PHY PICS review meeting tomorrow.

14.0 Motion: Adjourn Tim Blaney/Bruce Kraemer (unanimous)

14.0 Tim Blaney brought the meeting back to order on Wednesday September 16, 1998 at 8:45a.m. There were 15 people present and the group began reviewing the MAC & FH PHY PICS (See

documents -98/322, -98/323, -98/324).

Tim Blaney and Bob O'Hara led the group in a review of documents -98/322 & -98/323. This was a highly interactive session where the PICS document was reviewed line item by line item for applicability to the WPAN requirements. The effort was done for an AP and then repeated for a stand alone station. During this discussion Bob O'Hara and Tim Blaney suggested ways to change the existing 802.11 MAC to meet the WPAN requirements.
Bruce Kraemer wanted clarification on the comparison of a master-slave relationship (a control relationship) with an AP-based network.
Mike McInnis asked does an AP place timing on any other station in the network?
Bob O'Hara said it must provide the sync clock. All stations are independent, but the AP controls the traffic flow. The AP provides a strong central control point to the network. In our approach, the AP will not use the CFP (Contention Free Period) for transfer of data, and the individual stations will use the CP (Contention Period) for data transfer.
Bruce Kraemer wants to know the length of the CFP?
Bob O'Hara said there are 2 bytes of time allocated in 1024 usecs. Which would allow for a duty cycle as low as 0.01%. The exchange between any two stations will get priority based on data packet size.
Larry Ochs asked if all stations stay awake?
Bob O'Hara said that independent stations can decide when to wake up based on their beacon intervals. For this implementation, the AP may require some additional memory for packet buffering.
Greg Ennis suggests that you could get convergence with other TDM access. He could envision TDM activity during the shut-down period.
Steve Shellhammer states that the AP can only sleep during periods between the beacons. He also asked what would happen if there were collisions between two nodes contending for the back-up AP role?
Bob O'Hara suggests setting a priority level for back-up.
Pat Kinney asks if someone migrates out of range will he start beaconing?
Bob O'Hara said no. It will only start beaconing if it is an AP.
Pat Kinney says that if it comes back into the original WPAN, then there will be 2 AP's and possible collisions may occur?
Bob O'Hara says this could happen, but can be addressed.
Bruce Kraemer asked if the WPAN can establish an authorized list of users?
Bob O'Hara suggests that this function be performed at a higher layer.
Greg Ennis reminds the group that a WPAN MAC is not a WPAN system.
Dan McGlynn asked why 802.11 chose RC4 instead of Blowfish for encryption?
Bob O'Hara said that at the selection time, 4 years ago, RC4 was already exportable

The group points out that PC2.3 in the MAC PICS is the first line item that makes the WPAN implementation not compliant with 802.11

Bruce Kraemer views the NAV as a control signal that tells stations not to turn on. It sets a clock that says you cannot do anything until your clock expires.
Greg Ennis says the NAV function improves the chance of getting something through, but doesn't guarantee it.
Bruce Kraemer suggests that a conclusion slide be created that summarizes our thoughts on changing the 802.11 MAC for WPAN. Tim Blaney will redo the slide before submission.

Second point, removal of the RTS/CTS function makes the implementation non 802.11 compliant.

Tim Blaney suggests that the PCF is the master-slave portion of 802.11 and says it can be removed.
Bob O'Hara gave the group a quick tutorial on the IFS (Inter Frame Spacing) functions in the MAC.
Steve Shellhammer asks why SWAP didn't use the SIF?
Tim Blaney said they didn't feel that it met the QoS the same as DECT did.
Jacob Sharony wants more of a support for real-time voice , and wonders id centralized sleeping can support this?
Bob O'Hara says you can put the PCF in if you want more QoS for voice.
Greg Ennis reminds the group of the OH penalty with just seizing the medium. If you fragment at a higher layer, then you will pay a bigger penalty.
Steve Shellhammer states that a sequence of packets can be sent once the medium is seized.
Dan McGlynn states that Bluetooth does not have fragmentation, and that it is done at a higher layer.

Jon Rasmussen says that most packet lengths will be small for WPAN applications.

Break at 10:05 a.m.
Reconvened at 10:20 a.m.

Discussion continued where it left off.

Jacob Sharony states that a WPAN may have a highly dense network, and that 10 Mbps networks may be difficult to realize. The SG may want to consider subrates, such as 500 kbps, as well.
Bruce Kraemer says that if you have a group of radios, does the function of synchronization happen within the network? Is the intelligence in the network?
A discussion ensued on how to transfer this function and different usage scenarios were given (i.e. a shopping mall parking lot).

