Source: AH Chairman (Nokia Networks)

Title: Draft Report of 3GPP TSG RAN WG1 #AH Channel Model v0.0.6

(Ljubljana, Slovenia, 14th – 16th March 2016)

Document for: Endorsement



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**Main facts summary**

3GPP TSG RAN WG1 #AH Channel Model meeting, hosted by EF3 was held at the Hotel Lev, Ljubljana, Slovenia.

The meeting started at 9:00 on Monday 14th March 2016 and finished at 16:00 on Wednesday 16th March 2016.

AH was chaired by AH chairman (Nokia Networks)

There was no MCC support in Ljubljana

* AH chairman to allocate tdoc numbers, maintain tdoc list and provide the report

The week was scheduled as follows:

* Monday session on
  + General issues
  + Refinement of requirement, scenario, methodology and additional features
  + Large scale fading modelling for >6 GHz
* Tuesday session on
  + Fast fading modelling for >6 GHz
  + Additional features for channel modelling for >6GHz
  + Other issues
* Wednesday session on
  + 2nd round / Review of left-opened issues

The number of attending delegates, having signed the participants’ paper list, was **57.**

The number of contributions for this meeting was xxx.

RAN1 mandated this Ad hoc meeting to review and endorse any contributions related to Channel Modelling.

The decisions made during the ad-hoc will be ratified at RAN1#84bis.

LEGEND:

Noted, withdrawn or revised

Not treated

‘Return to’ during the meting

Working assumption

Agreement

# Opening of the meeting

Mr Tuomo Säynäjäkangas (AH Chairman) welcomed the participants of the RAN WG1 ad-hoc meeting related to the study item on *“Channel model for frequency spectrum above 6 GHz”* and opened the meeting at 09:00.

Chairman welcomed the delegates and detailed the domestic arrangements for the 3 days meeting, including coffee breaks and restaurants in the hotel vicinity.

He emphasized the importance of developing Channel model for frequencies >6 GHz in timely manner as it will be the basis for other next generation new radio access technology work in 3GPP.

## Call for IPR

*The attention of the members of this Technical Specification Group was drawn to the fact* ***that 3GPP Individual Members have the obligation*** *under the IPR Policies of their respective Organizational Partners to* ***inform their respective*** *Organizational Partners* ***of Essential IPRs they become aware of****.*

*The members take note that they are hereby invited:*

*- to investigate whether their organization or any other organization owns IPRs which were, or were likely to become Essential in respect of the work of 3GPP.*

*- to notify their respective Organizational Partners of all potential IPRs, e.g., for ETSI, by means of the IPR Information Statement and the Licensing declaration forms (e.g. see the ETSI IPR forms* [*http://webapp.etsi.org/Ipr/*](http://webapp.etsi.org/Ipr/)*).*

## Competition law statement

*The Chairman also drew Member’s attention to the fact that 3GPP activities are subject to antitrust and competition laws and that compliance with said laws is therefore required of any participant of this WG meeting including the Chairman and Vice Chairmen. In case of question, please contact your legal counsel.*

*The present meeting will be conducted with strict impartiality and in the interests of 3GPP.*

*Furthermore, the Chairman reminded Members that timely submission of work items/contributions in advance of WG meetings is important to allow for full and fair consideration of such matters.*

## Network usage conditions

*The PCG has laid down the following network usage conditions:*

|  |
| --- |
| **Users shall not use the network to engage in illegal activities. This includes activities such as copyright violation, hacking, espionage or any other activity that may be prohibited by local laws**.  **Users shall not engage in non-work related activities that consume excessive bandwidth** or cause significant degradation of the performance of the network.  Since the **network is a shared resource**, users should exercise some basic etiquette when using the 3GPP network at a meeting. It is understood that high bandwidth applications such as downloading large files or video streaming might be required for business purposes, but delegates should be strongly discouraged in performing these activities for personal use. Downloading a movie or doing something in an interactive environment for personal use essentially wastes bandwidth that others need to make the meeting effective. The meeting chairman should remind end users that the network is a shared resource; the more one user grabs, the less there is for another. Email and its attachments already take up significant bandwidth (certain email programs are not very bandwidth efficient). In case of need the chair can ask the delegates to restrict IT usage to things that are essential for the meeting itself.  **1. DON’T place your WiFi device in ad-hoc mode**  **2. DON’T set up a personal hotspot in the meeting room**  **3. DO try 802.11a if your WiFi device supports it**  **4. DON’T manually allocate an IP address**  **5. DON’T be a bandwidth hog by streaming video, playing online games, or downloading huge files**  **6. DON’T use packet probing software which clogs the local network (e.g., packet sniffers or port scanners)** |

# Approval of the agenda

**R1-161600 Proposed Agenda for Channel Model Ad-Hoc Meeting AH Chair (Nokia Networks)**

**Discussion:**

**Decision:** The agenda is agreed

# General

*TR approval, SI planning, white paper etc.*

***White papers***

**R1-161636 Updated White Paper on Channel Modelling for Bands up to 100 GHz NTT DOCOMO, AT&T, CMCC, Ericsson, Huawei, HiSilicon, Intel, KT Corporation, Nokia Networks, Qualcomm, Samsung**

*Proposal: Companies are encouraged to read and consider the updated white paper (version 2.0) on channel modelling for bands up to 100 GHz [3].*

**Discussion:**

Vodafone: Page 11 on measurements. Do you intend to have channel model for up to 1.24 km range?

Nokia: UMA measurements have been done PL measurements for such sizes. You can see that in the appendix.

**Decision:** The document is noted

**R1-161700 mmMAGIC white paper Fraunhofer HHI**

*Proposal: Companies are encouraged to read and consider the mmMAGIC white paper on 5G channel modeling [4].*

**Discussion:**

**Decision:** The document is noted

***Offline discussion report***

**R1-161740 Summary of offline discussion on Tuesday** **Samsung**

**Discussion:**

**Decision:** The document is return

***TR update***

**R1-161637 TP for Section 6 and some editorial changes Nokia Networks, Samsung**

*Include document status/expectation of existing information on high frequencies in section 6 based on RAN plenary email discussion outcome.*

**Discussion:**

Huawei: Section 6.2, what is the relation with this section and scenarios?

Nokia: Interested scenarios were identified by the plenary discussions. Scenarios are RAN1 agreements. This is more like a wish list.

Samsung: We can capture that in editor’s note.

Huawei: Is ETSI actually doing channel model activity at the moment?

Nokia: List is based on RAN email discussion. We are open to remove it if companies sees that necessary.

**Decision:** The document is revised in 1720

**R1-161720 TP for Section 6 and some editorial changes Nokia Networks, Samsung**

*Include document status/expectation of existing information on high frequencies in section 6 based on RAN plenary email discussion outcome.*

**Discussion:**

**Decision:** The document is return

**R1-161638 TP for sub-sections structure in section 7 Nokia Networks, Samsung**

*Setup sub-sections under section 7 following the structure from 3D channel model TR.*

**Discussion:**

Huawei: Clause 7.4, it is better to use the same term (PL modelling) as in 3D CM.

Samsung: It is not just PL, including LOS.

Huawei: This could be split into 2 parts. Large scale fading modelling is missing.

ZTE: Section 7.6. Spatial consistency may impact many other clauses too.

Nokia: 7.5 can include 2 steps. 7.6 has additional components.

**Decision:** The document is revised in 1721

**R1-161721 TP for sub-sections structure in section 7 Nokia Networks, Samsung**

*Setup sub-sections under section 7 following the structure from 3D channel model TR.*

**Discussion:**

**Decision:** The document is return

**R1-161639 TP for adding agreed scenarios in Section 7 Nokia Networks, Samsung**

*Include scenarios agreed in RAN1#84 in section 7.1*

**Discussion:**

**Decision:** The document is agreed

**R1-161672 Text proposal to TR 38.900 to add channel modeling requirements Huawei, HiSilicon**

*Implements the agreement in 3GPP RAN1#84.*

**Discussion:**

Nokia: We are not sure if we need to capture requirements in the TR. Those are just as guideline for the process, not the final outcome.

Huawei: This was one of the key agreements in last meeting.

Samsung: Working assumption says features are for fulfilling requirements.

Sharp: We share the same view with Samsung and Nokia.

Huawei: This is important point to capture. This shows the differences compared to previous model.

ZTE: We agree with Huawei. We could keep this as informative.

CMCC: We prefer to keep this in the TR.

Nokia: We could have it as editor’s note.

ALU: We prefer not to capture requirements in the TR. We could have it as editor’s note.

Sharp: Lot of bullets are not requirements at all.

Ericsson: It is important to capture the capabilities and limitations of the model.

**Decision:** The document is revised in 1722

**R1-161722 Text proposal to TR 38.900 to add channel modeling requirements Huawei, HiSilicon**

*Implements the agreement in 3GPP RAN1#84.*

**Discussion:**

**Decision:** The document is return

**R1-161719 WF on coordinate system Nokia Networks, Alcatel-Lucent Shanghai Bell, Alcatel-Lucent**

**Discussion:**

**Decision:** The document is revised in 1725

**R1-161725 WF on coordinate system Nokia Networks, Alcatel-Lucent Shanghai Bell, Alcatel-Lucent**

**Discussion:**

**Decision:** The document is return

# Refinement of requirement, scenario, methodology and additional features

***Channel modelling methodology***

**R1-161648 General Views on Above 6 GHz Channel Model INTERDIGITAL COMMUNICATIONS**

*Proposal 1: Take diamond shaped cell layout into consideration for the UMi street canyon scenario.*

*Proposal 2: Apply the LOS probability in [8] for UMa and UMi street canyon scenarios and apply the LOS probability in [4] for indoor office scenario.*

*Proposal 3: CI model could be used for LOS path loss. For NLOS path loss, whether to use CI/CIF model or to use ABG model relies on their performance evaluation.*

*Proposal 4: The building penetration loss model needs to cover as many factors (building materials, carrier frequency, grazing incidence) as possible.*

*Proposal 5: Include the frequency-dependent attenuation in the path loss model.*

*Proposal 6: Most parameters in the fast fading model in [4] can be applied, while some parameters need to be further examined, added or corrected.*

*Proposal 7: Consider the observations and modeling schemes for additional features in [13]-[15].*

**Discussion:**

**Decision:** The document is noted

**R1-161601 Framework of 5G channel modeling methodology Huawei, HiSilicon**

*Proposal 1: User centric Option a2 (User B takes the N strongest clusters, N is the number of clusters defined per scenario) is selected as a working assumption.*

*Proposal 2: Grid model is selected as a working assumption.*

**Discussion:**

Sharp: Term cluster is not never explicitly defined. Are you assuming uniformity of the grid?

Huawei: We agree the cluster is not fully described. It is coming from the grouping of multipaths. For the simplicity we assume uniform spacing for the grid.

Nokia: Simulator should have mobility for using this.

Huawei: Not necessary.

Qualcomm: Scatterers are fixed on the map. It is difficult to set up.

Huawei: We drop users. If they are in the grid point they take existing parameters. If not then from shared clusters.

ALU: How the figure 7 parameters are determined? What are the values d1 and d2? Distance relationship on PL is different in each clusters.

Samsung: What is the impact on modelling? What steps are affected?

Huawei: Step by step approach is not ready yet in our analysis. Maybe one step more is needed.

Samsung: Could this be similar than map-based model? How to define the cluster locations, over time or?

Huawei: Starting point is stochastic. Clusters are fixed.

Mitsubishi: Any guidance on figure 4 radius?

Huawei: Physical requirements dependent.

LGE: Figure 4. When users share clusters?

Huawei: Clusters are fixed in coordination.

Nokia: What benefit this will give? Why to have all this complexity. We have simple method in our joint contribution.

Huawei: We have other document discussing harms on not doing this.

Interdigital: How to capture moving users with fixed clusters?  
CMCC: We have interest on implementing spatial consistency. First we need to discuss benefits.

Intel: We agree with Nokia. We can solve this without generating clusters.

Keysight: Improvement to close by users is a good step. Do you intend the proposal also for close by base stations?

Ericsson: This method is not better than any other method. This need to be developed.

