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## **Minutes of the Conference Call**

### **Date**

The 13<sup>th</sup> conference call was held on April 5, 2005, at 8 PM EST.

### **Participants**

- 1 Gary Baldwin
- 2 Bruce Bosco
- 3 Chia-Chin Chong
- 4 Shahriar Emami
- 5 Abbie Mathew
- 6 Eli Pasternak
- 7 Alireza Seyedi
- 8 Su-Khiong Yong

### **Issues Discussed**

- (1) A decision was made to move model E to the indoor environment. Refer to [APPENDIX – A](#) for details.
- (2) Eli Pasternak reviewed published papers for model D. The details can be found in [APPENDIX – B](#) on page 5. Most of the discussion centered on the compatibility and synergy between the outdoor model and the indoor one which is the focus of 802.15.3c standard. Following action items emerged from the discussion.
  - Abbie to review the CFA describing outdoor applications and determine the possible maximum distance.
  - Abbie to talk to James Gilb and determine the effects of distance on the 802.15.3 MAC efficiency.

Shahriar's March 28<sup>th</sup> presentation is in [APPENDIX – C](#) for reference.

- (3) Considerable time was spent discussing the need to include an antenna in the channel model. [APPENDIX – D](#) contains email exchanged to date. This will be posted on the Reflector for comments. Those of you who do not have access to the reflector, please email your comments to Abbie.

As the conference call exceeded an hour, it had to be concluded. Incomplete action items will be discussed at the next conference call.

### **Action Items**

- (1) Review action items from March 28<sup>th</sup>.
- (2) Review action items from paragraphs 1 and 2 above.

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(3) Initiate discussions on capturing S-V parameters for the environment in [APPENDIX – A](#).

L	Number of clusters
$\Lambda$	Inter cluster arrival rate
$\lambda$	Ray arrival rate
$\Gamma$	Inter cluster decay factor
$\gamma$	Ray decay factor

(4) If time permits, lay out a structure for the materials we must present in Cairns.

### **Next Conference Calls**

The next meeting will be on April 12, 2005, Tuesday, at the times listed below. The dial-in number is (641) 497-7100 and the access code is 657719#.

Eastern Standard Time	8.00 PM, April 12 - Tuesday
Mountain Time	5.00 PM, April 12 - Tuesday
Pacific Time	5.00 PM, April 12 - Tuesday
Japan/South Korea time	9.00 AM, April 13 - Wednesday

**APPENDIX- A**

Environment			Comments	Reviewers
Indoor	Enterprise	Convention center	A	<ul style="list-style-type: none"> <li>▪ Chia-Chin Chong</li> <li>▪ Shahriar Emami</li> <li>▪ Abbie Mathew</li> </ul>
		Open office		
		Warehouse		
	Residential	Intra closed office	B	
		Intra closed room		
	Enterprise	Inter closed office	C	
	Residential	Inter closed room		
Enterprise	Train - platform link	?	Decision was made on March 28, 2005, to move this environment (model D, outdoor) to the indoor. As the distance is less than 3m (assuming this), the multipath effects are similar to that in an indoor environment.	
Outdoor	Enterprise	Campus	D	<ul style="list-style-type: none"> <li>▪ Sean Cahill</li> <li>▪ Eli Pasternal</li> <li>▪ Su-Khiong Yong</li> </ul>
		Stadium		
	Residential	Home-to-home		
		Utility pole-to-home		
		MDU <sup>1</sup> vertical link		

<sup>1</sup> Multiple dwelling unit

**APPENDIX – B**

April 5, 2005 Environment D

## Draft D Channel Model

- Operating Environment
- Published Papers
- Conclusions

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April 5, 2005 Environment D

## Operating Environment

Environment			Model
Indoor	Enterprise	Convention center	A
		Open office	
		Warehouse	
	Residential	Intra closed office	B
		Intra closed room	
		Inter closed office	
Residential	Inter closed room	C	
	Inter closed room		
Outdoor	Enterprise	Campus, metro	D
		Stadium	
	Residential	Home-to-home	
		Utility pole-to-home	
		MDU vertical link	
	Mobile	Vehicle-to-vehicle	
Vehicle-to-fixed station			

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Environment D

## Published Paper: Schäfer

- Schäfer-Lutz IEEE 1990
- Model for outdoor LOS distance >100m
- Free-space attenuation+ Oxygen absorption (15dB/km) + rain attenuation (17dB/km typ. 0.01% of time)
- Includes 1 multipath reflection in point to multipoint transmission
- Reflection and other multipath modeled with Rician Density
- Applicable for close to ground (or wall) antennas

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Environment D

## Published Paper: Kremer

- Kremer\_Hubner\_Hoff\_Benz\_Schafer\_IEEEApr1993
- Simulated model for outdoor 5 GHz and 60 GHz
- Rayleigh fading model
- Model developed for vehicle com
- Also uses free-space attenuation ( $r^{-2}$  law).

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Environment D

## Published papers: CRABS

- CRAB D3P1B 1999: “Propagation Planning Procedure For LMDS”
- Reports multipath delay variation in campus area-PMP transmission
- RMS delay is very small –corresponds to 0.01ns
- Similar results reported in the Broadway papers.

