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Technical Report

3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Enhanced performance requirement for LTE User Equipment (UE) (Release 11)

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Contents

Foreword

This Technical Report has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

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- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the document.

Introduction

A study item for further improved minimum performance requirements for LTE/LTE-Advanced UE (FDD/ TDD) was approved at the 3GPP RAN #53 meeting [1]. This technical report summarizes the work that RAN4 has accomplished in this study item to assess the feasibility of interference mitigation UE receivers. These receivers attempt to cancel the interference that arises from users operating outside the serving cell. This type of interference is also referred to as 'inter-cell' interference. In past link level evaluations, this type of interference has been modelled as AWGN, and as such can not be cancelled. The study item has developed models for this interference in terms of the number of interfering eNode Bs to consider, and their powers relative to the total other cell interference power, the latter ratios referred to as Dominant Interferer Proportion (DIP) ratios. DIP ratios have been defined based on three criteria; median values of the corresponding cumulative density functions, weighted average throughput gain, and field data.

The LTE basic receiver structure is that of an LMMSE receiver which takes into account not only the channel response matrix of the serving cell, but also the channel response matrices of the most significant interfering cells. LTE throughput estimates are developed using link level simulations, which include the other-cell interference. In addition, system level performance is assessed to determine the gains that interference mitigation receiver might provide in throughput and coverage. Complexity issues associated with implementing these types of receivers are also discussed. The content of each specific clause of the report is briefly described as follows.

Clause 1 of this document defines the scope and objectives of this feasibility study.

Clause 4 describes the receiver methods that can be applied to Interference Cancellation/ Mitigation (IC) receivers.

Clause 5 describes the network scenarios that were defined and used to generate the interference statistics, which were then used to develop the interference models described in clause 6.

Clause 6 defines the interference models/profiles that were developed in order to assess the link level performance of enhanced receivers. The DIP ratio is defined as a key statistical measure, which forms the basis of the three types of interference profiles considered.

1 Scope

The objective of this study is to evaluate the feasibility and potential performance improvements of interference cancellation/mitigation techniques for LTE/ LTE-Advanced FDD and TDD UE receivers, based on realistic network scenarios. Scope of the work includes:

- Identify realistic deployment scenarios, traffic models, interference models, and performance metrics to evaluate the performance of advanced receiver to mitigate inter-cell interference.
  - Evaluation should be based on realistic modelling of inter-cell interference, including both synchronous and asynchronous operations among macro eNBs, different precoders, ranks and powers applied over consecutive subframes, and effect of CRS and control channels to which different precoder is applied compared with data channels.
- Study and evaluate feasibility and potential gain by advanced receiver at link and system levels:
  - Identify the scenarios and conditions where inter-cell interference mitigation is effective
  - Identify the receiver structures that could be a baseline to specify performance requirement.
    - Receiver structures targeting spatial domain interference mitigation such as IRC are to be considered as a starting point.
    - Receiver structures targeted to TDM-eICIC are only to be studied under the eICIC enhancements WI.
    - Details of interference modelling for performance requirements and conformance testing shall be specified in the WI phase. Some complexity considerations should be taken into account during the SI phase to avoid over simplified model later on that doesn't reflect the performance benefits found.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] RP-111378, "Enhanced performance requirement for LTE UE," NTT DOCOMO, RAN #53.

[2] 3GPP, TR25.963, "Feasibility study on interference cancellation for UTRA FDD User Equipment (UE)," V10.0.0.

[3] 3GPP, TR36.814, "Evolved Universal Terrestrial Radio Access (E-UTRA); Further advancements for E-UTRA physical layer aspects," V9.0.0.

[4] R4-115789, "Missing parameters for the advanced receiver link and system level simulation setup," ST-Ericsson/Ericsson

[5] R4-114889, "Discussion on Advanced receiver SI," Huawei, HiSilicon

[6] R4-114971, "Considerations on Advanced Receivers for Inter-Cell Interference," Qualcomm Incorporated

[7] R4-114999, "Discussion of assumptions for Enhanced LTE UE performance requirements SI," Nokia Corporation

[8] R4-115116, "Consideration on baseline receiver for the enhancement of LTE performance," ST-Ericsson, Ericsson

[9] R4-115117, "Link level assumptions for evaluating the performance of the advanced receiver," ST-Ericsson, Ericsson

[10] R4-115118, "System level assumptions for evaluating the performance of the advanced receiver," ST-Ericsson, Ericsson

[11] R4-115131, "High level views on enhanced UE performance requirements for LTE UE," Renesas Mobile Europe Ltd

[12] R4-115134, "Interference aware receiver modeling at system level," Renesas Mobile Europe Ltd

[13] R4-115135, "System level results on UE MMSE receiver modeling," Renesas Mobile Europe Ltd

[15] R4-115212, "Performance Evaluation Methodologies for Enhanced UE Receiver," NTT DOCOMO

[16] R4-115213, "Reference receiver structure for interference mitigation on Enhanced performance requirement for LTE UE," NTT DOCOMO

[17] R4-115789, "Missing parameters for the advanced receiver link and system level simulation setup," ST-Ericsson/Ericsson

[18] R4-116086, "System simulation results for LTE UE enhanced performance requirements," Ericsson, ST-Ericsson

[19] R4-116009, "Interference Profiles and Rank Distributions for link level evaluations of the Enhanced performance requirements for LTE UE SI," Nokia Corporation, Nokia Siemens Networks

[20] R4-116068, "Discussion on simulation results and assumptions of advanced receiver SI," Huawei, HiSilicon

[21] R4-115741, "Interference profile evaluation for enhanced UE performance SI," Intel Corporation

[22] R4-115802, "System Level simulation results of DIP for Enhanced performance requirements," LG Electronics

[23] R4-115810, "System Level Studies on Advanced Receiver," Qualcomm Incorporated

[24] R4-115874, "System level results for advanced performance requirements for LTE UE," Renesas Mobile Europe Ltd

[25] R4-115911, "Interference Modeling for Enhanced UE Receiver Performance Evaluation," NTT DOCOMO

[26] R4-115921, "Evaluation results for interference modelling and DIP profile," Samsung

[27] R4-116182, "Further considerations on link level simulation assumptions for enhanced UE performance requirements for LTE UE," Renesas Mobile Europe Ltd

[28] R4-116208, "Summary of evaluation results for interference modelling/ profiles for Enhanced performance requirements for LTE UE SI," NTT DOCOMO.

[29] R1-111031, "On advanced UE MMSE receiver modelling in system simulations," Nokia, Nokia Siemens Network

[30] R1-111031, "On advanced UE MMSE receiver modelling in system simulations," Nokia, Nokia Siemens Network

[31] http://en.wikipedia.org/wiki/Estimation_of_covariance_matrices#Intrinsic_covariance_matrix_estimation

[32] http://en.wikipedia.org/wiki/Complex_normal_distribution#Circular_symmetric_complex_normal_distribution

[33] http://en.wikipedia.org/wiki/Wishart_distribution#Estimator_of_the_multivariate_normal_distribution

[34] 3GPP, R4-120526, Renesas Mobile Europe Ltd. , "Summary of individual company contributions and averaged DIP profiles for weighted average throughput gain study," February 2012.

[35] R4-120313, "Link level performance in Scenario 1 (TM6) of enhanced UE receiver," Nokia Siemens Networks, Nokia

[36] R4-120315, "Link level performance in Scenario 2 (TM9) of enhanced UE receiver," Nokia, Nokia Siemens Network.

[37] R4-120374, "Throughput simulation results for enhanced LTE UE receiver," Huawei, HiSilicon.

[38] R4-120375, "Discussion on advanced receiver modelling for system level performance evaluation," Huawei, HiSilicon.

[39] R4-120431, "On MMSE receiver performance under synchronous and asynchronous inter cell interference," Qualcomm Incorporated.

[40] R4-120509, "Performance Evaluation Results of MMSE-IRC Receiver based on Conditional Median DIP," NTT DOCOMO.

[41] R4-120511, "Investigation on Typical DIP Scenario based on Average Throughput Gain of MMSE-IRC Receiver," NTT DOCOMO.

[42] R4-120527, "Link level performance evaluation of MMSE-IRC receiver," Renesas Mobile Europe Ltd

[43] R4-120528, "System level performance evaluation of MMSE-IRC receiver," Renesas Mobile Europe Ltd.

[44] R4-120657, "Link-level simulation results for enhanced performance requirements for LTE UE," Motorola Mobility

[45] R4-120850, "System level evaluation of advanced receiver," Intel Corporation.

[46] R4-120855, "Advanced receiver link level performance evaluation," Intel Corporation.

[47] R4-120919, "Link level simulation results for advanced receiver," ST-Ericsson/Ericsson.

[48] R4-120937, "Link level simulation results for advanced receiver," LG Electronics.

[49] R4-120311, "On DIP distribution for Advanced Receivers Studies," Nokia, Nokia Siemens Network.

[50] R4-120525, "On DIP profiles conditioned to -3dB geometry," Renesas Mobile Europe Ltd

[51] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [51] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [51].

DIP: Dominate Interferer Propotion

IC: Interference Cancellation

LMMSE: Linear Minimum Mean Squared Error

UE: User Equipment

E-UTRA: Enhanced UMTS Terrestrial Radio Access

3.2 Symbols

For the purposes of the present document, the following symbols apply:

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [51] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [51].

4 Receiver structure

In this section, we give the system equations for enhanced receiver intended as a baseline receiver for evaluation benefits for interference mitigation.