**Decision:** The document is noted

**R1-161631 Refinement on above 6GHz channel modelling NEC Corporation**

*Proposal 1: Approve the working assumption in R1-161150.*

*Proposal2: Modelling UMi scenario firstly in this meeting.*

*Proposal3: Reuse 3D Los probability models.*

*Proposal4: Foliage, atmospheric and rain attenuations can be added as a non-linear function of frequency to the baseline pathloss.*

*Proposal5: Reuse 3D model for auto-correlation on large scale parameters.*

**Discussion:**

Proposal 1 was agreed

**Decision:** The document is noted

**R1-161654 Discussion of channel modelling methodology Lenovo, Motorola Mobility**

*Proposal 1: To use geometric based stochastic channel modeling methodology as a baseline.*

**Discussion:**

Fraunhofer: What is the difference? Model to be based or to be used as a baseline?

Lenovo. We mean the same thing.

**Decision:** The document is noted

***Requirements and features***

**R1-161699 5G Requirements on Channel Modeling Fraunhofer HHI**

*Proposal 1: Add requirements R6 and R7 to the list of requirements.*

*Proposal 2: Add features F1-F11 to the list of necessary additional features.*

**Discussion:**

Qualcomm: What actually do you mean by proposal 6?

Fraunhofer: It is needed to some features with variation with time.

CATT: F8, does it mean you have different antenna sizes and number of elements?

Interdigital: R7 and F11. Do you focus on high speed train scenario and/or highways?

Fraunhofer: Those are 2 examples. The current modelling should be extended.

Ericsson: What do you mean by necessary features?

Fraunhofer: We mean necessary requirements and optional features.

**Decision:** The document is noted

***Scenarios***

**R1-161702 Discussion on detailed modeling for indoor hotspot - office Samsung**

*Proposal: Antenna pattern and downtilt angle, together with a sectorization method need to be further studied for >6GHz indoor office scenario.*

**Discussion:**

Huawei: Is this layout used for calibration for other purpose?

Samsung: To RAN1 work based on CM.

CMCC: Do we need to model the interference?

**Decision:** The document is noted

**R1-161602 Indoor hotspot scenario for 5G channel model Huawei, HiSilicon**

*Proposal 1: Carrier frequency at least around 4 GHz, 30 GHz and 70 GHz should be included in channel modeling for indoor hotspot scenarios.*

*Proposal 2: Bandwidth up to 10% of carrier frequency should be included in channel modeling for indoor hotspot scenarios.*

*Proposal 3: Extension to more than 200 MHz bandwidth for below 6 GHz may be included in channel modeling for indoor hotspot scenarios.*

*Proposal 4: Mixed open and closed layout of indoor hotspot scenario may be included in channel modeling.*

*Proposal 5: Links between indoor BSs and indoor UEs should be included in channel modeling for indoor hotspot scenarios.*

*Proposal 6: UE speed of 3 km/h should be included in channel modeling for indoor hotspot scenarios.*

**Discussion:**

Fraunhofer: Proposal 6. Does it mean all the UEs should have 3 km/h velocity? We should say up to 3km/h.

Huawei: We should refine the requirements including different speeds.

Lenovo: Do you assume separate CMs for different frequencies?

Huawei: One for the total BW.

Samsung: This is good starting point for discussion.

Interdigital: Is 4GHz to be included in RAN discussions? Do you assume BW of 10% or up to 10%?

Huawei: Yes. BW is a cabability of CM.

CMCC: Indoor in important scenario in the future. We are in generally fine but we need to discuss layout further.

**Decision:** The document is noted

**R1-161604 Urban micro scenario for 5G channel model Huawei, HiSilicon**

*Proposal 1: Carrier frequency at least around 30 GHz and 70 GHz should be included in channel modeling for urban micro scenarios.*

*Proposal 2: Bandwidth up to 10% of carrier frequency should be included in channel modeling for urban micro scenarios.*

*Proposal 3: Diverse layouts (e.g., street canyon, open square, etc.) of urban micro scenario may be included in channel modeling.*

*Proposal 4: Links between outdoor BSs and outdoor/indoor UEs should be included in channel modeling for urban micro scenarios.*

*Proposal 5: UE speed of 3/30 km/h (indoor/outdoor) should be included in channel modeling for urban micro scenarios.*

**Discussion:**

Nokia: We have already agreed many aspects. Why to specifically mention 30 and 70 GHz? It is already approved to support the whole range.

Huawei: We encourage companies to provide results.

Samsung: Purpose of tdoc is not totally clear.

ALU: What is the link in proposal 4?

CATT: Does the BW means aggregated BW or single carrier?

Huawei: It means aggregated.

ZTE: We support proposal 3. We should include also 2nd priority scenarios.

**Decision:** The document is noted

**R1-161649 Diamond Shaped Cell Layouts for UMi Street Canyon Scenario INTERDIGITAL COMMUNICATIONS**

*Proposal: The diamond shaped cell layout instead of hexagonal shaped cell layout is considered for the UMi street canyon scenario for frequency spectrum above 6 GHz.*

**Discussion:**

Samsung: Figure 3. If we place sectroized antennas in the same shape there may be some further studies needed.

Qualcomm: One motivation is coming from the street layout. Things could be different considering diamond shaped layout.

Nokia: We discussed also in the last meeting. We concluded operators are not ready to consider this yet.

Lenovo: This may lead to bounching between square cells.

**Decision:** The document is noted

**R1-161671 Urban macro scenario for 5G channel model Huawei, HiSilicon**

*Proposal 1: Carrier frequency at least around 2 GHz, 4 GHz, 30 and 70 GHz should be included in channel modeling for urban macro scenarios.*

*Proposal 2: Extension to more than 200MHz bandwidth for below 6 GHz should be included in channel modeling for urban macro scenarios.*

*Proposal 3: Bandwidth up to 10% of carrier frequency should be included in channel modeling for urban macro scenarios.*

*Proposal 4: Range of more than 300 m may be included in channel modeling for urban macro scenarios.*

*Proposal 5: Links between outdoor BSs and in-car/indoor UEs should be included in channel modeling for urban macro scenarios.*

*Proposal 6: UE speed of 3/30 km/h (indoor/outdoor) should be included in channel modeling for urban macro scenarios.*

**Discussion:**

**Decision:** The document is noted

***Wide BW support***

**R1-161679 Support for wide bandwidths Huawei, HiSilicon, AT&T, CMCC, Ericsson, Intel, KT Corporation, Nokia, NTT DOCOMO, Qualcomm, Samsung**

*Proposal: The possibility to modify the cluster distributions in delay and the sub-path distributions within clusters should be studied in order to support simulations with large bandwidth.*

**Discussion:**

**Decision:** The document is agreed

***Map-based hybrid model***

**R1-161619 Map-Based Hybrid Model Keysight, ZTE**

*Discuss how the hybrid model is divided in two parts; the deterministic part is first used with the help of the map to calculate the propagation paths and the stochastic part is used to add to the channel matrix information that is difficult or too complex to achieve with the deterministic model.*

**Discussion:**

Ericsson: Do you propose that PL is modelled in deterministic or stochastic way?

Keysight: What is your proposal?

Ericsson: Deterministic may be good for finding pathways. Stochastic is better for PL modelling.

Sharp: If you take a representation using deterministic aspects the result would be specific for that scenario. Those are not generalizable.

**Decision:** The document is noted

**R1-161670 Simulations of hybrid channel model ZTE Corporation**

*Observation 1: At least the following profiles show smooth evolutionary along UE trajectory in the simulations based on the proposed hybrid channel model.*

* *The large-scale channel gain;*
* *The small-scale parameters including delay and angular directions of significant rays or components.*

*Observation 2: The birth and death of significant rays or components can be well emulated by the proposed hybrid channel model.*

**Discussion:**

Ericsson: What is the computation time for calculating channel routes?

ZTE: Less than 30 seconds for each grid. 10 minutes as a sum. Total time is not a direct summing.

Ericsson: Simulating outdoor scenario with 1000 user would require a lot of time.

**Decision:** The document is noted

**R1-161620 Details in hybrid channel modelling ZTE Corporation**

*Proposal-1: To include the following hybrid modelling method in RAN1's further study on high-frequency channel modelling*

* *Dominant rays are generated through the ray-tracing tool taking into account the geometry calculation and electric calculation*
* *Random rays involving with potential inter-cluster random rays and intra-cluster multi-paths are established through stochastic method.*

*Proposal-2: RAN1 allocates necessary discussions aiming at an agreeable methodology option based on a single map-based hybrid model.*

**Discussion:**

Sharp: We don’t see how using deterministic aspects could be generalized. We are designing 5G system working in many kind of environments.

ZTE: Intention is not to use this model as generalized tool. We are looking at two aspects.

Samsung: Could you clarify CM equation for each cluster.

ZTE: Channel amplitude has both aspects.

**Decision:** The document is noted

**R1-161659 Description of Map–Based Hybrid Model with Simulation Example Keysight**

*Proposal: RAN1 approves the intent to include a single hybrid map–based model in the TR 38.900 in the next two meetings.*

**Discussion:**

Ericsson: What is the computation time for running these simulations?

Keysight: We don’t know right now.

TIM: We agree with the principle proposed by Keysight and ZTE. We should keep the door open.

Sharp: It is premature to agree as we don’t know the computation time.

TIM: We have already agreed to study also other methods. Baseline is stochastic anyway.

Sharp: Precluded does not mean included.

NTT: What is the benefit with hybrid model? It is not clear.

Keysight: We have motivation in other document 1619.

**Decision:** The document is noted

**R1-161660 Map in the Map–Based Hybrid Modelling Keysight, ZTE**

*Proposal: Following sections from the Annex list the map descriptions per scenario when applying map–based hybrid modelling:*

* *Section A.1 for macro and micro urban cases*
* *Section A.2 for indoor case*
* *Section A.3 for shopping mall case*

**Discussion:**

Sharp: Random dropping based on conditions on map do not give much gain.

Vodafone: What about other scenarios than Madrid?

Keysight: These are defined in METIS project. Other scenarios can be included as well but this is our proposal based on METIS?

Vodafone: Why only Madrid?

Keysight There were lot of Spanish delegates in METIS. We don’t have data available from all cities. What data is large enough?

Sharp: We cannot escape the statistical model.

TIM: Madrid grid may be considered as representative of many scenarios.

Huawei: Madrid grid is not specific for Madrid city. It is just a name for generic city.

Sharp: All city layouts are very different.

ZTE: How could different cities then assume generalized model? Will stochastic model cover all case in next 5-10 years?

Sharp: That is wrong question to ask. CM should be generic enough to be basis for 5G system.

TIM: Unless you fit all over the world either the stochastic cannot be generalized for everything.

Sharp: It was a case for 3G and 4G in 3GPP, also with WiFi.

Ericsson: We have measurements from many cities already now. We can see the typical behaviour and variation which is difficult to capture by map-based model.

ZTE: Benefit is the cabability to work with any deployment.

**Decision:** The document is noted

**R1-161729 WF on Map–Based Hybrid Model Keysight**

**Discussion:**

**Decision:** The document is return

# Large scale fading modelling for >6 GHz

## LOS probability

*Analysis of LOS probability for the agreed scenarios*

***Indoor scenario***

**R1-161680 Discussion on LoS probability in indoor office scenarios LG Electronics**

*Observation: The three level LoS probability model with proper parameterizations can be useful in indoor office scenarios for channel modeling above 6GHz.*

**Discussion:**

**Decision:** The document is noted

**R1-161607 LoS probability modeling for indoor hotspot Huawei, HiSilicon**

*Proposal 1: the deficiency of ITU model should be addressed by increasing the accuracy of the model when distance exceeds certain threshold.*

*Proposal 2: the improved three segments model proposed in this contribution can be adopted as LOS probability model for indoor open office channel modelling in this SI.*

**Discussion:**

Fraunhofer: Have you considered different BS antenna heights?

Huawei: We measured different locations indoor.

Fraunhofer: We should include also the height dependency.

Qualcomm: How do you classify the LOS/NLOS scenario based on measurements?

Huawei: These are based on system simulations.

ALU: Why to have different antenna heights in the indoor scenario?

**Decision:** The document is noted

***UMi scenario***

**R1-161704 Discussion on LoS probability Samsung, NTT DOCOMO**

*Proposal 1: For UMi scenarios, reuse 3GPP 3D LoS Probability models.*

**Discussion:**

Fraunhofer: Question on setup. Are BSs located in the streets?

Samsung: Yes. We assumed 5 BS locations.

Fraunhofer: Did you consider different BS locations? Is 5 BS locations a sufficient number?

CATT: You say LOS probability is not frequency dependent. Did you model also blocking?

Samsung: It can be added on top.

ZTE: Do you intend different scenarios for UMi?

Samsung: We mean street canyon.

