3GPP TSG-RAN WG1 Meeting #98 Tdoc R1-19xxxxx

Prague, CZ, Aug 26th –30th, 2019

Agenda Item: x.x.x

Source: Ericsson

Title: Meeting report from informal F2F meeting on indoor industrial channel model

Document for: Information

# 1 Introduction

An informal F2F meeting was conducted on July 1-2 in Berlin, Germany. The purpose of this meeting was to facilitate technical discussions and consensus building among channel model experts to support the SI on Indoor Industrial channel modeling. This tdoc contains a meeting report summarizing the discussions and views that were exchanged during the meeting.

# 2 Participation

The following participants attended the meeting:

1. Ahmed Abotabl, Samsung
2. **Raschkowski, Leszek, Fraunhofer HHI**
3. **Henrik Asplund, Ericsson**
4. **Rodriguez Larrad, Ignacio, Nokia**
5. **Koshiro Kitao, DOCOMO**
6. **Prasanth Karunakaran, Fraunhofer IIS**
7. **Schmieder, Mathis, Fraunhofer HHI**
8. Keusgen, Wilhelm, Fraunhofer HHI
9. **Jaeckel, Stephan, Fraunhiofer HHI**
10. **Tommi Jamsa, Huawei**
11. **Landmann, Markus, Fraunhofer IIS**
12. **Müller, Robert, Fraunhofer IIS**
13. **Guo Bolun, Huawei**

Remote participants:

1. Piyush Gupta, Qualcomm
2. Raffaele D'Errico, CEA-LETI
3. **Jianwu Dou, ZTE**
4. **Georg Wannemacher, Deutsche Telekom**
5. **Rakesh Tamrakar, Vivo**
6. **Xiaodong Sun, Vivo**

# 3 Company input

Company input is available at <ftp://ftp.3gpp.org/Email_Discussions/RAN1/RAN1_IIChM_July19/Docs/>

# 4 Technical discussions

## 4.1 New measurements

Fraunhofer IIS presented the contribution [R1-XXXX-Single-band.docx](ftp://ftp.3gpp.org/Email_Discussions/RAN1/RAN1_IIChM_July19/Docs/R1-XXXX-Single-band.docx) containing new measurements in a high clutter density environment.

* Comments on how to take into account the very large relative bandwidth in the path loss analysis
* What percentage of floor area is covered by clutter? 3D scanner data available that can be processed
* Discussion on how this clutter density compares with some other available measurements
* Raw path loss data has been shared
* 30 GHz may be added before RAN1#98

Fraunhofer HHI presented the contribution [2019-07-01 Industrial Indoor Measurements.pptx](ftp://ftp.3gpp.org/Email_Discussions/RAN1/RAN1_IIChM_July19/Docs/2019-07-01%20Industrial%20Indoor%20Measurements.pptx) containing new measurements in high clutter density environments.

* Can share path loss data points (5500 points in total)
* Angular spread is based on specular only (100 paths)
* Question on ratio between power of specular components and dense multipath. Has been analyzed…
* Which sub-scenario? 2 and 4: high clutter density, 3 m clutter height, BS height 2-8 m
* Fraunhofer will add their LSP results (possibly split into sub-scenarios) into the email discussion summary during the day

## 4.2 Scenario description

Discussion on threshold between low and high clutter density:

* Nokia has estimated the clutter densities as above 50% for all high clutter density scenarios
* Fraunhofer IIS has calculated clutter density to 35% for a high clutter scenario
* Ask CMCC about clutter density in their low clutter scenario
* DOCOMO has estimated 29% in their scenario which is in between low and high clutter density, Huawei: DOCOMO path loss seems different compared to high density results

Outcome: High clutter density is above [35%] and low clutter density is below [35%]. Classify DOCOMO results as low clutter density

Discussion on clutter height:

* Ericsson proposes 1-10 m, Nokia proposes an open range with h\_clutter lower than ceiling height
* Nokia: open scenarios have higher ceiling height than high clutter density scenarios, suggest to couple ceiling height range with clutter density
* Nokia to compile a complete scenario description table until tomorrow when we will revisit

## 4.3 Path loss

Huawei presented a first attempt at producing merged path loss models in [IIot Path Loss measured data expressions and curves\_v1.3.xlsx](ftp://ftp.3gpp.org/Email_Discussions/RAN1/RAN1_IIChM_July19/Docs/IIot%20Path%20Loss%20measured%20data%20expressions%20and%20curves_v1.3.xlsx) based on (a sub-set of) the available raw path loss data. The following improvements were discussed:

* Classify/re-classify sub-scenario association
* Provide “all LOS” and “all NLOS” fitting (AP: Huawei)
* Include missing raw data, e.g. Huawei/CMCC/CEA-LETI/Fraunhofer (AP: Huawei)
* Include random raw data generated from contributed path loss parameters (AP: Huawei, Nokia)
  + How many data points? If not specified, check the reference if there is some information. Otherwise, handle later.
* How to apply weights to the data from different sources (low vs high number of samples in different data sets)
  + No additional weighting as a starting point. Revisit later.

Nokia: will provide random path loss data based on the v3 email discussion summary by end of Monday 1 July. Huawei has updated to v1.4 to include “all LOS” and “all NLOS”. Huawei will update the excel file with CMCC and CEA-LETI raw data by Tuesday afternoon.