The N_{Rx}-dimensional received signal vector **r** of the *k*-th subcarrier and the *l*-th OFDM symbol is assumed to be expressed as a sum of "own signal $\mathbf{H}_1(k,l)\mathbf{d}_1(k,l)$, interference signals $\mathbf{H}_j(k,l)\mathbf{d}_j(k,l)$ (j>1) and the white noise $n(k,l)$;

$$\mathbf{r}(k,l) = \mathbf{H}_1(k,l)\mathbf{d}_1(k,l) + \sum_{j=2}^{N_{BS}} \mathbf{H}_j(k,l)\mathbf{d}_j(k,l) + \mathbf{n}(k,l)$$

where $\mathbf{d}_j(k,l)$ and $\mathbf{H}_j(k,l), j = \{1,...,N_{BS}\}$ represent the N_{Tx} x1 transmitted signal vector and the (N_{Rx} x N_{Tx}) channel matrix between the *j*-th cell and the UE containing the contribution from both receiver branches, with $\mathbf{H}_j = \begin{bmatrix} (\mathbf{H}_{j,1})^H \\ (\mathbf{H}_{j,2})^H \end{bmatrix}$ and $\mathbf{H}_{j,i}$ channel-matrix of size N_{Tx} x1 for the *i*-th receiver antenna, respectively. The recovered N_{Stream} x 1 signal vector at the UE, $\hat{\mathbf{d}}_1(k,l)$, is detected by using the (N_{Stream} x N_{Rx}) receiver weight matrix $\mathbf{W}_{RX,1}(k,l)$ as follows.

$$\hat{\mathbf{d}}_1(k,l) = \mathbf{W}_{RX,1}(k,l)\mathbf{r}(k,l)$$

It is noted that there may exist different understanding among companies on the definition of Rel-8/9 baseline receiver against which to reference gains of advanced receivers. Some differences in gains reported may be due to assumptions used for baseline reference. Section 4.1 and 4.2 provide a description of two baseline MMSE and baseline MRC receivers, however there are also other baseline receiver assumptions possible.

4.1 Baseline receiver: MMSE receiver

For Release 8 baseline receiver, the MMSE receiver can weight matrix is expressed as follow:

$$\mathbf{W}_{RX,1}(k,l) = \hat{\mathbf{H}}_1^H(k,l)\mathbf{R}^{-1},\ \mathbf{R} = P_1\hat{\mathbf{H}}_1(k,l)\mathbf{H}_1{}^H(k,l) + \sigma^2\mathrm{I}$$

where $\hat{\mathbf{H}}_j(k,l)$ and σ^2 denote the estimated channel matrix and noise power, respectively. P_1 is the transmission power of the serving cell and is equal to $E[|d_1(k,l)|^2]$.

4.2 Baseline receiver: MRC receiver

Another Release 8 baseline receiver is MRC receiver. The MRC receiver for rank-1 transmission can be represented as

$$\mathbf{W}_{RX,1}(k,l) = \hat{\mathbf{H}}_1^H(k,l),$$

where $\hat{\mathbf{H}}_1(k,l)$ is the estimated channel matrix.

4.3 MMSE IRC receiver

For enhanced receiver, the MMSE-IRC receiver can suppress not only the inter-stream interference but also the inter-cell interference when the degrees of freedom at the receiver are sufficient, i.e., the number of receiver antennas is higher than that of the number of desired data streams, and MMSE IRC receiver weight matrix is expressed as follow:

$$\mathbf{W}_{RX,1}(k,l) = \hat{\mathbf{H}}_1^H(k,l)\mathbf{R}^{-1}$$

where $\hat{\mathbf{H}}_j(k,l)$ and $\mathbf{R}$ denote the estimated channel matrix and covariance matrix, respectively.

To obtain the MMSE-IRC receiver weight matrix, the covariance matrix including the sources of inter-cell interference needs to be estimated. Various schemes can be considered for that purpose.

- CRS based covariance matrix estimation scheme
  - The covariance matrix is estimated at CRS REs by following equations

$$\mathbf{R} = P_1\hat{\mathbf{H}}_1(k,l)\hat{\mathbf{H}}_1^H(k,l) + \frac{1}{N_{sp}}\sum_{k,l\in CRS}\tilde{\mathbf{r}}(k,l)\tilde{\mathbf{r}}(k,l)^H,\ \tilde{\mathbf{r}}(k,l) = \mathbf{r}(k,l) - \hat{\mathbf{H}}_1(k,l)\mathbf{d}_1(k,l),$$

    where P_1 is the transmission power of the serving cell and is equal to $E[|d_1(k,l)|^2]$ and N_{sp} is the number of sampling REs, respectively.

- DM-RS based covariance matrix estimation scheme (applicable when DM-RS are configured)
  - The covariance matrix is estimated at DM-RS REs by following equations:

$$\mathbf{R} = P_1\hat{\mathbf{H}}_1(k,l)\hat{\mathbf{H}}_1^H(k,l) + \frac{1}{N_{sp}}\sum_{k,l\in DM-RS}\tilde{\mathbf{r}}(k,l)\tilde{\mathbf{r}}(k,l)^H,\ \tilde{\mathbf{r}}(k,l) = \mathbf{r}(k,l) - \hat{\mathbf{H}}_1(k,l)\mathbf{d}_1(k,l)$$

- Data signal based covariance matrix estimation scheme
  - The covariance matrix is estimated at PDSCH REs by following equations:

$$\mathbf{R} = \frac{1}{N_{sp}}\sum_{k,l\in PDSCH,DM-RS}\mathbf{r}(k,l)\mathbf{r}(k,l)^H$$

5 Network Scenarios

To estimate the link gain that UE Interference Rejection (IRC) receivers might provide for LTE/LTE-Advanced downlinks it is necessary to first define the network scenarios under which the receivers must operate.

A network scenario for downlink performance evaluation is typically defined in terms of eNode B transmit characteristics, UE receive characteristics, traffic mix, inter-site distance, path loss model, etc. Once the network scenario(s) is defined one can then determine the associated interference profile/model that will be used in the actual link level characterization. This clause describes the network scenarios agreed to in this study, while the following clause defines the interference models that were developed based on system level simulations of these network scenarios.

The main system level assumptions are identical for each scenario, and are summarized in Table 5.1.

The system parameters and their associated values provided in Table 5.1 were initially defined in [TS36.814]. In some of these latter studies 3GPP case 3 was also considered in addition to 3GPP case 1 specified in Table 5.1, but since we are primarily interested in interference-limited environments the group felt that 3GPP case 1 condition alone was sufficient.

System level simulations were then conducted based on the above assumptions for the purposes of collecting interference statistics. Static system level simulators were deemed sufficient for this exercise, and are preferred over dynamic simulators since they are typically easier to develop and require less computation time. For every 'iteration'(or drop) in the static simulator UEs are randomly distributed across the simulated area and the relevant statistics collected. From these collected statistics certain key measures are developed, which provide some insight into how well an interference rejection receiver might work.

Table 5.1: System level assumptions for network scenarios

Parameter		3GPP Case 1	3GPP Case 3
Bandwidth		10 MHz	
Carrier frequency		2000 MHz	
Cellular Layout		Hexagonal grid, 19 cell sites, 3 sectors per site	
Inter-site		500 m	1732 m
Distance-dependent path loss		$L = 128.1 + 37.6\log_{10}(R)$, R: km	
Shadowing standard deviation		8 dB	
Shadowing correlation	Between cells	0.5	
	Between sectors	1.0	
Penetration loss		20 dB	
Antenna pattern	Horizontal	$A_H(\varphi) = -\min\left[12\left(\frac{\varphi}{\varphi_{3dB}}\right)^2, A_m\right]$ $\varphi_{3dB} = 70$ degrees, $A_m = 25dB$	
	Vertical	$A_v(\theta) = -\min\left[12\left(\frac{\theta-\theta_{etilt}}{\theta_{3dB}}\right)^2, SLA_v\right]$ $\theta_{3dB} = 10$ degrees, $SLA_v = 20dB$ Antenna height at the base station is set to 32m. Antenna height at the UE is set to 1.5m.	
		$\theta_{etilt} = 15$ degrees	$\theta_{etilt} = 6$ degrees
	Combining method in 3D antenna pattern	$A(\varphi,\theta) = -\min\{-[A_H(\varphi) + A_v(\theta)], A_m\}$	
Total BS TX power (Ptotal)		46 dBm	
Minimum distance between UE and Cell		>= 35 meters	
Hard handover hysteresis		3 dB	
Traffic model		Full buffer traffic and **non-full buffer/ non-full traffic model** (optional)	

6 Interference modelling

6.1 General

In this clause we define the interference models/profiles that were developed in order to assess the link level performance of Interference Rejection Combining (IRC) receivers. Clause 6.2 defines a number of statistical measures that were defined during the study, and which provide useful insight into understanding the complex interference environment. One of these measures, referred to as the Dominant Interferer Proportion (DIP) ratio, was agreed to in [2] as a key parameter for defining the interference profiles. System level simulations were conducted to generate results for the statistical measures defined in clause 6.2 Based on these simulation results interference profiles were developed, which were used in the link level performance characterization described in clause 8.

The working group defined the following types of interference profiles:

i) Interference profile based on median values

ii) Interference profiles based on weighted average throughput gain

Clauses 6.3 and 6.4 present the interference characterization results leading to the development of the above three types of interference profiles respectively. Finally, clause 6.5 presents a summary of all the interference profiles developed for this study item.