Huawei: Where is the BS antenna?

Samsung: In wall side.

**Decision:** The document is noted

***Multiple scenarios***

**R1-161626 Discussion on LOS probability CATT**

*Proposal 1: Radio frequency is one of the factors that affect the LOS propagation between Tx and Rx antennas. If the size of obstacle is large enough such that first Fresnel zone is significantly blocked, the obstacle should not be ignored in LOS probability feature for higher frequency wireless channel. However, to maintain the consistency with TR36.873, this impact can be modelled as blockage probability.*

**Discussion:**

Samsung: Fresnel zone does not affect the PL LOS state.

CATT: It depends on the size of the obstacles. We need to consider also mobile blocking.

Huawei: Blocking model impacts is not fully clear.

CATT: WE need to consider frequency dependency as well.

**Decision:** The document is noted

**R1-161646 To maintain spatial consistency in LoS/NLoS decision ZTE Corporation**

*Proposal 1: To add the spatial consistency to LOS/NLOS condition by replacing the current Step 2 in 3GPP 3D model with following:*

*- define a 2-D grid over simulated horizontal area;*

*- assign uniform i.i.d random variable within [0,1] to each anchor point on the grid, with such assignment to be common for all UEs;*

*- calculate the distance-weighted average of random variables that are on the anchor points surrounding the UE's location;*

*- decide the LOS/NLOS condition according to comparison between a CDF function of the distance-weighted average and the LOS probability threshold derived upon eNB-UE distance.*

**Discussion:**

Intel: Were interpolate states based on LOS probability? Was weighted random numbers based on uniform distribution?

Ericsson: Grid approach interpolate between four grid points. Change from LOS to NLOS is faster.

**Decision:** The document is noted

**R1-161663 LoS Probability for Indoor and Outdoor Environments Qualcomm Incorporated**

*The main conclusions are:*

1. *Most models result in comparable and reasonable fits for LOS probability for both indoor and outdoor settings by appropriate tuning of parameters.*
2. *Nevertheless, a certain simple modification of the existing (current) 3GPP ITU model provides the best fit in terms of mean squared error and good fit for the maximum absolute deviation amongst all of six models considered in this contribution.*
3. *Further, the 3GPP ITU model as well as its modification have a very simple and intuitive interpretation which other contender models lack.*
4. *Thus, the modification of the existing (current) 3GPP ITU model should be actively considered for LOS probability modeling in the over 6 GHz channel modeling framework.*
5. *Further, Qualcomm’s data on indoor and outdoor measurements should also be included in further studies that lead to development of a LOS probability model.*

**Discussion:**

**Decision:** The document is noted

**R1-161640 Joint proposal on the modelling of LOS probability Nokia Networks, AT&T, CMCC, Ericsson, Huawei, HiSilicon, Intel, KT Corporation, NTT DOCOMO, Qualcomm and Samsung**

*Proposal-1: For UMi – Street Canyon and UMa, Current 3GPP LOS probability model in [3GPP TR36.873] can be used for frequencies above 6.0 GHz.*

*Proposal-2: For Indoor office (Mixed Office), LOS probability should be determined using below formula:*



**Discussion:**

CATT: If we agree on this then we model blocking probability related to frequency.

Nokia: Blocking is included in additional features. These are independent issues.

ALU: Blockage is independent of frequency so there is no strong dependency between these.

ZTE: Proposal 2 is specific for mixed office?

Nokia: It is for mixed office. We don’t have enough measurement data on open office.

CATT: If we consider only large objects then fine but indoor we need to consider also smaller objects.

Nokia: We can discuss frequency dependent blockage further separately.

Fraunhofer. We need to consider also BS height dependency.

Nokia: It is scenario based.

ZTE: BS height shall be considered, also inside the building.

Nokia: Key conclusion is the LOS probability is not frequency dependent.

Huawei: Antenna heights have been different in these cases. Typical number like 3m can be used.

ALU: We don’t specify for all possible BS antenna heights.

Samsung: In future evaluations we need to specify also BS antenna height. We could use e.g. the value 3m.

ZTE: We seems to be very specific with antenna height now.

Samsung: It will change also LOS probability. We are doing very similar as in the past.

Nokia: Companies measurements have been done with different antenna heights. We try to generalize the LOS probability.

ZTE: mmWave signal is sensitive on impacts.

ALU: BS location is sensitive.

Nokia: Is ZTE concern in general for both proposals?

ZTE: Indoor is not the concern but UMi is.

Nokia: We can agree on proposal 2 first. Proposal 1 can be taken as working assumption.

Interdigital: How large is the mixed office and how many BSs.

Nokia: Results are coming from multiple companies with 8 different scenarios.

Fraunhofer need more time to evaluate the BS antenna height dependency.

Nokia: Which scenario?

Fraunhofer: Both scenarios by ray tracing simulations. There is possible range with heights like 2.5 m – 4 m.

Nokia: Ceiling is 3m high in the office.

Agreed with the note: Proposals are based on antenna height based on measurement data.

* Indoor was 3m
* UMi was 10 m
* UMa was 25 m.

Above 6 GHz can be removed from proposal 1.

Frequency dependent blockage modelling can be discussed further separately.

**Decision:** The document is agreed

**R1-161727 WF on LOS probability InterDigital, LG Electronics, Nokia Networks, Ericsson, Qualcomm**

**Discussion:**

**Decision:** The document is return

## Pathloss and shadow fading

*Measurement, analysis and modeling of pathloss and shadow fading*

***Measurements / indoor scenario***

**R1-161627 Measurement on path loss in Open office at 26GHz and 39.5GHz CATT, Keysight**

*Contribution present indoor open office path loss model and parameters based on measurements at 26GHz and 39.5GHz with 1GHz bandwidth.*

**Discussion:**

**Decision:** The document is noted

**R1-161633 Path loss measurement at 38GHz for indoor office scenario ETRI**

*Proposal 1: Table 2 can be considered as the PL parameters for Indoor-office scenario at 38 GHz.*

**Discussion:**

**Decision:** The document is noted

***Measurements / UMi scenario***

**R1-161632 Path loss measurement results at 28GHz and 38GHz for UMi-street canyon scenario ETRI**

*Proposal 1: Table 2 can be considered as the PL parameters for UMi-street canyon scenario at 28 and 38 GHz.*

**Discussion:**

**Decision:** The document is noted

***Measurements, UMa scenario***

**R1-161689 Urban macrocell measurements at 28 GHz Ericsson**

*RAN1 to take observations into account*

**Discussion:**

**Decision:** The document is noted

***Measurements, multiple scenarios***

**R1-161688 Measurements of path and penetration losses at multiple carrier frequencies Ericsson**

*Channel measurement results for indoor and outdoor-to-indoor scenarios in an office building have been provided as input for the 5G channel modelling.*

**Discussion:**

**Decision:** The document is noted

**R1-161664 Pathloss and shadow fading measurements for indoor office, outdoor street canyon and shopping mall settings Qualcomm Incorporated**

*Proposal: Given the extensive measurements on path loss performed at Qualcomm, data on indoor and outdoor measurements should be included in further studies that lead to development of path loss models for over 6 GHz channels.*

**Discussion:**

**Decision:** The document is noted

**R1-161657 14GHz channel measurements in multiple scenarios CMCC**

*Proposal 1: Once the data sample numbers is enough, the FI model could provide a more realistic model.*

*Proposal 2: Additional losses around 15db could be observed when UE moves from LOS to NLOS, which will impact the performance severely. The transition from los to nlos should be modeled in the >6GHz channel model to facilitate future technology developments and evaluations.*

**Discussion:**

**Decision:** The document is noted

***Pathloss and shadow fading, indoor scenarios***

**R1-161681 Discussion on pathloss and shadow fading in indoor office scenarios LG Electronics**

*Observation 1: It would be preferable to design PL model by using either ABG PL model or CIF PL model with frequency dependence for above 6GHz Channel model with proper parameterizations.*

*Observation 2: In mixed indoor scenario, since SF seems to have high distance-dependency, it would be beneficial to model SF as a function of distance with consideration of options 1 and 2*

*Observation 3: It would be beneficial to further consider the floor penetration loss for indoor scenarios in channel modeling above 6GHz.*

**Discussion:**

**Decision:** The document is noted

**R1-161614 Discussion on Modeling of Pathloss and Shadow Fading for Indoor Environment NTT DOCOMO, NTT**

*Proposal 1: For LOS case, CI model can be beneficial, since the model bases on physical basis.*

*Proposal 2: For NLOS case, single slope ABG model is appropriate because parameters of dual slope model highly depend on measurement environments.*

**Discussion:**

Huawei: For some cases even LOS 1 m reference distance is based on physical basis.

**Decision:** The document is noted

***Pathloss and shadow fading, UMi scenarios***

**R1-161613 Discussion on Modeling of Pathloss and Shadow Fading for UMi Environment NTT DOCOMO, NTT**

*Proposal 1: For LOS case, CI model can be beneficial, since the model bases on physical basis.*

*Proposal 2: For NLOS case, ABG model can be beneficial in order to achieve smaller RMSE than CI.*

**Discussion:**

**Decision:** The document is noted

***Pathloss and shadow fading, UMa scenarios***

**R1-161684 Discussion on Modeling of Pathloss and Shadow Fading for UMa Environment NTT DOCOMO, NTT**

*Proposal 1: For LOS case, CI model can be beneficial, since the model bases on physical basis.*

*Proposal 2: For NLOS case, ABG model can be beneficial in order to achieve smaller RMSE than CI.*

**Discussion:**

**Decision:** The document is noted

***Pathloss and shadow fading, multiple scenarios***

**R1-161705 Discussion on Path loss and shadow fading in UMi and UMa Samsung**

*Proposal 1: CI model is used for LOS pathloss modelling for UMi and UMa scenarios.*

*Proposal 2: ABG model is used for NLOS pathloss modelling for UMi and UMa scenarios.*

**Discussion:**

**Decision:** The document is noted

**R1-161685 Discussion on Modeling of Pathloss and Shadow Fading for Outdoor to Indoor Environment NTT DOCOMO, NTT**

**Discussion:**

**Decision:** The document is revised in R1-161714

**R1-161714 Discussion on Modeling of Pathloss and Shadow Fading for Outdoor to Indoor Environment NTT DOCOMO, NTT**

*Proposal: The model in reference [2] is preferable to adopt the path loss and shadow fading model for outdoor to indoor situation since the model can consider the frequency dependency.*

**Discussion:**

Nokia: Comment for all the ABG models. When going outside measurement data then ABG model is unstable. CI model is more robust.

**Decision:** The document is noted

***Pathloss and penetration modeling***

**R1-161641 Path Loss Modeling for Channels above 6 GHz Nokia Networks, Alcatel-Lucent Shanghai Bell, Alcatel-Lucent**

*Proposal: Adopt CI path loss model for both LOS and NLOS conditions for at least the outdoor channels.*

**Discussion:**

Ericsson: Current model for <6GHz is with ABG. Are you proposing to change that?

Nokia: Gamma parameter is very unstable. It does not follow the measurements.

Huawei: How do you explain 1m distance LOS meets the NLOS PL?

Nokia: LOS probability is already very high with 1m. Anchor point has physical meaning to define the formula. It is nmatching with the measurement data very well.

Huawei: Did you measure also 1m NLOS?

Nokia: No. We can verify 1 m distance after defining the model.

NTT DOCOMO: ABG is more appropriate model for NLOS.

Qualcomm: CI model is better from our view.

Nokia: 1m is the anchor point in the model. That not need to be physically measured.

Idaho National Lab: 1m can be used for both LOS and NLOS. It does not have to be measured.

Ericsson: We could choose whatever number for anchor point. It is arbitrary parameter.

Nokia: It fits the measurement data. It is an anchor point for the model.