Our suggestion of re-defining the MIB would also make it non 802.11 compliant

Mike McInnis asks if this approach can allow a WPAN device to converse with existing 802.11 stations or APs?
Tim Blaney says in general, yes, but if it communicates with a transmitted RTS first, then it wouldn't
Ken Clements asks if there is a higher layer in 802.11 to determine whether it is an RTS capable device?
Bob O'Hara says there is. It could query the MIB of a device, but it could use RTS to do this and it still wouldn't work.
Jon Rasmussen asked about Simon Black mentioning the ESS ID and Wireless DS.
Bob O'Hara suggests that we don't want to use either of these. The ESS ID function groups a number of BSS, and the peripheral only needs to know which BSS to address. To/From DS should be continued and reviewed for WPAN.
Bruce Kraemer asked the authors to prepare a summary set as it relates to 802.11. For example, a scenario might be a PAN passing through an 802.11 WLAN.
Scenario 1: He wants to be sure we have peaceful coexistence.
A FH PHY may land on the same WPAN channel. The AP's would be able to hear each other. Normal contention rules will take place and have peaceful coexistence during the time they share the same spectrum.
Bob O'Hara suggests that normal addressing is sufficient to address that scenario.
Scenario 2 (cont.): Desired Communication
An individual PAN station would be fully capable of communication and association with an 802.11 BSS, as long as it didn't have to respond to an RTS. In the case of a whole network of PAN devices, each device could associate, or the AP could act as the AP for the WPAN and as a gateway to the 802.11 network (Bimodal).
Mike McInnis asks if enough has been pulled out of the MAC to satisfy the cost and power of the PAN
This is the work the SG group needs to concentrate on next. TBD.

Harshal Chhaya then presented the overview of the CFA summary [-98/298] to the group. The group modified the submission in real-time.
Bruce Kraemer asked why "No" appeared in the Inter PAN connectivity column?
Jon Rasmussen stated that for an 802.11 device, you have to tell it to join a different network. It doesn't need to connect.
Tim Blaney suggests that the column "Power" has a discrepancy in that it is what a PAN wants versus what the available SIGs are capable of doing.
Jon Rasmussen suggests pedestrian speeds are about 2-3 mph.
Tim Blaney suggests that the speed column be consistent.

Break for lunch & Full WG at 12:00 p.m.

13.0 Reconvened after Full WG at 4:30 p.m. with 11 people present to discuss our PAR strategy and Future meetings

Bob Heile said that after discussing with Vic Hayes our timelines for a PAR, he suggested that we may want to resubmit the PAR in its current fashion.
Jon Rasmussen inquired whether this was a stall tactic?

Bob O'Hara suggests that we go on an extended schedule, but we should consider the chance of getting cancelled.
Bob Heile says that since the SG only got approved in March '98, this likelihood is low.
Mike McInnis suggests that we go above 802.11 to a full ExCom 802.x group.
Bob Heile would rather have the WG tell us one way or another that their MAC won't work and tell us to go to ExCom directly.
Bruce Kraemer suggests putting the modified PICS to the WG before we decide on this strategy.
Bob O'Hara suggests that we determine whether we intend to use 802.11 or not before we put it to the WG
Pat Kinney wants a chance to review the PICS modifications before sending it upward.
Bruce Kraemer can't compare HomeRF & Bluetooth relative to the PICS and submit as a comparison. He suggests that Bluetooth is about 2x in terms of state machine complexity over 802.11. What does this mean?
Jim Zyren agrees with a 2x in terms of HomeRF as well.
Bob O'Hara says that adding PCF to 802.11 makes it similar to HomeRF with CSMA & TDMA.
Jon Rasmussen doesn't want to make this a SG statement because we haven't reviewed it as a group.
Jim Zyren says you need two radios side by side for a comparison, otherwise you can't compare it on cost.
Jon Rasmussen believes the cost is the a big issue.
Greg Ennis asks if the complexity of the MAC is what's at stake?
Jon Rasmussen says his company built a PAN and they say the complexity of the MAC was a big problem in getting the cost down.
Bruce Kraemer restates that the SG has asked the Bluetooth & HomeRF committees to supply the specifications for the SG to compare as a whole, and we should base our opinions on that information.
Bob Heile makes an observation that we are not ready for a PAR. As a SG we still have work to do. We need to compare & contrast the points that are compliant & non-compliant with 802.11.
Jon Rasmussen wants to know if the SIGs will supply a comparison of the PICS from Bluetooth & HomeRF?
Tim Blaney suggests that it will be difficult to get this information.
Jon Rasmussen states that all we need to do is get the PAR to move forward.
Bob Heile says we need to get a decision on whether we are part of the WG of 802.11, or different enough that we warrant our own WG status. We need to determine the suitability of the 802.11 MAC. Focus on the logical differences and focus on getting the plenary approval.
Bruce Kraemer states that the motion to forward the PAR must be approved by the Plenary before it can be sent higher. One approach would be to present a plan of action to move the PAR forward. Get the plenary to tell us what they want in order to get approval of the PAR in January.
Bob Heile agrees with this approach.
Ken Clements asks if anyone has suggested a 900 MHz PHY?
Jon Rasmussen says the goal is international, so that is restrictive.
Pat Kinney says that 2.4 GHz is the only consistent band worldwide.
Ken Clements suggests this could be a lower cost & lower power solution.
Bruce Kraemer suggests the possibility of modifying the 802.11 MAC should proceed in parallel. We shouldn't bind ourselves by that restriction.
Greg Ennis asks if the Bluetooth or HomeRF specification is suitable for WPAN? What skeletons do they have in their closet? Suggests we are being asked to accept something as suitable without all of the knowledge