6.2 Statistical measures

Network interference statistics are computed using the following defined measures. Geometry G is defined as

$$G = \frac{\hat{I}_{or1}}{I_{oc}} = \frac{\hat{I}_{or1}}{\sum_{j=2}^{N_{BS}} \hat{I}_{orj} + \sigma^2}$$

where $\hat{I}_{orj}$ is the average received power from the *j*-th strongest base station ($\hat{I}_{or1}$ implies serving cell), σ^2 is the thermal noise power over the received bandwidth, and N_{BS} is the total number of base stations considered including the serving cell.

In the general case of asynchronous network, the inter-cell interference is categorized into two parts on asynchronized network. Therefore, the DIP was defined as the ratio of the power of a given interfering eNodeBs over the total other cell interference power. According to [2], the DIP of synchronized, and asynchronized interference, DIP_i^s , DIP_i^a is expressed as follows.

$$DIP_i^s = \frac{\hat{I}_{or(i+1)}^s}{I_{oc}} \quad , \quad DIP_i^a = \frac{\hat{I}_{or\,i}^a}{I_{oc}}$$

where $\hat{I}_{or\,j}^s$, $\hat{I}_{or\,j}^a$ is the average received power from the j-th strongest eNodeB for synchronized, and asynchronized interference ($\hat{I}_{or1}^s$ implies serving cell), σ^2 is the thermal noise power over the received bandwidth, and N_{BS} is the total number of eNodeBs considered including the serving cell. I_{oc} is defined as follows.

$$I_{oc} = \sum_{j=2}^{N_s} \hat{I}_{or\,j}^s + \sum_{j=1}^{N_a} \hat{I}_{or\,j}^a + N \quad .$$

Where Ns +Na = N_{BS} , i.e. is the total number of eNodeBs considered including the serving cell.

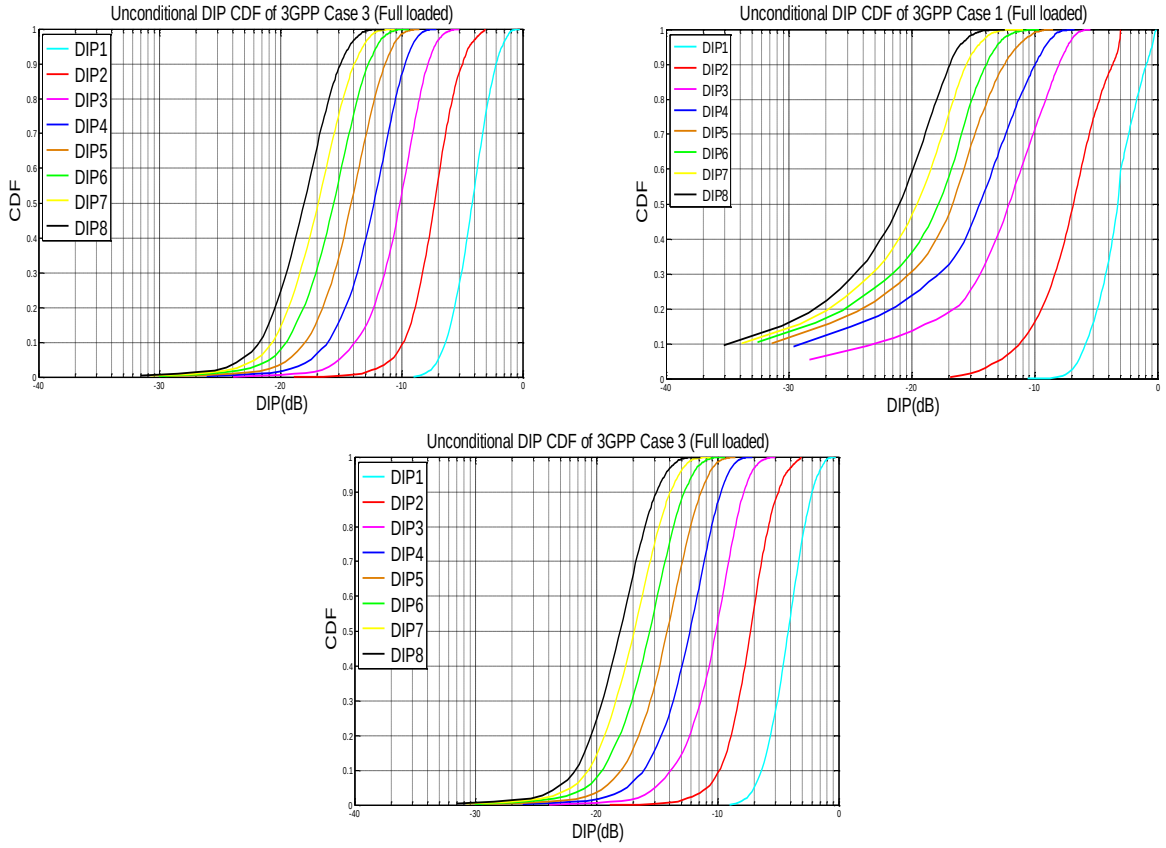
Note that power from the serving cell, $\hat{I}_{or1}^s$, is never included in any DIP calculation.

6.3 Interference profile based on median values

This clause presents interference characterization results leading to the development of the interference profile based on median DIP values. DIP ratio statistics are presented after that showing unconditional DIP CDFs and conditional median DIP values, the latter conditioned on various geometry values. This led to the group selecting an interference profile defined by a single set of median DIP values for all geometries.

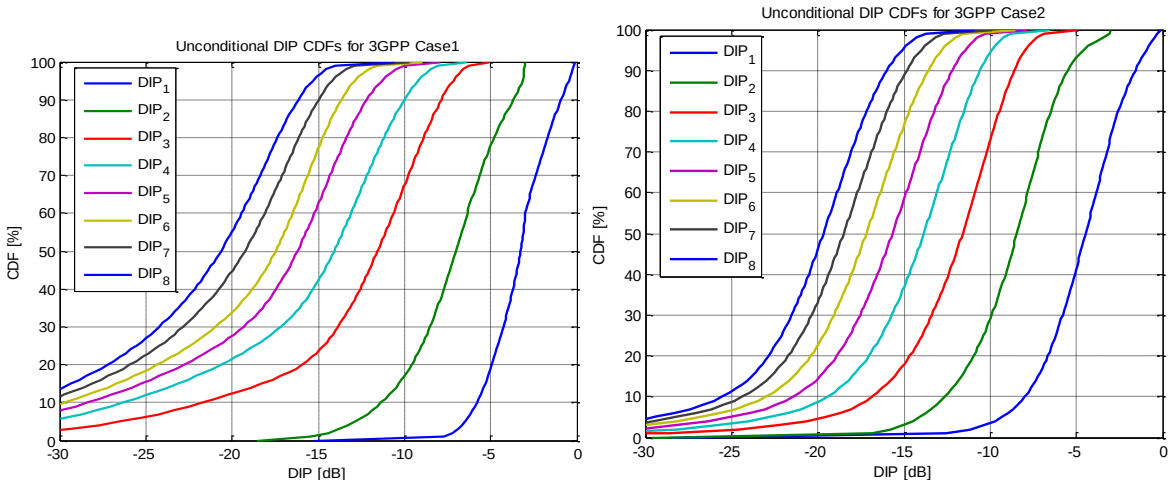
6.3.1 Unconditional DIP values

Figures 6.3-1 to 6. 3-7 present results generated by various companies to show the contribution of the strongest interfering cells to the total interference in the system. Here, the term total interference refers to I_{oc} as defined in Clause 6.2.



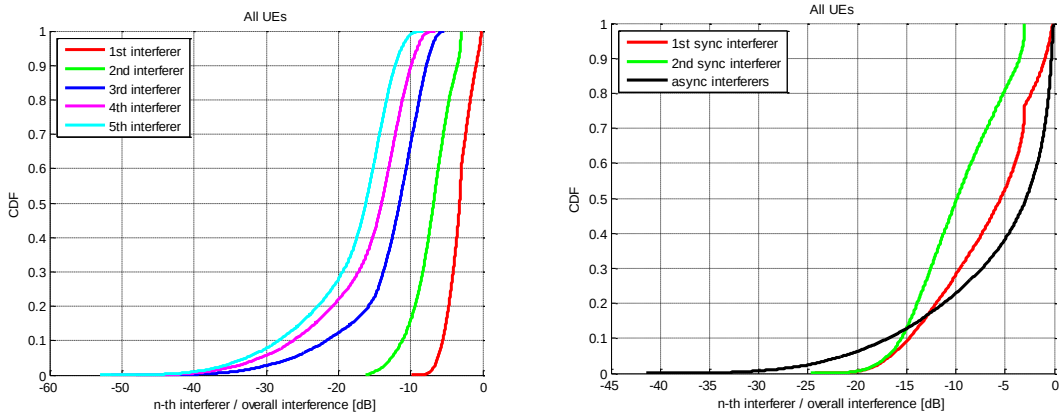
(a) 3GPP Case 1 **(b) 3GPP Case 3**

Figure 6. 3-1: Unconditional DIP performance (R4-115741, Intel Corporation)



(a) 3GPP Case 1 **(b) 3GPP Case 3**

Figure 6.3-2: Unconditional DIP performance (R4-115802, LG Electronics)



(a) All cells **(b) Only collocated cells are synchronous**

Figure 6.3-3: Unconditional DIP performance (R4-116155, Qualcomm Incorporated)