**Decision:** The document is noted

**R1-161647 Joint proposal on the modelling of Pathloss Nokia Networks, AT&T, CMCC, Ericsson, ETRI, Huawei, HiSilicon, Intel, KT Corporation, NTT DOCOMO, Qualcomm, Samsung**

*Proposal-1: For LOS case, adopt CI model for UMa/UMi-Street Canyon/UMi-Open Square/Indoor office/Indoor-Shopping Malls (Details can be found in Table.4)*

*Proposal-2: For NLOS case, adopt either CI model or ABG model for each of UMa/UMi-Street Canyon/UMi-Open Square/Indoor office. (Details can be found in Table.4)*

*Proposal-3: For NLOS case, adopt either single slope or dual slope modelling for indoor office scenario. (Details can be found in Table.4)*

**Discussion:**

**Decision:** The document is revised in R1-161718

**R1-161718 Joint proposal on the modelling of Pathloss Nokia Networks, AT&T, CMCC, Ericsson, ETRI, Huawei, HiSilicon, Intel, KT Corporation, NTT DOCOMO, Qualcomm, Samsung**

*Proposal-1: For LOS case, adopt CI model for UMa/UMi-Street Canyon/UMi-Open Square/Indoor office/Indoor-Shopping Malls (Details can be found in Table.4)*

*Proposal-2: For NLOS case, adopt either CI model or ABG model for each of UMa/UMi-Street Canyon/UMi-Open Square/Indoor office. (Details can be found in Table.4)*

*Proposal-3: For NLOS case, adopt either single slope or dual slope modelling for indoor office scenario. (Details can be found in Table.4)*

**Discussion:**

LGE: Table 2. Is it only for indoor scenario?

Nokia: For indoor only.

LGE: Range is up to 72 GHz.

Nokia: Measurement data is up to 72 GHz.

ZTE: Table 1. Why do you use distance dependent SF calculations?

Nokia: Probability to reach the gap is not very high. Table numbers are not right in this version.

Sharp: Proposal 3. What is the recommendation?

Nokia: There is no clear view yet. Both models has their merits.

ZTE: Frequency dependent SF should be considered.

Nokia/Samsung proposed the Working assumption with the note that distance dependent shadowing and consistency to <6GHz PL model can be studied further.

ZTE: Table 1 should be revised

Huawei need more time to discuss CI model in this meeting. We propose to revise proposal 1. We are not the only company not agreeing the CI model for LOS case.

Nokia was not sure what to study further. Both models are still included.

Ericsson: Two models gives the same expression.

Nokia: ABG for LOS is the same than NLOS.

Huawei: The concept should be clarified.

Nokia: We can keep the proposals 2 and 3.

Samsung: CI is the same as ABG for LOS case in term of equation.

Huawei: Formulas are not the same.

Nokia: Proposals 2 and 3 as a working assumption?

Not OK for ZTE.

**Decision:** The document is revised in 1724

**R1-161724 Joint proposal on the modelling of Pathloss Nokia Networks, AT&T, CMCC, Ericsson, ETRI, Huawei, HiSilicon, Intel, KT Corporation, NTT DOCOMO, Qualcomm, Samsung**

**Discussion:**

**Decision:** The document is return

**R1-161687 Building penetration loss modelling Ericsson, Nokia Networks, AT&T, CMCC, ETRI, Huawei, HiSilicon, Intel, KT Corporation, NTT DOCOMO, Qualcomm, Samsung**

*Proposal: Adopt the building penetration loss model described in section 3 for the outdoor to indoor path loss in the UMa and UMi scenarios*

**Discussion:**

ZTE: Figure 1 say PL is frequency dependent. There is an impact on penetration loss by material thickness. Table 1 says the value for the concrete penetration which do not seem right.

Ericsson: Figure 3 compare measurements matching well with the model. These are done in many buildings.

ZTE: Do you mean we don’t need to study O2I at all?

Ericsson: There is frequency dependent term in concrete. Incident angle shall be considered too. We added the average term in table 2.

Sharp: How high in frequency you studied IIR class?

Ericsson: 20 GHz, maybe also up to 73 GHz.

Qualcomm: Table 1. This is not complete. Building in different areas may be different.

Ericsson: This should be sufficient with scenarios.

ZTE: Incident angle will be different in different floors.

Ericsson: Following angle more explicitly is tricky with the stochastic model. That suits better with map-based model.

**Decision:** The document is agreed

**R1-161723 WF on NLOS Pathloss Modeling Huawei, HiSilicon, Ericsson**

**Discussion:**

**Decision:** The document is return

**R1-161734 WF on LOS Pathloss Modeling Huawei, HiSilicon, Ericsson**

**Discussion:**

**Decision:** The document is return

**R1-161733 WF on Pathloss Model Nokia Networks**

**Discussion:**

**Decision:** The document is return

***Multi-zone propagation***

**R1-161606 Consideration on multi-zone propagation Huawei, HiSilicon**

*Proposal: 3GPP members are encouraged to conduct measurement campaigns in a variety of frequency bands, environments and scenarios that will enable the development of new channel models to address the 3GPP 5G multi-scenario deployments.*

**Discussion:**

Nokia: How do you define the size of the zones?

Huawei: It depends on lot of things. For the indoor we propose a dual slope model.

Nokia: Base on measurement we don’t see the existence of these zones.

Huawei: Measurements has limited range due to reasons like measurements limitations.

Samsung: Is this applicable to indoor only?

Huawei: So far we have indoor measurements but that not prevent measuring also outdoor scenarios.

ZTE: Do you propos distance dependent shadow fading also for multi zone?

Huawei: We propose both single and dual slope for shadowing.

Nokia: Either way is based on stochastic methodology. It generalize different scenarios together. That is a reason not to introduce zones.

**Decision:** The document is noted

**R1-161674 Text proposal to TR 38.900 to add multi-zone propagation Huawei, HiSilicon**

**Discussion:**

**Decision:** The document is noted

## Others

No contributions

# Fast fading modelling for >6 GHz

## Large scale parameters

*Measurement, analysis and modeling of delay & angular spread, etc.*

***Measurements, indoor scenarios***

**R1-161628 Indoor fast fading measurement results at 26 GHz CATT, Keysight**

*Present indoor open office channel model and parameters based on measurements at 26GHz with 1GHz bandwidth with Keysight sounding solution. The results obtained can be used for higher frequency band channel modeling.*

**Discussion:**

**Decision:** The document is noted

**R1-161692 60 GHz shopping mall measurements Ericsson**

*Observations: Similar angular characteristics at both frequencies. NLOS EOA offset is always towards horizon.*

**Discussion:**

**Decision:** The document is noted

**R1-161713 Parameter Statistics for Indoor Office Scenario at High Frequency Nokia Networks, Alcatel-Lucent Shanghai Bell, Alcatel-Lucent**

*Proposal: Taking into account both Table 1 and Table 2 for statistical modelling parameterization for indoor office scenario at 28GHz*

Chair: Tdoc was requested late but document submitted before the deadline.

**Discussion:**

**Decision:** The document is noted

***Measurements, UMi scenarios***

**R1-161634 Measurement of Large scale parameters at 28GHz and 38GHz for UMi-street canyon scenario ETRI**

**Discussion:**

**Decision:** The document is withdrawn

**R1-161691 Microcell measurements Ericsson**

*Observations*

* *The same antenna pattern, BW and dynamic range required when comparing different measurements e.g. at different frequencies*
* *Diffraction contribution negligible in NLOS*
* *Results support that the main propagation mechanisms are specular reflections and scattering by objects*
* *Excess path-loss have only small frequency dependency*
* *Delay spread does not show any significant frequency dependency*

**Discussion:**

**Decision:** The document is noted

**R1-161655 6GHz channel measurement and results in UMi CMCC**

*Proposal 1: K factor of UMi scenarios is around 15dB.*

*Proposal 2: The delay spread in 6 GHz UMi scenario could be fitted by lognormal distribution. And the parameters are proposed in Table 3 and 4.*

*Proposal 3: The angle spread in both horizontal and elevation could be fitted by lognormal distribution. And the parameters are proposed in Table 5 and 6.*

*Proposal 4: The cross-correlation of large scale parameter are proposed in Table 7*

**Discussion:**

**Decision:** The document is noted

***Measurements, UMa scenarios***

**R1-161656 6GHz channel measurements and results in UMa CMCC**

*Proposal 1: K factor of UMa scenario is around 17.48db.*

*Proposal 2: The delay spread in 6 GHz UMa scenario could be fitted by lognormal distribution. And the parameters are proposed in Table 3.*

*Proposal 3: The angle spread in both horizontal and elevation could be fitted by lognormal distribution. And the parameters are proposed in Table 4 and 5.*

*Proposal 4: The cross-correlation of large scale parameter are proposed in Table 6.*

**Discussion:**

**Decision:** The document is noted

***Measurements, multiple scenarios***

**R1-161683 Comparability of channel measurements to estimate large scale parameters for channel modelling Rohde & Schwarz, Fraunhofer HHI**

*Proposal 1: Channel models and the scenario specific propagation parameters should be verified by comparable channel measurements in representative environments.*

*Proposal 2: Measurement parameters that affect the estimation of large scale parameters (e.g. noise threshold) should be documented along with the measurement results in order to ensure comparability.*

*Proposal 3: The noise threshold should be defined according to the proposed equation in this paper. For all measurements the effective noise threshold as well as the used parameters in the proposed equation to estimate this noise threshold should be documented in order to achieve comparability of the derived large scale parameters.*

**Discussion:**

Ericsson: This is very important point.

Nokia: In general we agree this is valid issue but do we need to define noise threshold now? We encourage companies to contribute for the value.

Fraunhofer: We propose to make it as future requirement.

Nokia: Maximum is to encourage. It is hard to mandate.

Huawei: This is related to analysis, not measurements.

**Decision:** The document is noted

***Large scale parameters***

**R1-161615 Discussion on Modeling of Large Scale Parameters NTT DOCOMO, NTT**

**Discussion:**

**Decision:** The document is withdrawn

**R1-161658 Large scale parameters for multiple scenarios CMCC**

*Proposal 1: Once the transition from los to nlos are introduced in the simulation. The change of delay spread should be captured in the channel modeling. And it also should be an important part of spatial consistency in >6GHz channel model.*

*Proposal 2: The angle of arrival should be changed according to different location. The strong relationship between location and angle of departure and arrival should be reflected in the channel model, which is part of spatial consistency.*

Chair: Document title “Multiple frequency measurements in indoor office scenario” in tdoc list was wrong. Correct one is “Large scale parameters for multiple scenarios”

**Discussion:**

Huawei: Frequency dependency can be observed. Maybe we could consider that.

Ericsson: Before stating having frequency dependency it could be good to clarify noise floor first.

**Decision:** The document is noted

**R1-161706 Joint proposal on large-scale and small-scale parameters for >6GHz channel model Samsung, AT&T, CMCC, Ericsson, Huawei, HiSilicon, Intel, KT Corporation, Nokia Networks, NTT DOCOMO, Qualcomm, ETRI**

*Proposal 1: For UMi – Street Canyon, consider the large-scale parameters for DS, ASD, ASA, ZSD, ZSA and ZoD offset model described in Table 2 and Table 3 for above 6 GHz channel model.*

*Proposal 2: For UMi – Street Canyon, adopt the cluster parameters in Table 4.*

*Proposal 3: For UMi – Street Canyon, keep the values of correlation distance / cross-correlation parameters on 3GPP 3D-SCM.*

**Discussion:**

Nokia: Why Table 2 have a note for frequency dependency?

Samsung: Some measurements shows that dependency but not all.

ZTE: There is also cross correlation between parameters. Do you intend to change those? Cross correlation seems independent on frequency.

Samsung: Those two things can co-exist.

Interdigital: Table 4. Is the cluster delay spread also depending on the BW?

Samsung: We used the ray tracing data.

Working assumption with the note: We can study frequency dependency on cross correlation, number of clusters, angle&delay spread further.

**Decision:** The document is Working assumption

**R1-161661 Joint proposal on large-scale parameters for UMa scenario Nokia Networks, AT&T, CMCC, Ericsson, Huawei, HiSilicon, Intel, KT Corporation, NTT DOCOMO, Qualcomm and Samsung**

*Proposal: For UMa, adopt the large-scale parameters described in section-3.*

**Discussion:**

ZTE: Cross correlation is frequency dependent.

Nokia: Dependency is weak in many parameters.

Working assumption with the note: We can study frequency dependency on cross correlation, number of clusters, angle&delay spread further.

**Decision:** The document is Working assumption

***Frequency dependency***

**R1-161698 Frequency-dependent LSP modeling Fraunhofer HHI**

*Proposal: Consider the proposed frequency-dependent offset on mean and standard deviation for the LSP modeling.*

**Discussion:**

Ericsson: This is based on literature survey. Are there different measurements on different frequency bands?

Fraunhofer: Multiple measurements at the same time.

Ericsson: Have you analysed the noise floor impact?

Fraunhofer: Not sure about that but clarify for the next meeting.