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Environment D

## Conclusions

- The published papers describe models and tests for narrow band 60 GHz channel
- For PMP applications, a two-cluster model is needed. The second cluster is reflections from ground.
- For PTP applications distance >100m and with directional antennas, the model is free-space, single ray model with oxygen and rain attenuation.
- S\_V model can be parameterized to cover all reported results

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**APPENDIX – C**

**Channel Model for Environments A,B, C**

Shahriar Emami, Freescale  
Abbie Mathew, NewLANS

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Environments A, B, C

**Environments**

- **A: Convention center, ware house**
- **B: Residential**
- **C: Office**

2

Environments A, B, C

## Published Work-1

### **Samsung SAIT: Analysis of 60 GHz Band Indoor Wireless Channels with Channel Configurations**

- Room size: ~12m x 9m with 4 windows on one side
- Walls made of brick/stone and concrete floor
- Partitions, desk, PCs (typical of office environment)
- $R_b = 200$  MHz
- S-V model was fitted to the measurement
- Model tested against measurements to generate BER curves
- Modeling quite successful

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Environments A, B, C

## Published Work-2

### **MEDIAN: MEDIAN 60 GHz wideband indoor radio channel measurements and model**

- Library 13m x 5m with concrete walls
- Windows on one side of room
- Metal bookshelves filled w/ books (height 2m - length 2.5 to 5m)
- Tables and chairs
- Bandwidth 960 MHz
- Single cluster S-V model
- Covers LOS and almost LOS conditions

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Environments A, B, C

## Published Work-3

- **Compound statistical model for 60 GHz channel**  
proposes a variation of S-V model where amplitude are K-law distributed (instead of Rayleigh)
- **A Statistical Model for the MM-Wave Indoor Radio Channel**  
proposes a single cluster S-V
- **Wireless broadband Multimedia communications in mmWaves**  
proposes a frequency domain model

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Environments A, B, C

## Summary

- S-V model and its variations are the most popular model for indoor applications in 60 GHz
- Published results are most relevant to office environment
- LOS is the focus of the published work

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Environments A, B, C

## Issues

- NLOS parameters for environment C have not been reported in literature (attenuate LOS cluster by 20 dB?)
- A and B environments are not treated in the literature
- There are a few choices for amplitude distribution

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**APPENDIX – D**

**From:** Abbie Mathew  
**Sent:** Wednesday, March 30, 2005 4:46 PM  
**To:** Emami Shahriar; Su-Khiong Yong  
**Subject:** RE: AOA

Gentlemen,

I talked to an acquaintance involved in the .11n. They have considered the antenna in the channel model because MIMO is the heart and soul of .11n. As I recollect, 'directional antenna' found its way into the PAR to show that we are not limited to omni-directional antenna. Note that 802.15.3 MAC supports omni-directional antenna. This is why I am on the fence. I agree with you that more investigation is required. I will bring this up at the next conference call.

-Abbie-

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**From:** Emami Shahriar  
**Sent:** Wednesday, March 30, 2005 12:10 PM  
**To:** Abbie Mathew; Emami Shahriar  
**Cc:** 'Su-Khiong Yong'  
**Subject:** RE: AOA

To answer the question, I think we should review the requirement and the channel modeling documents of 11.n, since they had similar if not exact same issue. I agree with Su-Khiong's suggestion to try to get input from other task group members as well.

Shahriar

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**From:** Abbie Mathew  
**Sent:** Wednesday, March 30, 2005 6:55 AM  
**To:** Shahriar Emami  
**Cc:** Su-Khiong Yong  
**Subject:** RE: AOA

Shahriar,  
Your thoughts on this?  
-Abbie-

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**From:** Su-Khiong Yong  
**Sent:** Tuesday, March 29, 2005 8:40 PM  
**To:** Abbie Mathew; Shahriar Emami  
**Subject:** Re: AOA

Hi!

Yes you are right, the antenna effects have to be separated from the channel models. Since I am a newcomer to 3c, I am not sure whether the TG3c anticipates the use of antenna arrays (Maybe we need to clarify this). If that is the case, AOA is a must. Nevertheless in the PAR, I understand that TG3c supports the use of directional antenna which will have significant difference in the delay domain compared to omni-directional counterpart. Other issues which are not part of the channel modeling work need further consideration. Perhaps, we should forward this email to other members in the group to get more inputs.

Thanks

Regards,  
Su-Khiong

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----- Original Message -----

**From:** Abbie Mathew  
**To:** Shahriar Emami ; Su-Khiong Yong  
**Sent:** Wednesday, March 30, 2005 7:14 AM  
**Subject:** AOA

Gentlemen,

Need a clarification from you.

We discussed yesterday for the need to gather information on AOA. As we are only dealing with the channel model, this assumes that the antenna effects have to be modeled separately. I understand that 802.15.3 MAC assumes omni-directional antenna. If these statements are true, should we gather information on AOA?

Thanks.

-Abbie-