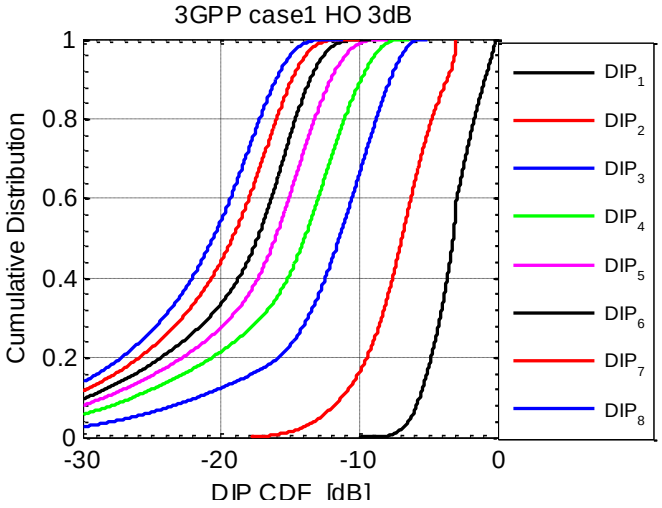


Figure 6.3-4: Unconditional DIP performance (R4-115874, Renesas Mobile Europe Ltd)

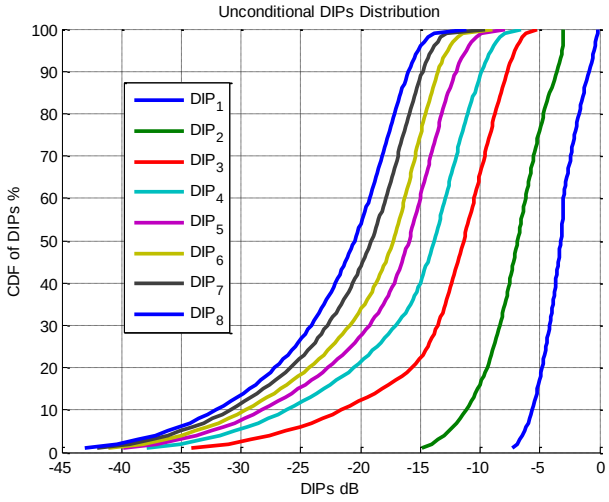
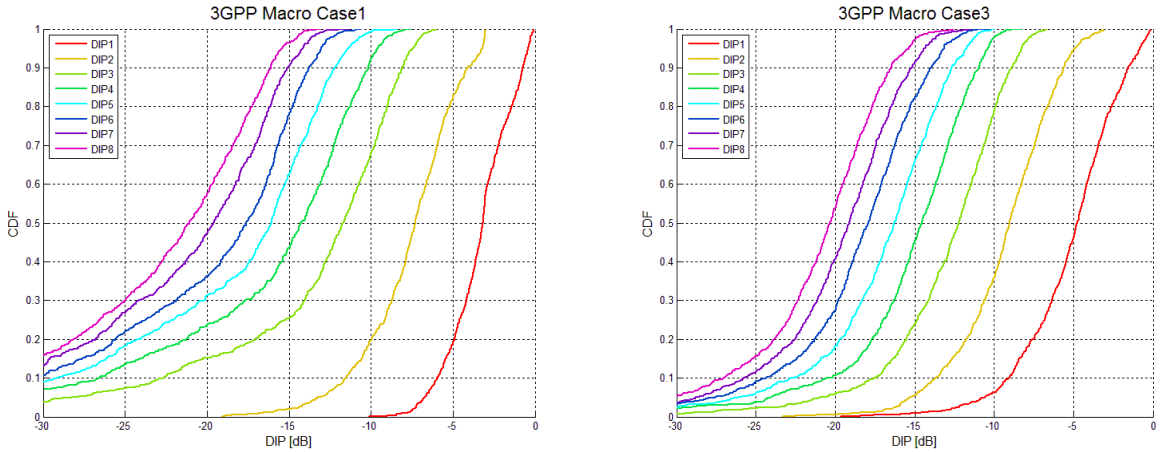


Figure 6.3-5: Unconditional DIP performance (R4-115921, Samsung)



(a) 3GPP Case 1 **(b) 3GPP Case 3**

Figure 6.3-6: Unconditional DIP performance (R4-116009, Nokia Corporation, Nokia Siemens Networks)

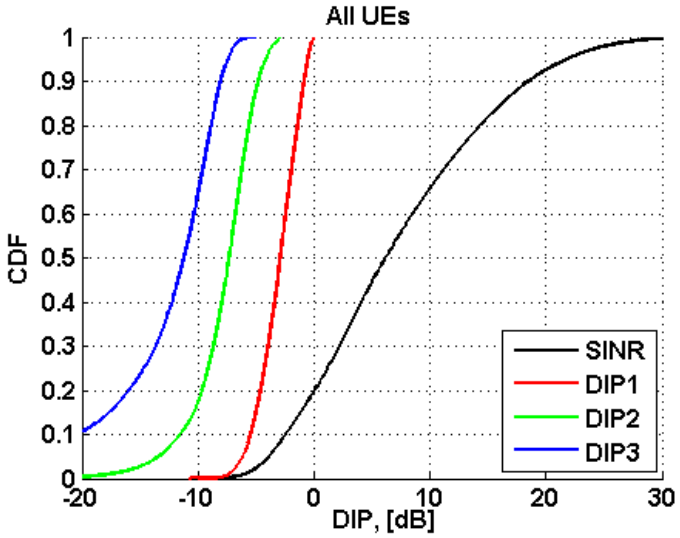


Figure 6.3-7: Unconditional DIP performance (R4- 116086, Ericsson, ST-Ericssons)

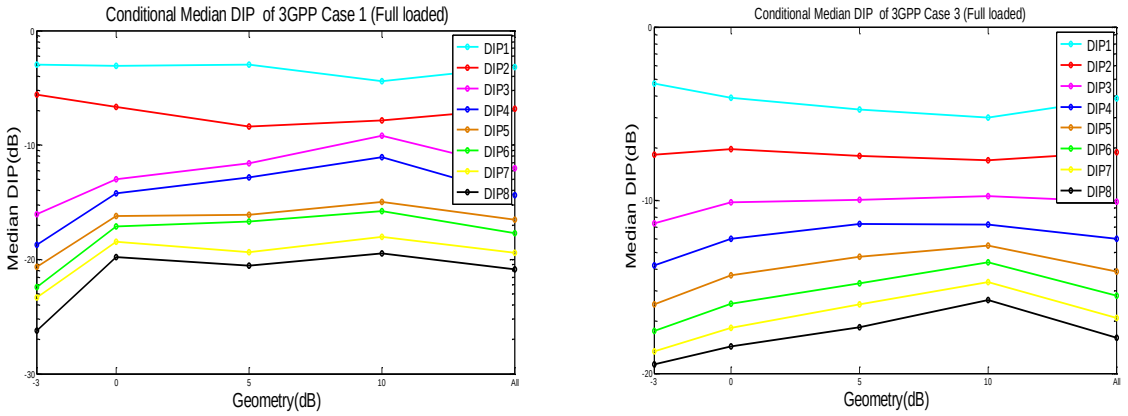
Thus, an interference profile was defined on the basis of averaging unconditional median DIP values submitted by interested companies as shown in Table 6.3-1.

Table 6.3-1: Interference Profile Based on Averaged Set of Unconditional Median DIP Values (3GPP Case 1)

	Intel (R4-115741)	LG Electronics (R4-115802)	Renesas Mobile Europe Ltd (R4-115874)	Samsung (R4-115921)	Nokia Corporation, Nokia Siemens Networks (R4-116009)	Average
DIP1	-3.21	-3.3	-3.21	-3.2483	-3.2	-3.2
DIP2	-6.81	-7	-6.92	-6.8642	-7.3	-7.0
DIP3	-12.01	-11.6	-11.44	-11.387	-11.7	-11.6
DIP4	-14.36	-14.1	-13.96	-13.854	-14.3	-14.1
DIP5	-16.53	-16.2	-16.08	-15.963	-16	-16.1
DIP6	-17.7	-17.5	-17.36			-17.5
DIP7	-19.44	-19.3	-19.17			-19.3
DIP8	-20.87	-20.7	-20.57			-20.7

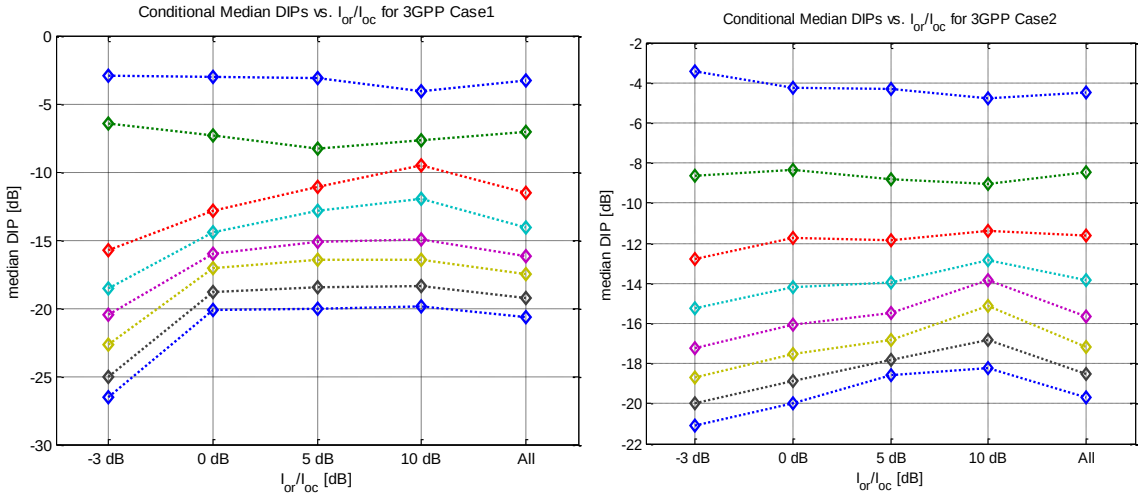
6.3.2 Conditional DIP values

Figures 6.3-8 to 6.3-15 show median values of conditional DIP_i for different values of geometry.