**Decision:** The document is noted

**R1-161677 Joint proposal on large-scale parameters for >6GHz channel model in indoor hotspot Huawei, HiSilicon, AT&T, CMCC, Ericsson, Intel, KT Corporation, Nokia, NTT DOCOMO, Qualcomm, Samsung**

*Proposal: The observations indicate that, for some of the LSP, frequency dependency should be studied for channel modelling for the frequency range up to 100 GHz.*

**Discussion:**

CATT: Is given data based on already submitted contributions from all companies?

Huawei: Yes

**Decision:** The document is noted

**R1-161608 Frequency dependency for large scale parameters Huawei, HiSilicon**

*Proposal 1: Frequency dependency on LSP should be modeled to get an accurate model on frequency range up to 100 GHz.*

*Proposal 2: The frequency dependency characteristic at high frequency proposed in the table 4 can be used as baseline for further investigation.*

**Discussion:**

Lenovo: Trend can be seen but could you explain the form of equations?

Huawei: We think this is the best way at the moment. This is aligned also with UMi. Intention is to use this as a starting point for further studies.

Ericsson: Have you analysed the noise floor and dynamics?

Huawei: We are not sure about NF but dynamics is analysed.

Ericsson: Which frequency the ray tracing data was simulated?

Huawei: 2GHz. There is no dominant impact on results.

Ericsson: Ray tracing should provide comparable results with same frequencies. More attention is needed before agreeing. It is too premature at this point. We should study further all the details.

**Decision:** The document is noted

**R1-161673 Text proposal to TR 38.900 to add frequency dependency on large scale parameters Huawei, HiSilicon**

**Discussion:**

**Decision:** The document is noted

**R1-161738 WF on frequency dependency for LSP Huawei, HiSilicon, Fraunhofer HHI, Qualcomm**

**Discussion:**

**Decision:** The document is return

***Delay spread***

**R1-161665 Delay spread for Indoor office, Outdoor open square, Street Canyon and Shopping Mall Qualcomm Incorporated**

*Proposal 1: Ray-tracing based delay spread values seriously underestimate measured delay spreads in both indoor and outdoor settings because of the lack of modeling of small scatterers. Thus, these values should not be used for realistic modeling of over 6 GHz channels.*

*Proposal 2: Given the extensive measurements on delay spread performed at Qualcomm, Qualcomm’s data on indoor and outdoor measurements should be included in further studies that lead to development of delay spread models for over 6 GHz channels.*

**Discussion:**

ZTE: Proposal 1. When ray tracing is used it includes small scatterers. What is the reflection in ray tracing studies? For the outdoor the ray tracing do not under estimate. We see different results in our simulations.

Qualcomm: We have different understanding. If you add more objects that would add the complexity.

**Decision:** The document is noted

**R1-161693 15 GHz indoor delay spread Ericsson**

*Observation: Very similar to IMT-Advanced Indoor hotspot model (ITU-R M.2135). Indoor delay spread is probably determined by room size and not by frequency*

**Discussion:**

**Decision:** The document is noted

## Small scale parameters

*Measurement, analysis and modeling of number of rays per cluster, number of clusters, cluster power/delay, etc.*

***Small scale parameters***

**R1-161616 Discussion on Modeling of Small Scale Parameters NTT DOCOMO, NTT**

**Discussion:**

**Decision:** The document is withdrawn

**R1-161635 Measurement of Small scale parameters at 28GHz and 38GHz for UMi-street canyon scenario ETRI**

**Discussion:**

**Decision:** The document is withdrawn

***Clustering methodology***

**R1-161666 Clustering Methodology and Cluster statistics based on Omni directional and Azimuthal scans at 29 and 61 GHz Qualcomm Incorporated**

*Proposal 1: Discarding azimuthal scan data in lieu of power-angle-delay profile measurements and clustering driven purely by PADP measurements is disadvantageous!*

*Proposal 2: Given the extensive measurements on azimuthal and spherical scans performed at Qualcomm, Qualcomm’s data on indoor office and shopping mall should be included in further studies that lead to development of cluster statistics for over 6 GHz channels.*

**Discussion:**

ZTE: If clustering is based on angular information only it will have big impact on results. You would then see two clusters. It is difficult to distinguish real path from fake path.

Qualcomm: We are not sure why should there be any issues here.

**Decision:** The document is noted

## Others

***Large scale and small scale parameters***

**R1-161690 Modelling of LSPs and SSPs for the outdoor to indoor propagation Ericsson, Nokia Networks, AT&T, CMCC, ETRI, Huawei, HiSilicon, Intel, KT Corporation, NTT DOCOMO, Qualcomm, Samsung**

*Proposal: Adopt one of the three approaches described in section 3 for the LSP and SSP parameters for the outdoor to indoor links in the UMa and UMi scenarios*

* 1. *The existing 3D O2I LSP and SSP parameter values from 3GPP TR 36.873 [4] could be applied also for the frequency range up to 100 GHz. Note that the building penetration loss model is frequency-dependent as already described.*
  2. *The existing 3D O2I LSP and SSP parameter values from 3GPP TR 36.873 [4] could be modified to reflect the new measurements. All parameters are modelled as frequency-independent except the building penetration loss.*
  3. *Split the O2I scenario into a LOS variant parameterized using the new measurements in Table 28, and a NLOS variant parameterized using possible future NLOS O2I measurements.*

**Discussion:**

Samsung: What is Ericsson view?

Ericsson: Alternative 1 could be the working assumption.

Nokia: We agree and support alternative 1.

Huawei: Using 3D model would be the easy way but we are not sure about the accuracy. We need to be careful with the choice.

Samsung: Can we take Proposal 1 as working assumption.

Huawei not OK now.

Nokia: When are we going to make a selection? We need to make conclusion to meet the schedule. How much Huawei need time to study?

Huawei: May would be OK for us.

Nokia: That is the last meeting for the SI.

Samsung: We need to also calibrate and time is needed also for that.

Huawei: 3 weeks maybe too tight.

Nokia: Calibrations are need for the May meeting. Do you propose to extend the SI?

Huawei: What work is needed for calibration?

Nokia: That will be discussed in April. We need to finish the calibration in May.

Samsung: We need to calibrate the geometry and all the rays and parameters. We need a full CM for calibration.

Ericsson: We have already agreed to start from 3D model with possible extensions. Those can be worked further still later.

Huawei:

Chair: Decision will be taken in RAN1#84bis in Busan.

**Decision:** The document is agreed

***Fast fading generation***

**R1-161662 Channel Coefficient Generation Procedure Nokia Networks, AT&T, CMCC, Ericsson, Huawei, HiSilicon, Intel, KT Corporation, NTT DOCOMO, Qualcomm and Samsung**

*Proposal: Adopt the figure.1 and 12 steps in section-2 in TR36.873 as a starting point. These steps can be modified/updated in the future as needed*

**Discussion:**

Huawei: How to ensure to cover all additional features? Which features will be implemented? It is too premature to agree now.

Nokia: One company should not block everything which is based on simulations. What is your counter proposal?

Samsung: We already agreed to have section for additional features.

Ericsson: Proposal already says: *These steps can be modified/updated in the future as needed.*

Huawei: We could have editor’s note in TR instead.

Samsung: That is also OK.

ZTE: We are OK but question on figure. Is it only for LSP and SSP?

Nokia: This is a copy from 3D CM. Optional features can be in the own section.

Fraunhofer: Is this a TP? Everybody knows these steps already so this is not necessary.

Nokia: No, but TP can be provided if this is agreed.

Sharp: We have agreement that steps will be modified only if we want to model additional features. What is the connection for <6GHz.

Samsung: It would be good to capture agreement in a TR. We can add the editor note to the TR.

ALU: We want to highlight the steps we need for the work. Each steps may have sub steps in the future.

CATT: We are fine with the proposal in principle but is it allowed to add more steps?

Nokia: Yes, if needed. We need to do the work step by step basis. This is a starting point.

Huawei: Some steps are very generic. Steps 2-9 may need to be updated. How the hybrid model is implemented here?

Nokia: We can update this when we decide the modeling. We don’t need to solve everything in one day.

**Decision:** The document is agreed

# Additional features for channel modelling for >6 GHz

*Measurement, analysis and modelling of blockage, spatial consistency, attenuation, large BW, large antenna, etc.*

*Extension to <6GHz can be considered under agenda 8 after finalizing the additional features for >6GHz*

***Additional features***

**R1-161612 On modeling of additional features above 6 GHz Sharp**

*Proposal: For characterizing scenarios with foliage, blockage and frequency dependent attenuation, extensions of traditional models of shadowing should be used.*

**Discussion:**

Ericsson: Blockage has spatial component not captured in traditional channel models.

**Decision:** The document is noted

**R1-161630 Views on additional features for above 6GHz channel modeling Mitsubishi Electric Co.**

*Proposal: Incorporate effects of main-lobes and side-lobes in spatial consistency and correlation model for channels at frequencies above 6GHz*

**Discussion:**

Sharp: Side lobes depends on how large the array is. Have you studied that?

Mitsubishi: That is also question to the group. Silos can be considered.

Samsung: 3D CM has main and side lobes. Our CM will also capture these aspects.

Ericsson: We agree with Samsung. This is not an additional feature.

**Decision:** The document is noted

**R1-161653 Discussion of additional features for channel model for >6GHz Lenovo, Motorola Mobility**

*Proposal 1: Blocking by static objects can be modeled by at least one additional shadow fading term with a negative mean. It is FFS whether two random variables with different correlation distances shall be used to model blocking by different sized objects.*

*Proposal 2: Blocking caused by moving objects shall be studied.*

*Proposal 3: Intra-site, inter-frequency correlation needs to be taken into account, including the correlation between above 6 GHz and below 6 GHz frequencies.*

*Proposal 4: Define separate models for blocking caused by moving objects in different scenarios.*

*Proposal 5: It is FFS whether the birth/death process of specular paths and clusters need to be modeled.*

*Proposal 6: Define specific dynamic blocking scenarios for separate simulation of individual UEs.*

*Proposal 7: Spatial consistency shall be included in the channel model to capture the channel evolution through space, time and frequency.*

*Proposal 8: Consider incorporating spatial consistency in the channel model with a two-step approach.*

**Discussion:**

Qualcomm: Modeling of static objects can be addressed by measurement. Why to model them as additional SF?

Ericsson: Blocking is acting as a special filter, by directional characteristic of blocker.

**Decision:** The document is noted

***Spatial consistency***

**R1-161603 Consideration on spatial consistency modeling Huawei, HiSilicon**

*Proposal 1: UEs sharing close-by locations should have correlated LSPs including path loss and shadow fading. SSPs in a drop (e.g. angle, power, and delay) should be dynamically changing with position including time-variant angles and cluster death and birth.*

*Proposal 2: The geometry position of UE should be updated at each time even in a drop.*

*Proposal 3: The path loss should be updated based on the updated position of UE even in a drop.*

*Proposal 4: For correlated large-scale parameters, adopt the method in section 3-C.*

*Proposal 5: For the angles (AoA, AoD, ZoA, and ZoD) at each time, adopt the method in section 3-D.*

*Proposal 6: For cluster birth and death, adopt the method in section 3-E.*

**Discussion:**

Samsung: Figure 4. 5s is a long time for the number of evaluation. All parameters may net be relevant for simulations. Time scale is much lower in system level simulation setup.

Huawei: We kept the same distance than Intel in their simulations. Correlation distance is the most important.

Nokia: Did you simulate only one UE. Did you consider FD-MIMO? Did you compare with measurement data? From where this model comes from?

Huawei: One UE. 2 grids have different LSPs. Fig 6 shows the cluster delay. Cluster birth/death should be considered.

Nokia: Those are not based on measurements. Cluster grouping algorithm is not based on measurements but intuition.

Ericsson: There is a discontinuity in figures 5 and 7. Birth and death is not just on-off process.

ALU: Proposal 1 is not in line with observations. Weakest cluster has the fastest changing rate. There is no measurements to support that. What is the grid size for the birth and death? What is the criteria?

Intel: Anchor changes fast was the concern for Huawei in offline discussions but here it is even faster. This is not based on physical measurements.

ZTE: Concept is not clear. There is a conflict with grid size.