Discussion on embedded devices:

* Qualcomm may do new measurements on other aspects than path loss, trying to complete before August meeting
* Wait with further discussion until August, Qualcomm encouraged to provide a complete model proposal

## 4.4 LOS probability

Discussion on LOS probability:

* Agreement from Reno:
* Two proposals: empirical or analytical as captured in ZTEs contribution [ZTE\_LOS probability.docx](ftp://ftp.3gpp.org/Email_Discussions/RAN1/RAN1_IIChM_July19/Docs/ZTE_LOS%20probability.docx).

Discussion outcome: As a starting point for calibration, use proposal 2 from ZTE:

***Proposal 2***: For analytical LOS probability model, use following formula to calculate , where r is the effective clutter density after removing the clutters no higher than UE, represents the clutter size, {,,} are the heights of clutter, base station and terminal, respectively.

* and are FFS.

Agree tentative proposals for , r, , and as part of the scenario discussion.

Discussion on LOS autocorrelation:

* Two proposals: 18/20 m or equal to
* Nokia: Related to , to make it different for different sub-scenarios
* Huawei: 18/20 m is seen as too long, perhaps use a smaller distance such as 10/20?
* Ericsson: good to have short correlation distance to get better statistical significance of simulation of a limited area
* Fraunhofer HHI: prefer single number
* Outcome of discussion: Use [10 m] for calibration

## 4.5 Fast fading modelling

Discussion on how to merge LSP proposals

* Ericsson will provide an updated plot of DS vs hall volume to include new results that were not part of the tdoc in Reno (also including HHI results that will be shared today…)
* Huawei will provide also angular spreads by today (send to Leszek)
* Return to this discussion tomorrow

Discussion on dense multipath

* The experience from Fraunhofer IIS is that up to 80-90% of indoor power is captured in the dense multipath, more dense multipath in sub-6 GHz than at mmw
* Different views on the spatial properties of the DMC, white or not?
* How to capture dense multipath? Proposals:
  1. Optional model: Consider if 38.901 sec 7.6.2 approach can be used to emulate DMC using more rays
  2. Optional model: Colored noise process to model the transfer function (of frequency and tx/rx antenna elements), using frequency correlation function and angular correlation functions. Few analysis available on the correlation properties of the DMC in f and antenna dimensions
  3. Baseline model: Change (increase) the number of clusters and rays in the baseline model
  4. Room electromagnetics for DMC (Univ of Ghent): 30% of the power in the DMC
  5. Do nothing
* Conclusion: encourage companies to analyze DMC in their measurements and if necessary propose models and parameterizations until Prague. If no such proposals, don’t do anything.

## 4.6 Additional modelling components

Presentation on additional delay modeling and measurements on Tuesday between 10.30 and 11.00.

## 4.7 Channel model calibration

* Table 7.8-2: Simulation assumptions for large scale calibration for the indoor industrial scenario

|  |  |
| --- | --- |
| Parameter | Values |
| Scenario | Indoor industrial – sub-scenarios 1-4 |
| Room size | 100x100 m |
| Room height | 10 m |
| Sectorization | None |
| BS antenna configurations | 1 element (vertically polarized), Isotropic antenna gain pattern |
| UT antenna configurations | 1 element (vertically polarized), Isotropic antenna gain pattern |
| Handover margin (for calibration) | 0dB |
| BS deployment | Rectangular grid with ISD = 20 m, FFS on exact grid and number  BS height = [1.5] m or 8 m |
| UT distribution | uniform dropping for indoor with minimum distance ([2D or 3D]) of [1] m  UT height = 1.5 m |
| UT attachment | Based on pathloss |

* Outcome of discussion: Use the following simulation assumptions for calibration of the indoor industrial scenario:
  + Use a minimum 2D dropping distance of 1 m
  + BS height is 1.5 m for the clutter-embedded scenarios
  + BS tx power: 30 dBm
  + BS deployment: in locations with x and y coordinates 10, 30, 50, 70, 90 m, i.e. 25 locations in total
  + UT noise figure: 9 dB
  + Carrier frequency: 3.5 GHz, 28 GHz
  + Bandwidth: 100 MHz
* Outcome of discussion: The following metrics are proposed for the channel model calibration:
  + 1) Coupling loss – serving cell
  + 2) Geometry with and without noise
  + 3) CDF of delay and angle spread (ASD, ZSD, ASA, ZSA) according to definition in Annex A.1 of TR 38.901
  + 4) CDF of first path excess delay for serving cell

Agree tentative proposals for , r, , and

Possibly use the following parameters for calibration (revisit on Tuesday):

|  |  |  |
| --- | --- | --- |
|  | Low clutter density | High clutter density |
| Clutter density: r | 20% | 60% |
| Clutter height: | 2 m | 6 m |
| Clutter size: | 10 m | 5 m |
|  | 1 | 1 |
|  | 0 | 0 |

# References

1. RP-182138, SID on Channel Modeling for Indoor Industrial Scenarios, Ericsson, 3GPP TSG-RAN Meeting #81, Gold Coast, Australia, September 10th – 13th 2018.
2. R1-1907920, List of agreements, Ericsson, RAN1#97, Reno, USA, May 13-17, 2019.
3. R1-1907940, Addition of indoor industrial channel model, Ericsson, RAN1#97, Reno, USA, May 13-17, 2019.
4. R1-1907405, Summary of email discussion on path loss, Ericsson, RAN1#97, Reno, USA, May 13-17, 2019.
5. R1-1907407, Summary of email discussion on fast fading, Ericsson, RAN1#97, Reno, USA, May 13-17, 2019.