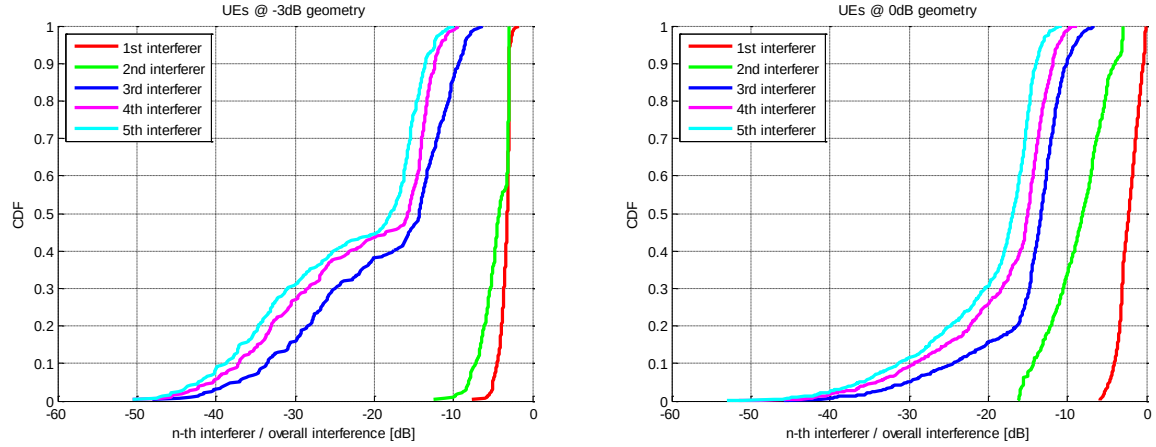
(a) 3GPP case 1 **(b) 3GPP Case 3**

Figure 6.3-8: Conditional median DIP value (R4-115741, Intel Corporation)



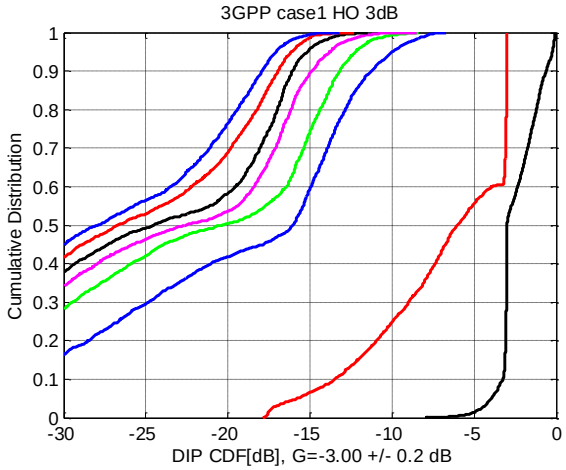
(a) 3GPP Case 1 **(b) 3GPP Case 3**

Figure 6.3-9: Conditional median DIP value (R4-115802, LG Electronics)

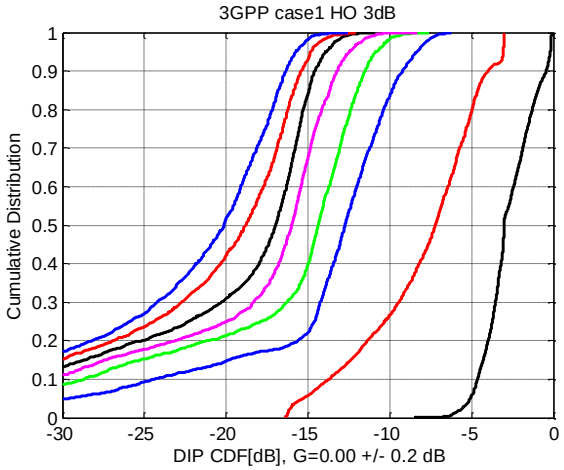


(a) -3 dB Geometry **(b) 0 dB Geometry**

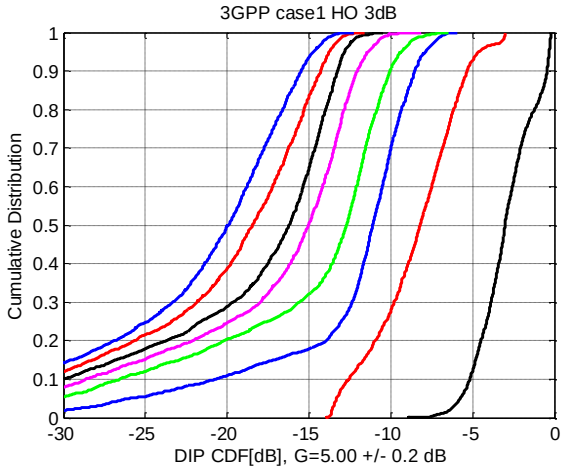
Figure 6.3-10: Conditional DIP performance (R4-116155, Qualcomm Incorporated)