**Decision:** The document is noted

**R1-161610 Discussion on spatial consistency in 5G channel model Huawei, HiSilicon**

*Proposal 1: The Observations 1 – 7 should be taken into account in the channel modeling study.*

*Proposal 2: Large scale parameters should be spatially consistent.*

*Proposal 3: Small scale parameters should be spatially consistent.*

*Proposal 4: The channel model should support very large arrays and distributed antennas in spatially consistent manner.*

*Proposal 5: The channel model should support comparison of different network topologies.*

*Proposal 6: The channel model should support evaluation of MU-MIMO performance.*

**Discussion:**

**Decision:** The document is noted

**R1-161617 Discussion on Modeling of Spatial Consistency NTT DOCOMO, NTT**

*Observation: Alternative 1 can be beneficial to simulate spatial consistency*

*Alternative 1: Method of using spatially consistent random variables*

**Discussion:**

**Decision:** The document is noted

**R1-161643 Investigation of Spatial Consistency Nokia Networks, Alcatel-Lucent Shanghai Bell, Alcatel-Lucent**

*Proposal: Adopt the spatial consistency model proposed in R1-160437 for drop-based simulations including the addition of implementing the spatial consistency for step 8 (random coupling of rays), step 9 (XPRs), and step 10 (random phases) of TR 36.873.*

**Discussion:**

**Decision:** The document is revised in R1-161716

**R1-161716 Investigation of Spatial Consistency Nokia Networks, Alcatel-Lucent Shanghai Bell, Alcatel-Lucent**

*Proposal: Adopt the spatial consistency model proposed in R1-160437 for drop-based simulations including the addition of implementing the spatial consistency for step 8 (random coupling of rays), step 9 (XPRs), and step 10 (random phases) of TR 36.873.*

**Discussion:**

Intel: This is good work but comment on additional steps. Order of indigit numbers could be changed.

Nokia agrees the number may be jumping.

Interdigital: There are also updated proposals for modeling.

Nokia: We are not sure how to implement those other proposals.

**Decision:** The document is noted

**R1-161651 Spatial Consistency for LOS/NLOS State INTERDIGITAL COMMUNICATIONS**

*Proposal 1: The spatial consistency should be applied to LOS/NLOS state.*

*Proposal 2: We could apply the exponential decay filtering scheme to generate correlated uniformly distributed variables, and compare them with the distance dependent LOS probability to determine the UE’s LOS/NLOS state.*

**Discussion:**

Intel: We are generally in line but how to generate uniform numbers need further discussions.

Qualcomm: Did you consider the complexity only or also other issues?

Interdigital: Complexity.

Ericsson: Figure 1. Which of the figures represent the decay filter?

Interdigital: Top right one.

ZTE: In general OK but different schemes may end up with different results.

**Decision:** The document is noted

**R1-161708 Discussion on spatial consistency Samsung**

*Proposal: The interpolation method for spatial consistency shall be:*



**Discussion:**

Intel: Proposed method 3 try to solve the problem under the straight line?

Samsung: Yes.

Ericsson: Exponential filter would solve this issue.

Samsung agree.

Interdigital also agree.

**Decision:** The document is noted

**R1-161675 Text proposal to TR 38.900 to add spatial consistency Huawei, HiSilicon**

**Discussion:**

Sharp: Based on discussions we don’t have a conclusion.

Nokia: We agree with Sharp.

Telecom Italia: We sympathise the TP. Further analysis and details are needed.

Ericsson: Intel proposal is not considered here.

Intel: We need to clarify how to do the simulations.

Samsung: We agree with Intel. Unnecessary to capture in the TR.

Interdigital: 1st sentence is not correct. Also static UEs should have spatial consistency.

LGE: WE agree with Intel and Samsung. TP is not needed for a TR.

**Decision:** The document is noted

**R1-161622 Spatial consistency modeling in drop based model Intel Corporation, Ericsson, Huawei, HiSilicon, Nokia Networks, Samsung, AT&T, CMCC, KT Corporation, NTT DOCOMO, Qualcomm**

*Proposal 1: Companies are encouraged to check details of all three alternatives to solve the spatial consistency issue.*

*Proposal 2:  Adopt one of the three alternatives for spatial consistency.*

**Discussion:**

Interdigital: There may be also other alternatives. We could consider Alt 1.

ZTE: Grid size and correlation distance play a critical role. How to handle the multi-site case?

Intel: Correlation distance is FFS with other WF. We have starting point already. Very large inter-site distance do not have correlation.

ZTE: inter-site correlation is important. How large is large? It is important for LSPs.

Intel: Shadowing has inter-site correlation. Similar could be applied if there is a need.

Lenovo: UEs are correlated. How to incorporate that?

Ericsson: Correlation distance is important. That can be accounted by interpolation. 3D CM do not model inter-site correlation. It could be FFS in this SI. There are only few measurements available, basically nothing.

Interdigital: Decay filtering scheme would help.

Nokia: Correlation distance here is to generate the channel. It is different from final channel response.

Intel: We could start by modeling framework instead of details.

**Decision:** The document is noted

**R1-161726 WF on Spatial consistency Intel Corporation, Ericsson, InterDigital, Nokia, ALU, ASB, Samsung, NTT DoCoMo**

*Alternative 1 (spatial consistent random variable based approach) in R1-161622 is set as working assumption for this SI.*

**Discussion:**

Huawei: What is the meaning of working assumption?

Intel: Meaning is companies can start implementing this proposal. They can further develop also other alternatives if needed in the future.

Huawei: Alternatives 2 and 3 are not mentioned. Can those still be considered?

Intel: Yes, if needed.

Sharp: We are fine in general but question cluster specific random delays calculated.

Intel: Yes

Sharp: Then we are fine.

ZTE: Why is the last distance smaller in the last page? Only distance related parameter seems to be d.

Ericsson: It is not a distance as such. Soft LOS changes towards or from the base station.

Qualcomm: We agree in general. Is the proposal 4 as optional? Do we really need this additional complexity?

Nokia: We compared with measurements. We are open for further evaluations.

Intel: Yes, optional.

Huawei: Joint proposal encourage to check. Now you propose a down selection. Why?

Intel: Based on documents on this meeting some companies have already studied the details. This WF is not for agreement but for working assumption. It can be changed later if needed.

Huawei: Does this approach support D2D and dual mobility? Periodic phenomena in delays requires clarification. More info is needed for the major paths. How the large arrays are supported?

Intel: It can be extendable also for that. Details FFS. This is not purely periodical. Large arrays are FFS.

Sharp: Only issue is the possibility to cover non-planar effects.

ZTE: D2D and V2V scenarios are not included in this SI but the possibility to extend the model need to be ensured. What shall be provided to ensure that?

Intel: Model can be extended to cover also D2D and V2V.

ZTE: We need to consider the complexity, especially in link level.

Nokia: How to manage the complexity is not part of the WF.

Ericsson: Alt 1 already solve the special consistency needed for MU-MIMO.

*Alternative 1 (spatial consistent random variable based approach) in R1-161622 is set as working assumption for this SI.*

Chair: Can we take this as working assumption?

Huawei not OK. Compromise is to take this as working assumption but technical issues to be solved before final decision.

Samsung: We have discussed those already many times.

Huawei: We could make a list of those items.

Nokia: If we found big issues we can revisit the working assumption.

Ericsson: Mobility issue is to be solved.

Working assumption with the condition that alternative 1 should (it is recommended but not mandatory) be further studied, including at least mobility and large array support. Working assumption can be revisited if major technical issues are found.

**Decision:** The document is Working assumption

**R1-161728 Comparison and WF on Spatial Consistency Methods Huawei, HiSilicon**

* *Encourage members to resolve the problems of each method and provide solid simulations to verify the feasibility of the methods.*
* *A harmonized model for spatial consistency is appreciated, or adopt one of the three alternatives for spatial consistency in future meetings.*

**Discussion:**

Sharp: Your intention is not to have a decision. Non planar issues can be done as add on.

Intel: Some features in Alt 2 and 3 can be beneficial. Real issue is how to model. It is artificial. All featured do not have smooth behaviour so difficult to agree with harmonised alternative.

Samsung: These issues could be discussed separately. We propose to take Alt 1 as working assumption.

Nokia: It is difficult as we don’t know how to implement Alternatives 2 and 3. We don’t know what to compare?

Huawei: We can discuss details further.

Nokia: If we don’t know the metric to compare we cannot complete the work. Our WF is supported by multiple companies.

**Decision:** The document is noted

***Blockage modelling***

**R1-161621 Statistical modeling of human blockage ZTE Corporation**

*Proposal 1: The human blockage should be modelled on the small-scale level (path or cluster level.).*

*Proposal 2: The human blockage could be statistically modelled by introducing the statistic properties for blockage probabilities for UE, percentage of the blocked paths/clusters, the spans of the blocked angle coverage and the power attenuation.*

*Proposal 3: The modelling of blockage probability, blocked path percentage and spans of blockage coverage in angular domains is dependent on human density but independent from frequency. In contrast, the modelling of blockage power attenuation per path is dependent on both the human density and frequency.*

*Proposal 4: The blockage effects among different clusters may not be independent; the blockage power attenuations for different sub-paths in the same cluster are the same.*

*Proposal 5: In the hybrid modelling, the proposed human blockage modelling is integrated in the stochastic part.*

*Proposal 6: In the stochastic modelling extended from 3GPP 3D channel model, the proposed human blockage modelling is integrated right before Step 8 in the 3GPP 3D channel model.*

**Discussion:**

Sharp: What was the average density of human / square meter?

ZTE: We cannot preconfigure that. Frequency and density are independent.

**Decision:** The document is noted

**R1-161629 Human blockage measurement results and modeling CATT, Keysight**

*Propose 1：The dynamic blocking should be considered especially for higher frequency bands. Considering the effectiveness and simplicity of the channel model, a static model with additional rapid shadow fading may be appropriate.*

**Discussion:**

ALU: What percentage of clusters can be blocked?

CATT: It is not easy to determine based on measurements.

Ericsson: These looks similar with our results.

**Decision:** The document is noted

**R1-161644 Considerations of Channel Propagation Blockage for Frequency Bands above 6GHz Nokia Networks, Alcatel-Lucent Shanghai Bell, Alcatel-Lucent**

*Proposal # 1: Static/semi-static blockage can be modeled by slow fading components sufficiently with LoS/NLoS probability functions and shadow fading coefficients which may be relevant to distance, frequency, and scenarios.*

*Proposal #2: If needed, dynamic blockage can be modeled by fast fading components for frequency bands above 6GHz. However dynamic blockage shall not be overestimated by duplicated modeling mechanisms.*

*Proposal 3: It is preferred to support dynamic blockage as an additional feature. Detailed of blockage functionality and cross-relationship can be studied further*

*Proposal 4: If needed, it is slightly to prefer to use statistical model like Alternative#1 to determine the status of blockage per cluster by which spatial and temporal consistency can be easily maintained, modeled and extended for supporting multiple simulation tasks, frequencies, and scenarios.*

**Discussion:**

**Decision:** The document is noted

**R1-161650 Dynamic Blockage and Self Blockage for Above 6 GHz Channel INTERDIGITAL COMMUNICATIONS**

*Proposal 1: Model dynamic blockage scenario at the cluster level.*

*Then, we propose some modifications of the existing 3GPP 3D channel model for dynamic blockage:*

*Proposal 2: The total number of clusters needs to be increased to model the new clusters resulting from moving human and vehicle.*

*Proposal 3: A birth-death process is introduced to track if a cluster is being blocked or not.*

*Proposal 4: Additional power attenuation is applied on the clusters being dynamically blocked.*

*Also, we observe that self-blockage (i.e., blocker is the person holding the UE) results in a higher signal attenuation than an ordinary dynamic human blockage. Hence, we propose the following:*

*Proposal 5: Self-blockage needs to be considered and modeled separately from an ordinary dynamic human blockage.*

**Discussion:**

**Decision:** The document is noted

**R1-161667 Human and Hand Blockage Modeling for >6GHz bands Qualcomm Incorporated**

*Observation 1: To model the effect of humans in intermediate distances, it is important to consider both the shadowing and reflective aspects of human body.*

*Observation 2: To capture the near field effects of hand blockage, one may introduce an angular blocking probability to model the blocked clusters due to the presence of the hand. Alternately, one may also consider specific subarrays to become inactive or unavailable due to blocking.*

**Discussion:**

NTT: Can the reflection component be ignored?

Qualcomm: It seems it should not be ignored based on these measurements.

Huawei: How to take these effects into account in the model?