13.0 Plan for Albuquerque

Westford Actions
- Distribute the MAC PICS analysis to the 802.11 WG
- Start a similar analysis of the FH PICS (Ken)
    - Potentially consider a new class of devices
- Get the WG to approve our plan of action for the November Plenary

Work to be accomplished prior to the November Plenary
- Need to identify the key points from this analysis that show the places within the MAC that forces difficulties for WPANs
    - Recommend that we:
        - Revise the existing MAC, or…
        - Create a new MAC

Albuquerque Actions

- Present this analysis to the 802.11 WG
- Agree on the direction of the WPAN SG
    - Either a TG within 802.11, or
    - A WG within 802
- Submit our modified PAR for approval by the 802.11 Plenary and to forward to ExCom for March approval

13.0 Adjourned at 5:50 p.m.

14.0 The Study Group was brought back to order on Thursday September 17, 1998 at 9:05 a.m. with 11 people present to discuss the next steps and review the FH PHY PICS [-98/324].

Bruce Kraemer reviewed the Summary of CFAs with the group. Document 8/298 was edited by the group for correctness prior to official submission.

Bob O'Hara and Tim Blaney recapped a discussion that they had with Vic Hayes the previous evening. Vic had inquired about the status of our PAR. He was concerned that we would not have the new PAR 30 days prior to the November mtg. Bob/Tim informed Vic that it was not important to have the PAR approved by the next Plenary, but rather by the March Plenary. Vic felt that this approach would be fine and continuation of the SG would be no problem as long as we were showing progress.
Bruce Kraemer wants to know if we can submit an improved PAR for vote in November?
Bob O'Hara said it won't get voted on or approved unless it is ready for ExCom by Oct 3rd.
Bruce Kraemer asked if the PAR was withdrawn?
Bob Heile said that the only place the PAR has gone is 802.11. ExCom hasn't seen it yet because it was rejected by the 802.11 WG.
Bruce Kraemer suggests two approaches: 1) substantial edits, 2) submit original with an addendum to be ready by November.
Ken Clements asks if there is a plan to give 802.11 an update this week?
Yes.
Mike McInnis asks how long it takes to make a decision on the PAR?
Immediate.
Bob Heile believes we could have an answer as early as Monday during the Plenary. Once that is approved, then it is forwarded to 802 for approval. This is typically a rubber-stamp process.
Mike McInnis is concerned that we may do all of this work and still not get approved. To have two groups working on wireless under the 802 umbrella could be a challenge.
Bruce Kraemer reminded everyone that the infrastructure under 802.11 is already in place and we should take advantage of it.
Mike McInnis would like ExCom to encourage 802.11 to support the SG efforts.

Tim Blaney suggests that the group review the FH PICS. This was edited with no notes taken and will be submitted as an official document at the next meeting.

Ken Clemets suggests that we list the degree of difficulty when evaluating the PICS:

1) Do nothing - let the manufacturer figure out how to reduce cost
2) Recommended WPAN implementation - look at standard for things to tweak…Here is the lowest common denominator
3) Amend 802.11 - specific areas for WPAN (both MAC & PHY)
4) Create a new WPAN PHY with same or slightly amended MAC
5) Create a new WPAN MAC & PHY under 802.11
6) Become a new 802.x WG

Break 10:40 a.m.
Reconvene 11:30 a.m.

Group reviewed the MACS PICS and highlighted areas that were non-compliant with 802.11 and areas

that needed to be changed.

15.0 The Study Group adjourned at 11:50 a.m. for Full WG

16.0 Next Steps

Refer to Section 13.0 for a complete listing of the next actions.
The Study Group wishes to thank the 802.11 WG for their time, assistance and help. We look forward to participating in the Plenary in Albuquerque, NM.

Tentative meeting schedule

Date	Month	Year	Place	Type	Location	Host
26	*Oct*	*1998*	*Atlanta*	*Ad Hoc*	*Grand Hyatt Atlanta, GA*	*AMP*
8-13	Nov	1998	Albuquerque, NM	Plenary	Hyatt Regency	
11-15	Jan	1999	Orlando, FL	Interim	Grosvenor Resort, Lake Buena Vista	Harris
8-12	March	1999	Austin, TX	Plenary	Hyatt Regency, Town Lake	
5-9	July	1999	Montreal, PQ	Plenary	Queen Elisabeth Hotel	
8-12	Nov	1999	Koloa, HI	Plenary	Hyatt Regency Kauai	

Note: The October 26th, 1998 Ad Hoc Meeting Venue & Agenda will be sent to the IEEE WPAN Majordomo reflector before the 30 day rule imposed by IEEE; however this is not to be considered an IEEE official meeting.