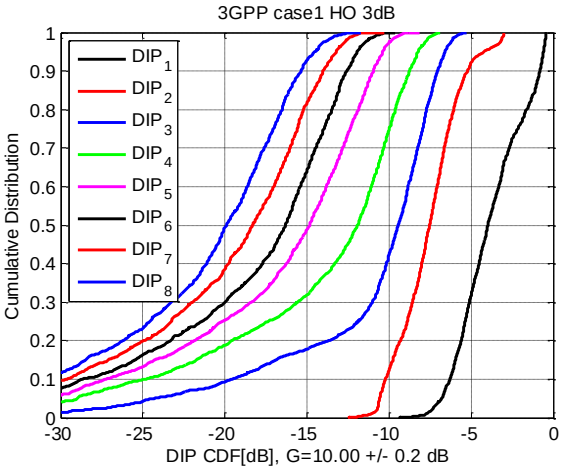
(a) -3 dB Geometry



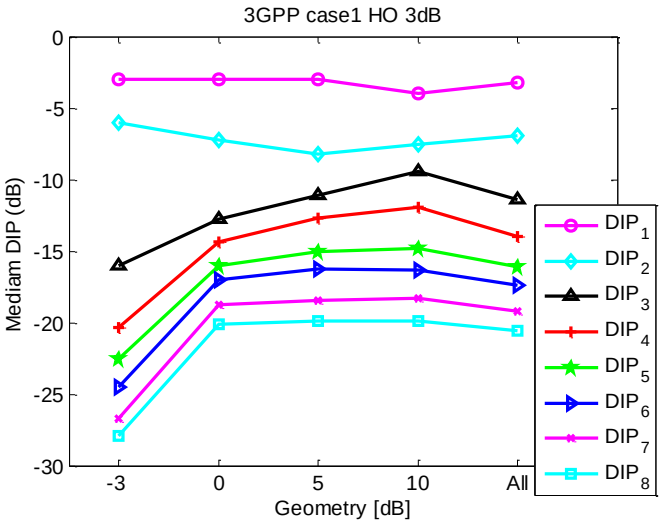
(b) 0 dB Geometry



(c) 5 dB Geometry

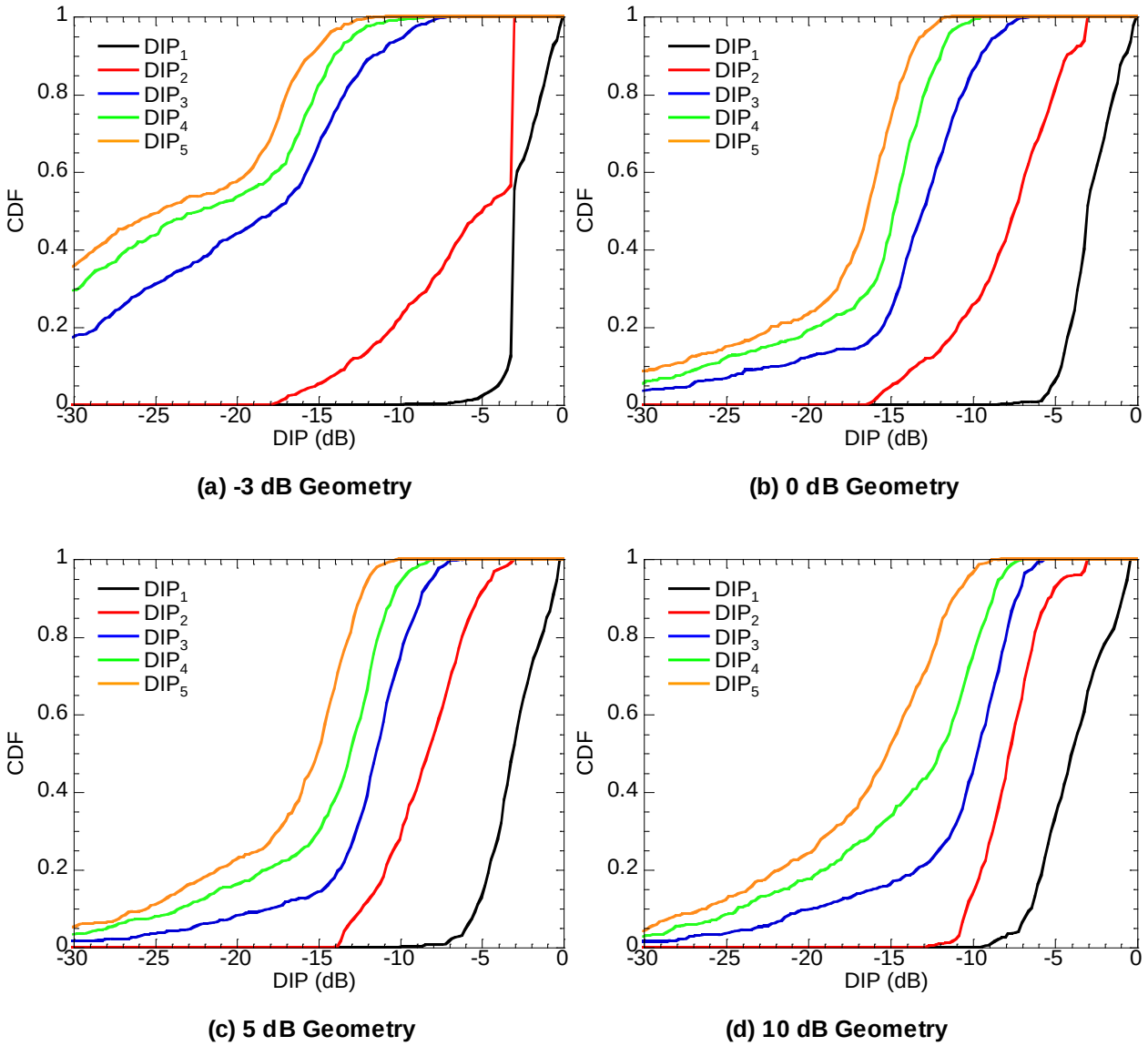


(d) 10 dB Geometry



Conditional median DIP value

Figure 6.3-11 : Conditional DIP performance (R4-115874, Renesas Mobile Europe Ltd)



(a) -3 dB Geometry

(b) 0 dB Geometry

(c) 5 dB Geometry

(d) 10 dB Geometry

Figure 6.3-12: Conditional DIP performance (R4-115911, NTT DOCOMO)

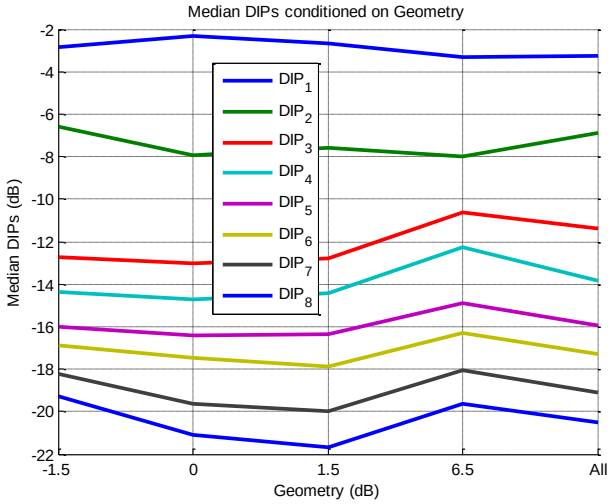
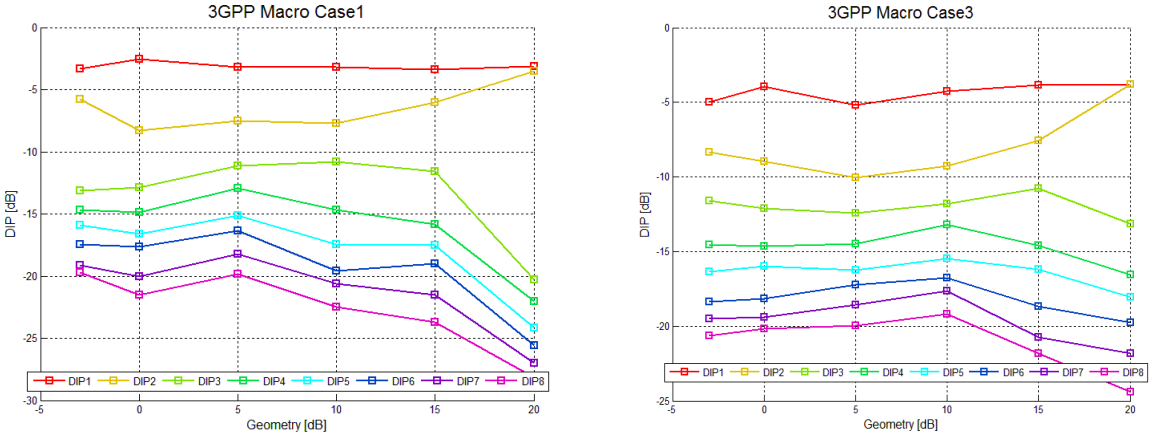
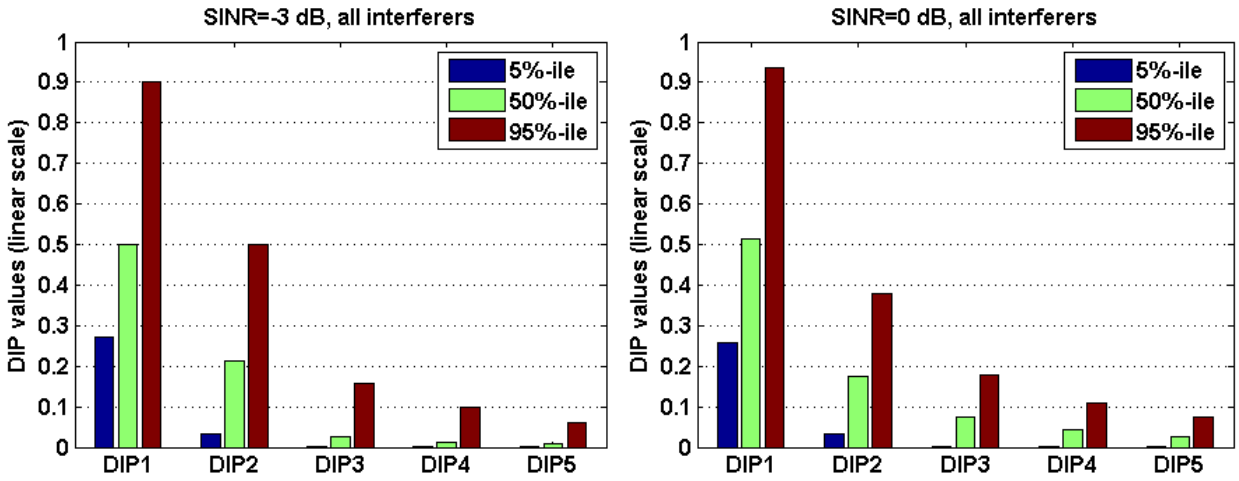


Figure 6.3-13: Conditional median DIP value (R4-115921, Samsung)



(a) 3GPP Case 1 **(b) 3GPP Case 3**

Figure 6.3-14: Conditional median DIP value (R4-116009, Nokia Corporation, Nokia Siemens Networks)



(a) -3 dB Geometry **(b) 0 dB Geometry**

Figure 6.3-15: Conditional DIP performance (R4- 116086, Ericsson, ST-Ericssons)

Thus, an interference profile was defined on the basis of averaging conditional median DIP values submitted by companies as shown in Tables 6.3-2 to 6.3-2.

Table 6.3-2: Interference Profile Based on Averaged Set of conditional Median DIP Values on -3 dB geometry (3GPP Case 1)

	Intel Corporation (R4-115741)	LG Electronics (R4-115802)	Renesas Mobile Europe Ltd (R4-115874)	NTT DOCOMO (R4-115911)	Nokia Corporation ,Nokia Siemens Networks (R4-116009)	Qualcomm Incorporated (R4-116155)	Huawei (R4-116068)	Average
DIP1	-2.99	-2.9	-3.01	-3.02	-3.3	-3.57	-3.2	-3.1
DIP2	-5.58	-6.5	-5.99	-4.97	-5.8	-4.12	-4.28	-5.4
DIP3	-16.07	-15.8	-16.02	-17.65	-13.1	-11.64	-14.58	-14.5
DIP4	-18.74	-18.5	-20.33	-22.17	-14.7	-14.79	-16.95	-17.3
DIP5	-20.63	-20.5	-22.54	-24.61	-15.9	-16.99	-18.33	-19.1
DIP6	-22.43	-22.6	-24.51			-19.2		-21.7
DIP7	-23.35	-25	-26.69			-21.26		-23.6
DIP8	-26.22	-26.5	-27.89					-26.8

Table 6.3-3: Interference Profile Based on Averaged Set of conditional Median DIP Values on 0 dB geometry (3GPP Case 1)

	Intel Corporation (R4-115741)	LG Electronics (R4-115802)	Renesas Mobile Europe Ltd (R4-115874)	NTT DOCOMO (R4-115911)	Samsung (R4-115921)	Nokia Corporation,Nokia Siemens Networks (R4-116009)	Qualcomm Incorporated (R4-116155)	Huawei (R4-116068)	Average
DIP1	-3.07	-3	-3.02	-3.01	-2.6	-2.5	-2.47	-2.53	-2.8
DIP2	-6.67	-7.3	-7.21	-7.42	-7.55	-8.3	-6.57	-7.13	-7.3
DIP3	-12.97	-12.8	-12.74	-12.97	-12.79	-12.9	-11.17	-12.36	-12.5
DIP4	-14.24	-14.4	-14.37	-14.76		-14.8	-14.09	-14.4	-14.4
DIP5	-16.2	-16	-15.99	-16.37		-16.6	-16.29	-16.22	-16.2
DIP6	-17.11	-17.1	-16.98				-18		-17.3
DIP7	-18.46	-18.8	-18.79				-19.44		-18.9
DIP8	-19.79	-20.1	-20.13						-20.0