**Decision:** The document is noted

**R1-161668 Human and Hand Blockage Modeling for >6GHz bands Qualcomm Incorporated**

**Discussion:**

**Decision:** The document is withdrawn

**R1-161669 Human and Hand Blockage Modeling for >6GHz bands Qualcomm Incorporated**

**Discussion:**

**Decision:** The document is withdrawn

**R1-161682 Discussion on modeling of blockage for channel modeling above 6GHz LG Electronics**

*Proposal 1: The blockage effect will be captured by adding extra components either in large-scale fading either per link or per cluster with consideration of properly defined blockage probability.*

*Proposal 2: It would be preferable to separately model the self-body blockage effect by adding an extra component in large-scale fading per one link between Tx and Rx.*

**Discussion:**

**Decision:** The document is noted

**R1-161686 Discussion on modeling of blockage NTT DOCOMO, NTT**

**Discussion:**

**Decision:** The document is withdrawn

**R1-161697 Blocking loss measurements Ericsson**

*Observation: This kind of blocking can probably be considered to be part of the modeled “shadow fading”*

**Discussion:**

**Decision:** The document is noted

**R1-161696 Modeling of blocking Ericsson, Keysight**

*Proposal 1: Use the described blocking model in this contribution for the new 3GPP channel model*

*Proposal 2: Consider whether the blocking model parameters should be specified as part of the channel model or as part of simulation assumptions*

**Discussion:**

Fraunhofer: Shadowing screen model LOS connection is always depending on the screen. How do you consider carbage truck case?

Ericsson: Model could be extended. This is for simplicity.  
Samsung: Is blockage modelled per link and over time?

Ericsson: We could specify that.

Intel: Table 1. How to model diffracted distance blocker?

Ericsson: This is only distance to the closest one.

Qualcomm: Do you consider single reflection model?

Ericsson: Model can be applied to any channel, stochastic or map-based.

ALU: How do you get details on the path and potential dynamic blockage?

Ericsson: We should look at dedicated measurements. We introduce blocker close to antenna.

ZTE: It seems to be geometric problem. Is it independent of frequency?

Ericsson: Frequency is taken into account. Blocking is more sever in higher frequencies.

**Decision:** The document is noted

**R1-161707 Discussion on blockage modeling Samsung**

*Proposal 1: The improved process of channel generation shown in Figure 2 is used for the above 6 GHz 3GPP 3D SCM.*

*Proposal 2: Each scenario can have a scenario-specific typical set of blockage screens for computing the dynamic blockage attenuation. Human is considered in indoor scenarios and human and vehicle are considered in outdoor scenarios as baseline.*

*Proposal 3: Static blockage is treated as shadow fading.*

*Proposal 4: Equations (1) and (2) are used in the calculation of blockage attenuation for the above 6 GHz 3GPP 3D SCM.*

**Discussion:**

Qualcomm: What distances are assumed for blockers?

Samsung: Random distance

LGE: If the 1st cluster is blocked is it LOS or NLOS?

Samsung: It depends on which clusters are blocked.

**Decision:** The document is noted

**R1-161623 Blockage modeling in drop based model Intel Corporation, Ericsson, Samsung, AT&T, CMCC, Huawei, HiSilicon, KT Corporation, NTT DOCOMO, Nokia Networks, Qualcomm**

*Proposal 1: Channel blockage is directional and applied to channel cluster.*

*Proposal 2: One blocker is modelled as one surface which is close to the receiver.*

*Proposal 3: The additional shadowing of one blocker is modelled using edge knife model described in equation (1) (2-1) (2-2) and (3).*

*Proposal 4: The additional shadowing of multiple blockers are summed up.*

*Proposal 5: For link level simulation, the centre of the blocker can be defined using a trajectory either in Cartesian coordinate or polar coordinate.*

*Proposal 6: For system level simulation, the centre of the blocker can be defined assuming fixed distance and random AoA/ZoA center which are derived from spatial/temporal consistent random numbers.*

**Discussion:**

Interdigital: If you consider e.g. Uma and open space how would that impact the complexity?

Intel: We introduce additional parameter to be added in the centre of the blocker.

CATT: How the blocking probability? Is it related to environment?

Intel: It depends on blocker location.

Qualcomm: Proposal 5 is dropping on the map?

Intel: It is for link level simulations. System level model can be used also for link level. For system level we propose the fixed distance.

ZTE: In equation 2.1 the blocker is very close to receiver. Transmitter is not necessary far away e.g. in indoor scenario. All assumptions are not feasible.

Ericsson: There might be other situation when different kind of models may be needed for link level simulations, e.g. RAN4 type of models.

ALU: What is the moving assumption in system level simulations?

**Decision:** The document is noted

**R1-161739 WF on Dynamic Blockage Qualcomm Incorporated, Qualcomm, Intel, Interdigital, Nokia, ALU, ASP**

**Discussion:**

**Decision:** The document is return

***BW dependency***

**R1-161605 Consideration on bandwidth dependent channel characteristics Huawei, HiSilicon**

*Proposal 1: 3GPP 3D model should be further extended to support large bandwidth.*

*Proposal 2: Bandwidth dependency for LSP could be modeled as proposed in Table 2. And typical values of these parameters of different frequencies need further investigated.*

**Discussion:**

ALU: What is the motivation? You suggest BW dependent channel model.

Huawei: Some characteristic should be changed with BW.

Ericsson: Effects are not due to channel but RX filter instead. This is considered in simulations as separate from channel model which should be valid for all BWs.

ALU: Model is independent on channel BW.

Huawei: We try to consider for the future with large BWs.

Ericsson: BW dependency would lead to huge implementation problems. It would complicate things very much.

**Decision:** The document is noted

**R1-161676 Text proposal to TR 38.900 to add bandwidth dependent channel characteristics Huawei, HiSilicon**

**Discussion:**

**Decision:** The document is noted

***Large antenna arrays***

**R1-161678 Support for large antenna arrays Huawei, HiSilicon, AT&T, CMCC, Ericsson, Intel, KT Corporation, Nokia, NTT DOCOMO, Qualcomm, Samsung**

*Observation: The following aspects can be relevant to large antenna array modeling:*

* *Spherical wave effect and other alignment problems*
* *Propagation effects of very large arrays*

*Proposal: How to model these aspects should be further discussed in RAN1.*

**Discussion:**

LGE: We have considered the spherical wave with 8 antennas in 2GHz and simulations. We have not found critical issues by simulations. If this is critical we need to define it.

**Decision:** The document is noted

**R1-161611 On the support for large antenna array in existing 3GPP 3D channel model Huawei, HiSilicon**

*Deficiency 1: The existing 3GPP 3D does not support spherical waves.*

*Deficiency 2: The existing 3GPP 3D channel model has limited angular resolution.*

*Deficiency 3: The existing 3GPP 3D channel model provides inconsistent spatial correlation in 3D sphere.*

*Deficiency 4: The existing 3GPP 3D channel model does not support extremely large arrays.*

*Proposal: All the deficiencies will be taken into account when specifying the 3GPP 5G channel model.*

**Discussion:**

**Decision:** The document is noted

**R1-161645 Wideband Array Modeling for Frequency Spectrum above 6 GHz Nokia Networks, Alcatel-Lucent Shanghai Bell, Alcatel-Lucent**

*Proposal: Adopt the wideband array modeling extension as an option for potential use in future studies.*

**Discussion:**

**Decision:** The document is revised in R1-161717

**R1-161717 Wideband Array Modeling for Frequency Spectrum above 6 GHz Nokia Networks, Alcatel-Lucent Shanghai Bell, Alcatel-Lucent**

*Proposal: Adopt the two options for wideband array modeling extension as an option for potential use in future studies.*

**Discussion:**

**Decision:** The document is noted

**R1-161710 Discussion on large BW and large antenna size Samsung**

*Proposal: To support large channel bandwidths and large antenna arrays, a wideband model which allocates a unique TOA to each ray can be adopted. In addition, the uniform angular sampling method is more suitable for large array systems than the conventional uniform power sampling method.*

**Discussion:**

**Decision:** The document is noted

**R1-161730 WF on large BW and large antenna modeling LG Electronics, ???**

**Discussion:**

**Decision:** The document is return

**R1-161732 WF on large antenna array support Huawei, HiSilicon, ???**

**Discussion:**

**Decision:** The document is return

***UE rotational modelling***

**R1-161652 UE Rotational Motion Support for Above 6 GHz Channel Modeling INTERDIGITAL COMMUNICATIONS**

*Proposal: UE rotational motion should be taken into account in the above 6 GHz channel modeling.*

**Discussion:**

Ericsson: Isn’t it already supported by current models?

Qualcomm: Self blocking aspect is not covered.

**Decision:** The document is return

***Atmospheric and foliage loss***

**R1-161709 Discussion on additional attenuation Samsung**

*Proposal: The additional attenuation due to atmospheric attenuations (water-vapour and oxygen absorption) and rain losses are modelled as an additional path loss term, L(f, p, t, ρ, R), according to [4] and [5]:*

*L*(*f*, *p, t, ρ, R*) = *Lgas*(*f*, *p, t, ρ*) + *Lrain*(*f*, *R*)

**Discussion:**

ZTE: This is basically OK but whether this influence on radio polarisation?

Samsung: We did not polarization in details.

Interdigital: How do you determine rain attenuation parameter R?

Samsung: It is a simulation condition as a given number.

**Decision:** The document is noted

**R1-161694 Modelling of atmospheric loss Ericsson, Nokia Networks, AT&T, CMCC, ETRI, Huawei, HiSilicon, Intel, KT Corporation, NTT DOCOMO, Qualcomm, Samsung**

*Proposal 1: Water vapor attenuation should not be considered for the UMi, UMa, and indoor office scenarios*

*Proposal 2: Subtract the impact of oxygen absorption from the measurement data before parameterizing the model*

*Proposal 3: Apply an oxygen loss to the generated channel impulse response on the form [dB]*

*Proposal 4: Rain attenuation should be considered with lower priority for the UMi and UMa scenarios, and not at all for the indoor office scenario*

**Discussion:**

**Decision:** The document is agreed

**R1-161695 Consideration on foliage loss Ericsson, Nokia Networks, AT&T, CMCC, ETRI, Huawei, HiSilicon, Intel, KT Corporation, NTT DOCOMO, Qualcomm, Samsung**

*Proposal: Do not model foliage loss explicitly since it is already implicitly accounted for in the stochastic path loss models*

**Discussion:**

Fraunhofer: Have you seen any differences between summer and winter time? It would be good to investigate.

Ericsson: No. In Sweden we typically measure at summer time.

**Decision:** The document is agreed

***Ground reflection***

**R1-161701 Explicit ground reflection modeling Fraunhofer HHI**

*Proposal: Consider the explicit modeling of the ground reflection as an additional necessary feature for the 3GPP-5G channel model.*

**Discussion:**

**Decision:** The document is agreed

***Time evolution***

**R1-161711 Discussion on time evolution of the channel model Samsung**

*Proposal:*

* *The channel generation equation in 3GPP TR36.873 is reused for modeling time evolution of >6GHz channel modeling, at least when UE speed is less than or equal to [30] km/h.*
* *FFS channel generation equation for > [30]km/h*

**Discussion:**

Fraunhofer: How to deal with spherical wave? You are not supporting large antenna arrays in UE side.

Samsung: It is not considered in this proposal. How large is large?

Ericsson: We should be able to do drop based simulations also in the future. Proposal could be changed mentioning new features as add on. We should not have criteria for UE speed.

Telecom Italia: How is this related to fast fading?

Fraunhofer: It should be dependent on observation period instead, not UE speed.

**Decision:** The document is revised in 1735

**R1-161735 Discussion on time evolution of the channel model Samsung**

**Discussion:**

**Decision:** The document is return

# Other issues

*Including measurements, analyses, and additional features for <6 GHz*

***Outdoor to indoor propagation***

**R1-161642 Building Penetration Loss Measurement for mmWave with a Range of Materials Nokia Networks, Alcatel-Lucent Shanghai Bell, Alcatel-Lucent**

**Discussion:**

**Decision:** The document is revised in R1-161715

**R1-161715 Building Penetration Loss Measurement for mmWave with a Range of Materials Nokia Networks, Alcatel-Lucent Shanghai Bell, Alcatel-Lucent**

**Discussion:**

**Decision:** The document is noted

**R1-161609 Measurements on outdoor to indoor propagation Huawei, HiSilicon**

*Proposal 1: The penetration and O-to-I model in current 3GPP model should further extended to consider support for bands both below 6 GHz and above 6 GHz.*

*Proposal 2: The O-to-I model and glass, wood, etc. proposed in Table 4 can be adopted as O-2-I model pathloss model for this SI.*

**Discussion:**

Ericsson: Do you have suggestion on different proportion f building materials?