Table 6.3-4: Interference Profile Based on Averaged Set of conditional Median DIP Values on 5 dB geometry (3GPP Case 1)

	Intel Corporation (R4-115741)	LG Electronics (R4-115802)	Renesas Mobile Europe Ltd (R4-115874)	NTT DOCOMO (R4-115911)	Average
DIP1	-3	-3.1	-3.03	-3.08	-3.1
DIP2	-8.4	-8.3	-8.2	-8.29	-8.3
DIP3	-11.61	-11.1	-11.1	-11.44	-11.3
DIP4	-12.85	-12.8	-12.7	-13.05	-12.8
DIP5	-16.11	-15.1	-15.01	-15.05	-15.3
DIP6	-16.67	-16.4	-16.22		-16.4
DIP7	-19.39	-18.5	-18.45		-18.8
DIP8	-20.53	-20	-19.91		-20.1

Table 6.3-5: Interference Profile Based on Averaged Set of conditional Median DIP Values on 10 dB geometry (3GPP Case 1)

	Intel Corporation (R4-115741)	LG Electronics (R4-115802)	Renesas Mobile Europe Ltd (R4-115874)	NTT DOCOMO (R4-115911)	Average
DIP1	-4.44	-4.1	-3.97	-3.92	-4.1
DIP2	-7.85	-7.7	-7.52	-7.74	-7.7
DIP3	-9.18	-9.6	-9.44	-9.69	-9.5
DIP4	-11.06	-12	-11.92	-12.01	-11.7
DIP5	-14.96	-15	-14.83	-15.15	-15.0
DIP6	-15.75	-16.5	-16.31		-16.2
DIP7	-18	-18.4	-18.31		-18.2
DIP8	-19.47	-19.8	-19.91		-19.7

Table 6.3-6 Interference Profile Based on Averaged Set of conditional Median DIP Values on -2.5 dB geometry (3GPP Case 1)

	Renesas Mobile Europe Ltd.	Qualcomm	NTT DOCOMO	LG Electronics	Samsung	Nokia & NSN	Huawei, HiSilicon	Intel	Ericsson/ ST-Ericsson	Average
DIP1	-1.80	-3.32088	-1.82	-1.88	-1.86	-1.86245	-2.05	-1.6143	-2.1509	-2.01583
DIP2	-8.81	-6.68858	-8.74	-8.87	-8.69	-8.75842	-8.4	-8.2199	-8.0601	-8.3061
DIP3	-13.82	-11.9205	-14.31	-14.06	-13.78	-13.9684	-14.01	-14.7588	-12.6122	-13.6095
DIP4	-15.38	-14.2839	-15.90	-15.49	-15.55	-15.474	-15.49	-15.8655	-14.8345	-15.3354
DIP5	-17.12	-15.8067	-17.52	-17.10	-17.32	-16.7555	-17.14	-17.2333	-17.0936	-16.9827
DIP6	-18.03			-18.07	-18.27	-18.0096		-17.7536	-18.8292	-18.148
DIP7	-19.69			-19.82	-20.16	-19.859		-18.7361	-20.2962	-19.7281
DIP8	-21.38			-21.54	-21.62	-21.3519		-22.3888	-21.5206	-21.6216
DIP9	-22.65			-22.87		-22.6504		-22.3888	-22.7336	-22.6554

6.4 Interference profiles based on weighted average throughput gain

6.4.1 General

This clause led to the development of an alternative method for calculating DIP values based on what is called the 'weighted average throughput gain'. This method develops multiple sets of DIP ratios, the resulting throughput gains of which are averaged to find an average throughput gain. The set of DIP ratios closest to this average is then selected as the typical interference profile. Two profiles were ultimately defined, one for 0 dB geometry, and the other for -3 dB geometry. The remainder of this clause describes the methodology used to define these two interference profiles along with their associated values.

6.4.2 Averaged evaluation results

This sub-clause shows the averages of evaluation results for weighted average throughput gain. The details of evaluation results by interested companies are shown in sub-clause 6.4.3 and 6.4.4.

Table 6.4-1: Average of the evaluation results on 0 dB geometry

#	DIP1 [dB]	DIP2 [dB]	DIP3 [dB]	DIP4 [dB]	DIP5 [dB]	DIP6 [dB]	DIP7 [dB]	DIP8 [dB]	DIP9 [dB]
1	-5.88	-7.07	-9.22	-11.64	-13.26	-14.48	-15.43	-16.41	-17.24
2	-4.87	-6.30	-9.89	-12.43	-13.93	-15.13	-16.15	-17.18	-17.97
3	-4.42	-6.07	-10.47	-12.67	-14.30	-15.52	-16.56	-17.57	-18.36
4	-4.09	-5.78	-10.92	-13.09	-14.79	-15.92	-16.99	-18.03	-19.07
5	-3.83	-5.85	-11.41	-13.21	-15.05	-16.06	-17.13	-18.10	-19.15
6	-3.62	-5.76	-11.52	-13.61	-15.43	-16.58	-17.70	-18.69	-19.86
7	-3.43	-5.64	-11.94	-14.12	-15.85	-16.73	-17.99	-19.06	-20.12
8	-3.25	-5.19	-12.73	-14.71	-16.64	-17.22	-18.41	-19.47	-20.69
9	-3.12	-4.98	-13.62	-15.64	-17.45	-18.53	-19.80	-20.97	-22.12
10	-3.00	-4.39	-15.93	-17.87	-19.97	-24.11	-25.21	-26.20	-28.36
11	-2.88	-5.09	-14.60	-16.46	-18.47	-20.87	-21.97	-22.86	-25.58
12	-2.62	-7.21	-12.48	-14.18	-16.24	-17.39	-18.71	-19.73	-21.29
13	-2.33	-7.57	-12.71	-14.47	-16.42	-17.53	-19.02	-20.23	-21.76
14	-2.06	-8.25	-12.86	-14.73	-16.52	-17.66	-19.22	-20.51	-22.04
15	-1.78	-8.96	-12.98	-14.83	-16.81	-17.68	-19.64	-21.16	-22.53
16	-1.52	-9.74	-13.25	-15.20	-16.97	-18.01	-20.48	-22.15	-23.71
17	-1.24	-10.71	-13.67	-15.62	-17.13	-18.77	-21.70	-23.57	-24.95
18	-0.87	-11.52	-14.41	-17.60	-19.32	-22.32	-24.58	-26.10	-27.27
19	-0.41	-13.38	-17.54	-22.56	-24.76	-27.72	-29.12	-30.29	-31.57
20	-0.17	-15.60	-24.18	-29.22	-31.84	-34.02	-35.24	-36.41	-37.91

Table 6.4-2: Average of the evaluation results on -3 dB geometry

#	DIP1 [dB]	DIP2 [dB]	DIP3 [dB]	DIP4 [dB]	DIP5 [dB]	DIP6 [dB]	DIP7 [dB]	DIP8 [dB]	DIP9 [dB]
1	-5.23	-6.62	-9.56	-12.06	-13.54	-14.91	-16.11	-17.22	-18.05
2	-4.01	-5.85	-10.76	-12.92	-14.90	-16.88	-18.09	-19.04	-20.02
3	-3.54	-4.46	-13.26	-15.92	-17.44	-20.66	-21.93	-23.23	-23.32
4	-3.37	-4.04	-14.19	-16.89	-18.31	-22.42	-23.85	-25.07	-24.88
5	-3.22	-4.00	-15.20	-17.73	-19.45	-24.18	-25.34	-26.72	-26.73
6	-3.11	-3.60	-18.84	-21.61	-23.49	-30.35	-31.66	-32.64	-33.23
7	-3.07	-3.35	-20.65	-23.71	-25.42	-32.64	-33.55	-34.70	-36.79
8	-3.04	-3.34	-21.90	-26.00	-27.63	-34.34	-35.54	-36.57	-37.78
9	-3.01	-3.54	-20.45	-24.70	-26.18	-30.65	-31.85	-33.19	-33.42
10	-2.97	-3.46	-20.74	-23.63	-25.78	-27.47	-28.25	-29.37	-28.97
11	-2.87	-4.13	-17.51	-20.16	-21.66	-22.42	-23.55	-24.59	-25.74
12	-2.60	-5.69	-13.95	-16.01	-17.63	-17.91	-19.11	-20.12	-21.25
13	-2.33	-5.90	-14.29	-16.30	-18.26	-18.21	-19.42	-20.36	-21.82
14	-2.08	-6.42	-14.71	-16.50	-18.42	-18.39	-19.56	-20.59	-22.01
15	-1.86	-6.67	-15.05	-16.84	-18.81	-18.64	-20.04	-21.27	-22.80
16	-1.66	-7.01	-15.60	-17.22	-19.09	-18.77	-20.71	-22.20	-23.83
17	-1.45	-7.85	-15.39	-17.19	-18.89	-19.34	-21.78	-23.45	-25.29
18	-1.21	-8.76	-15.38	-17.52	-19.04	-20.65	-23.68	-25.46	-27.15
19	-0.87	-10.13	-16.23	-19.78	-21.61	-26.10	-27.99	-29.24	-30.94
20	-0.62	-12.46	-18.56	-20.66	-22.39	-33.02	-34.31	-35.44	-36.81