Huawei: We agreed to consider at least glass and concrete. We could consider more that two materials. We don’t have specific numbers for the portions.

**Decision:** The document is noted

**R1-161737 WF on outdoor to indoor propagation Huawei, HiSilicon**

**Discussion:**

**Decision:** The document is Return

***UE antenna modelling***

**R1-161624 UE antenna modeling for high band Intel Corporation (UK) Ltd**

*Proposal: Specify 2D UE antenna array for high band in TR 38.900 based on the 2D eNB antenna array defined in TR 36.873. The detailed parameters such as (N, M, P) and antenna element radiation pattern and orientation can be defined further.*

**Discussion:**

Sharp: What is the frequency you are looking at? How large is large in the UE?

Intel: Antenna size will be smaller when the frequency is higher. There would be some beamforming at the UE. It can be discussed further in 5G RAT SI.

Ericsson: Why do we need to have models for the UE antenna in CM TR?

Intel: Number one is for calibration. Directivity in high band is very important.

Qualcomm: Typically the design is to ensure the good coverage. This seems not to improve the coverage.

Intel: Intention is to achieve the full coverage.

Ericsson: There are 2 steps in CM, implementing clusters and rays, second part may be used for calibration purposes.

Sharp: Are you modeling also antenna pattern function as frequency?

Fraunhofer: It would be good the add assumption that antenna pattern is not frequency dependent. It would be better to discuss on RF level, not in CM.

**Decision:** The document is noted

***Calibration***

**R1-161618 Detailed Description of Scenarios for Calibration NTT DOCOMO, NTT**

*Proposal 1: Agree on the basic description of the channel model calibration scenarios in Appendix A, at least for high priority scenarios, i.e., UMi-street canyon, indoor office and UMa scenarios.*

*Proposal 2: Continue discussion to complete the evaluation scenario description, taking into consideration additional parameters needed to characterize and verify the additional features or requirements.*

**Discussion:**

ZTE: Some details are needed for calibrating also hybrid models.

NTT DOCOMO: Those can be added later if we find those are needed.

CMCC: We need scenario for future calibration but we still need time to evaluate further.

**Decision:** The document is return

**R1-161625 Details on Calibration assumptions for 1st priority deployment scenarios CATT**

*Proposal 1: Scenarios parameter as in table*

*Proposal 2: The channel calibration simulation work for above 6GHz can be divided into three phases similar to the simulation phases in TR 36.873.*

*Proposal 3: Simulation assumptions shown in table 2 can be used for phase 1 calibration for above 6GHz channel modeling.*

**Discussion:**

Fraunhofer: It might be too early to set all these calibration details now. Antenna features might be impacted by other features.

CATT: CM should be independent on features.

Ericsson: Do you really need phase 3? It is unnecessary work to do. What parameters you proposed to look at?

CATT: Phase 3 could be discussed in the next meeting. We can start with what we did for 3D CM.

**Decision:** The document is noted

**R1-161703 Discussion on >6GHz antenna modeling for calibration and RAN1 work Samsung**

*Proposal: (Mg,Ng) and (dg,H, dg,V) are introduced as illustrated in Figure 1 in addition to those parameters specified for <6GHz antenna modeling in 36.873: (M,N,P) and (dH, dV).*

**Discussion:**

CATT: Do we need this specific antenna model for calibration? CM should not be specific to antenna.

Samsung: We need to consider large antenna array. This would be useful for calibration.

**Decision:** The document is noted

**R1-161731 Way forward on antenna modelling for channel model calibration Intel Corporation, Samsung**

**Discussion:**

CATT want to understand the figure. What is the definition of element?

Intel: We have elements and panels.

CATT: Why do we need that for calibration purposes?

Samsung: WE need to model large antenna array. We could have multiple panels. This is potentially used also for other evaluations.

Ericsson: How Baseband port is connected to antenna?

Samsung: That is FFS.

NTT DOCOMO: If we introduce this panel in UE side we will complicate the calibration.

Fraunhofer: If we agree on this panel design we need to model also rotation of mobile station.

Intel: Antenna orientation need to be defined in coordination system.

**Decision:** The document is noted

***Link level evaluations***

**R1-161712 Joint Proposal on Channel Models for Link-level Evaluations Samsung, AT&T, CMCC, Ericsson, Intel, KT Corporation, Nokia Networks, NTT DOCOMO, Qualcomm**

*Proposal 1: TR36.104 (i.e., ETU, EVA, EPA) channel models can be used for 5G link level simulations for up to100 MHz BW for any frequency band.*

*Proposal 2: Evaluate the possibility of modifying TR36.104 (i.e., ETU, EVA, EPA) and TR25.996 (SCM-A, B, C, D) channel models to support large bandwidths, e.g., up to [TBD] GHz.*

*Proposal 3: Evaluate the possibility of modifying TR25.996 (SCM-A, B, C, D) channel models to support large antenna arrays [TBD].*

*Proposal 4: Consider if there is a need to introduce a dynamic blocking component in link level simulations. If so, consider if some dynamic blocking model component could be reused from the system-level channel model*

**Discussion:**

Huawei: This contribution was submitted very late. We have not enough time to evaluate. Proposals 1-3 are contradicting each other. These cannot be used for >6GHz.

Samsung: This was submitted on time. Models are representative of different delay spreads. We are not sure why we could not use these for >6GHz.

Huawei: We are not sure all co-sourcing companies have checked all the details. We don’t know how to use RAN4 models for > 6GHz.

Sharp: Proposals 2 onwards are modification on existing models. That makes a lot of sense.

Ericsson: We don’t know what contradiction Huawei means with proposals 1-3.

Nokia: We agree with Ericsson and Samsung. These proposals are reasonable.

Huawei: Max BW in models is not enough. In principle this is good idea to do link level model under this SI but we have concerns on models itself. These were in the past extended for RAN4 conformance tests. They were not considered to be realistic. There are limitations with the number of antennas, frequency range and BW. DS is also different. These models are from different world. SCM extensions have different amount of taps compared to original SCM. MIMO matrix will explode. Link level model should reflect new frequency, BW and large antenna model. It could be simplified model.

ZTE: We have same concern with Huawei for proposal 1. Most of the LSPs are frequency dependent.

Samsung: RAN4 models are representative for delay spread. We are not sure what Huawei’s intention here is. We propose to study further. We should have constructive discussion rather than blocking.

Ericsson: We need to be very constructive now. What kind of model Huawei is proposing for RAN1 work?

Huawei: We are not blocking this. It is important but we have technical concerns. Our proposal is to make link level model as a Clustered Delay Line model with expectation values of LSP of generic model. Also why not to consider 36.101 models?

Nokia: That would be in May earliest when we should finish the SI. RAN1 need the model in April.

Huawei: We don’t need spatial consistency and PL. We can do it very quickly.

Nokia: This proposal is constructive way. Link level simulations cannot wait.

Samsung: Link level do not need to do MIMO all the time. We could have TDL first, then extensions later.

Ericsson: Link level models should not have names.

Nokia: WE should make decision this week. Huawei proposal is coming much later than joint proposal.

**Decision:** The document is return

**R1-161736 Channel Models for Link-level Evaluations Huawei, HiSilicon**

**Discussion:**

**Decision:** The document is return

# Close of the meeting

AH Chair thanked delegates and expressed his feeling for the good progress and achievements in this additional ad-hoc meeting.

Special thanks to EF3 for hosting.

Safe journey and see you all in Busan.

Meeting was closed at zz:zz on Wednesday 16 March 2016.

# Annex A: List of Tdocs at RAN1 #AH Channel model

Please see excel file attached to this report

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# Annex B: List of agreements at RAN1 #AH Channel Model

|  |  |  |  |
| --- | --- | --- | --- |
| **Tdoc Number** | **Title** | **Source** | **Conclusion/Decision** |
| R1-161600 | Proposed agenda | Chair (Nokia Networks) | Agreed |
| R1-161639 | TP for adding agreed scenarios in Section 7 | Nokia Networks, Samsung | Agreed |
| R1-161640 | Joint proposal on the modelling of LOS probability | Nokia Networks, AT&T, CMCC, Ericsson, Huawei, HiSilicon, Intel, KT Corporation, NTT DOCOMO, Qualcomm and Samsung | Agreed |
| R1-161679 | Support for wide bandwidths | Huawei, HiSilicon, AT&T, CMCC, Ericsson, Intel, KT Corporation, Nokia, NTT DOCOMO, Qualcomm, Samsung | Agreed |
| R1-161687 | Building penetration loss modelling | Ericsson, Nokia Networks, AT&T, CMCC, ETRI, Huawei, HiSilicon, Intel, KT Corporation, NTT DOCOMO, Qualcomm, Samsung | Agreed |
| R1-161661 | Joint proposal on large-scale parameters for UMa scenario | Nokia Networks, AT&T, CMCC, Ericsson, Huawei, HiSilicon, Intel, KT Corporation, NTT DOCOMO, Qualcomm and Samsung | Working assumption |
| R1-161706 | Joint proposal on large-scale and small-scale parameters for >6GHz channel model | Samsung, AT&T, CMCC, Ericsson, Huawei, HiSilicon, Intel, KT Corporation, Nokia Networks, NTT DOCOMO, Qualcomm, ETRI | Working assumption |
| R1-161726 | WF on Spatial consistency | Intel Corporation, Ericsson, InterDigital, Nokia, ALU, ASB, Samsung, NTT DoCoMo | Working assumption |
| R1-161690 | Modelling of LSPs and SSPs for the outdoor to indoor propagation | Ericsson, Nokia Networks, AT&T, CMCC, ETRI, Huawei, HiSilicon, Intel, KT Corporation, NTT DOCOMO, Qualcomm, Samsung | Agreed |
| R1-161662 | Channel Coefficient Generation Procedure | Nokia Networks, AT&T, CMCC, Ericsson, Huawei, HiSilicon, Intel, KT Corporation, NTT DOCOMO, Qualcomm and Samsung | Agreed |
| R1-161694 | Modelling of atmospheric loss | Ericsson, Nokia Networks, AT&T, CMCC, ETRI, Huawei, HiSilicon, Intel, KT Corporation, NTT DOCOMO, Qualcomm, Samsung | Agreed |
| R1-161695 | Consideration on foliage loss | Ericsson, Nokia Networks, AT&T, CMCC, ETRI, Huawei, HiSilicon, Intel, KT Corporation, NTT DOCOMO, Qualcomm, Samsung | Agreed |
| R1-161701 | Explicit ground reflection modeling | Fraunhofer HHI | Agreed |
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# Annex C: List of participants at RAN1 #AH Channel Model

Please see excel file attached to this report. Registered delegates who did not sign the participants list are highlighted by red

# Annex D: TSG RAN WG1 meetings in 2016 – 2017

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **TITLE** | **TYPE** | **DATES** | **LOCATION** | **CTRY** |
| 3GPPRAN1#84bis | WG | 11 – 15 Apr 2016 | Busan | Korea |
| 3GPPRAN1#85 | WG | 23 – 27 May 2016 | Nanjing | China |
| 3GPPRAN1#86 | WG | 22 – 26 Aug 2016 | Gothenburg | Sweden |
| 3GPPRAN1#86bis | WG | 10 – 14 Oct 2016 | Lisbon | Portugal |
| 3GPPRAN1#87 | WG | 14 – 18 Nov 2016 | TBD | US |
| 3GPPRAN1#88 | WG | 13 – 17 Feb 2017 | Athens (TBC) | Greece |
| 3GPPRAN1#88bis | WG | 03 – 07 Apr 2017 | TBD | TBD |
| 3GPPRAN1#89 | WG | 15 – 19 May 2017 | TBD | China |
| 3GPPRAN1#90 | WG | 21 – 25 Aug 2017 | Berlin | Germany |
| 3GPPRAN1#90bis | WG | 09 – 13 Oct 2017 | Prague | Rep Czech |
| 3GPPRAN1#91 | WG | 27 Nov – 01 Dec 2017 | TBD | US |

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| MEETING TYPES | |
| AH = Ad Hoc | CM = Chairmen's meeting |
| JM = Joint | OR = Ordinary |
| PM = Preparatory Meeting | RG = Rapporteurs Group |
| RM = Resolution Meeting | SG = Steering Group |
| ST = Startup Meeting | TG = Task Group |
| WG = Working Group | XO = Extraordinary |

*End of document*