Table 6.4-2a Average of the evaluation results on -2.5 dB geometry

#	DIP1 [dB]	DIP2 [dB]	DIP3 [dB]	DIP4 [dB]	DIP5 [dB]	DIP6 [dB]	DIP7 [dB]	DIP8 [dB]	DIP9 [dB]
1	-5.71	-6.77	-9.27	-11.87	-13.42	-14.75	-15.85	-16.94	-18.01
2	-4.34	-5.91	-10.48	-12.91	-14.34	-15.86	-16.99	-17.95	-18.66
3	-3.86	-5.63	-11.11	-13.36	-15.04	-16.68	-17.83	-18.88	-20.09
4	-3.49	-5.54	-11.51	-13.90	-15.57	-17.32	-18.40	-19.46	-20.81
5	-3.22	-5.42	-12.48	-14.84	-16.34	-18.09	-19.27	-20.13	-20.83
6	-2.99	-5.95	-12.30	-14.63	-16.31	-17.78	-19.03	-19.91	-21.10
7	-2.72	-6.80	-11.76	-14.14	-16.00	-17.70	-18.95	-19.91	-21.09
8	-2.50	-7.21	-12.20	-14.52	-16.13	-17.82	-19.16	-20.06	-21.25
9	-2.30	-7.28	-12.76	-14.95	-16.50	-18.15	-19.30	-20.46	-22.05
10	-2.12	-7.78	-12.63	-14.96	-16.71	-18.29	-19.90	-20.98	-22.37
11	-1.90	-8.33	-12.68	-14.89	-16.68	-18.24	-19.61	-21.12	-22.34
12	-1.73	-8.66	-12.92	-15.23	-16.81	-18.46	-19.94	-21.45	-22.64
13	-1.55	-9.31	-13.11	-15.36	-16.79	-18.41	-20.28	-21.95	-23.48
14	-1.39	-9.55	-13.17	-15.71	-17.13	-18.77	-21.05	-22.78	-24.35
15	-1.21	-9.92	-13.37	-16.23	-17.52	-19.40	-22.05	-23.60	-25.03
16	-1.03	-10.99	-13.59	-16.39	-17.67	-20.10	-22.96	-24.73	-26.06
17	-0.83	-11.44	-14.37	-17.66	-19.06	-22.80	-25.38	-26.92	-28.19
18	-0.58	-12.12	-15.65	-19.92	-21.64	-27.09	-28.38	-29.65	-30.81
19	-0.41	-13.21	-17.70	-21.65	-22.91	-30.41	-31.63	-32.68	-33.66
20	-0.31	-13.73	-19.72	-22.65	-24.09	-35.27	-36.76	-37.84	-38.74

6.4.3 0 dB geometry

Table 6.4-3 to 6.4-10 present the evaluation results generated by various interested companies to show the contribution of the strongest interfering cells to the total interference in the system. Here, the term total interference refers to I_{oc} as defined in Clause 6.2.

Table 6.4-3: Averaged DIP profiles for weighted average throughput gain study (Renesas Mobile Europe Ltd)

#	DIP1 [dB]	DIP2 [dB]	DIP3 [dB]	DIP4 [dB]	DIP5 [dB]	DIP6 [dB]	DIP7 [dB]	DIP8 [dB]	DIP9 [dB]
1	-5.65	-6.76	-8.84	-11.37	-12.74	-14.2	-15.02	-16.16	-16.84
2	-4.82	-6.11	-9.22	-12.2	-13.8	-14.9	-15.81	-16.86	-17.63
3	-4.46	-5.88	-10.05	-12.25	-13.88	-15.28	-16.3	-17.14	-17.96
4	-4.13	-5.79	-10.4	-12.55	-14.32	-15.78	-16.69	-17.8	-18.51
5	-3.84	-5.68	-11.24	-12.98	-14.57	-15.79	-16.87	-17.91	-18.65
6	-3.63	-5.36	-11.42	-13.62	-15.34	-16.34	-17.41	-18.43	-19.34
7	-3.45	-5.74	-11.49	-13.23	-15.29	-16.37	-17.49	-18.57	-19.45
8	-3.29	-5.45	-12.11	-13.59	-15.2	-16.81	-18.03	-19.25	-20.46
9	-3.12	-4.3	-14.59	-16.37	-17.89	-19.21	-20.27	-21.34	-22.36
10	-3.04	-3.65	-16.99	-19.48	-21.3	-22.45	-23.21	-24.18	-25.21
11	-2.91	-5.43	-12.9	-14.84	-16.68	-17.91	-18.98	-19.71	-20.48
12	-2.57	-7.2	-11.72	-13.55	-15.74	-16.75	-17.97	-18.87	-19.99
13	-2.28	-7.24	-12.34	-13.86	-15.73	-16.81	-18.74	-19.97	-21.07
14	-1.99	-8.49	-12.42	-13.94	-16	-16.84	-18.38	-19.68	-20.8
15	-1.73	-9.11	-12.64	-14.15	-16.16	-17.02	-18.81	-20.47	-21.41
16	-1.44	-10.04	-12.8	-14.66	-16.34	-17.39	-19.8	-21.55	-22.76
17	-1.12	-11.09	-13.34	-15.55	-16.82	-18.33	-21.08	-23.27	-24.51
18	-0.7	-12.01	-14.56	-18.15	-20.25	-22.33	-24.78	-26.28	-27.28
19	-0.29	-14.05	-19.37	-24.27	-26.97	-28.39	-29.65	-30.63	-31.43
20	-0.15	-15.65	-25.89	-31.5	-33.74	-34.89	-36.04	-37.06	-38.23

Table 6.4-4: Averaged DIP profiles for weighted average throughput gain study (Huawei)

#	DIP1 [dB]	DIP2 [dB]	DIP3 [dB]	DIP4 [dB]	DIP5 [dB]
1	-5.865	-7.0647	-9.2521	-11.957	-13.275
2	-4.6605	-6.2999	-10.367	-12.634	-14.03
3	-4.182	-5.826	-10.574	-12.999	-14.737
4	-3.8497	-5.6965	-11.322	-13.668	-15.189
5	-3.5753	-6.0072	-11.384	-12.96	-15.339
6	-3.3504	-5.7166	-11.903	-13.637	-15.728
7	-3.1384	-4.8773	-12.981	-15.629	-17.58
8	-3.04	-3.7061	-17.302	-19.378	-21.343
9	-2.9615	-5.1678	-13.412	-14.853	-17.141
10	-2.7738	-7.0038	-11.795	-13.565	-15.53
11	-2.5934	-7.2618	-11.903	-13.633	-15.956
12	-2.389	-7.8348	-12.502	-13.811	-15.867
13	-2.1735	-8.1787	-12.492	-13.953	-16.135
14	-1.9587	-8.3529	-12.511	-15.069	-16.329
15	-1.7387	-9.604	-12.323	-14.38	-16.28
16	-1.547	-9.4992	-12.968	-15.121	-16.321
17	-1.3649	-10.321	-12.941	-14.94	-16.456
18	-1.1231	-10.911	-13.703	-15.681	-16.564
19	-0.6185	-12.389	-15.33	-19.193	-20.519
20	-0.2047	-15.026	-22.095	-27.624	-30.573

Table 6.4-5: Averaged DIP profiles for weighted average throughput gain study (NTT DOCOMO)

#	DIP1 [dB]	DIP2 [dB]	DIP3 [dB]	DIP4 [dB]	DIP5 [dB]	DIP6 [dB]	DIP7 [dB]	DIP8 [dB]
1	-5.92	-7.07	-9.19	-11.84	-13.61	-14.83	-15.76	-16.70
2	-4.82	-6.20	-9.60	-12.56	-14.13	-15.42	-16.44	-17.46
3	-4.34	-5.87	-10.36	-12.94	-14.57	-15.88	-16.91	-17.92
4	-4.02	-5.67	-10.99	-13.24	-14.98	-16.21	-17.26	-18.22
5	-3.78	-5.57	-11.34	-13.54	-15.35	-16.56	-17.60	-18.54
6	-3.58	-5.49	-11.65	-13.86	-15.68	-16.87	-17.93	-18.90
7	-3.39	-5.38	-11.99	-14.23	-16.06	-17.28	-18.40	-19.36
8	-3.24	-5.13	-12.66	-14.87	-16.65	-17.89	-19.04	-20.01
9	-3.11	-4.38	-14.35	-16.56	-18.40	-19.63	-20.73	-21.71
10	-3.04	-3.55	-18.08	-20.28	-22.09	-23.38	-24.54	-25.52
11	-2.95	-5.24	-13.27	-15.25	-17.11	-18.35	-19.49	-20.47
12	-2.66	-6.79	-12.18	-14.12	-16.02	-17.22	-18.37	-19.38
13	-2.35	-7.34	-12.42	-14.24	-16.21	-17.37	-18.59	-19.74
14	-2.05	-8.07	-12.63	-14.40	-16.37	-17.41	-18.80	-20.13
15	-1.76	-8.81	-12.94	-14.61	-16.56	-17.50	-19.18	-20.74
16	-1.48	-9.64	-13.27	-15.00	-16.82	-17.68	-19.83	-21.68
17	-1.19	-10.58	-13.71	-15.54	-17.15	-18.16	-21.06	-23.03
18	-0.84	-11.54	-14.35	-17.21	-18.91	-20.71	-23.82	-25.59
19	-0.39	-13.45	-17.23	-22.63	-25.39	-26.92	-28.28	-29.47
20	-0.17	-15.47	-23.45	-28.87	-31.42	-32.87	-34.09	-35.21

Table 6.4-6: Averaged DIP profiles for weighted average throughput gain study (LG Electronics)

#	DIP1 [dB]	DIP2 [dB]	DIP3 [dB]	DIP4 [dB]	DIP5 [dB]	DIP6 [dB]	DIP7 [dB]	DIP8 [dB]	DIP9 [dB]
1	-5.8619	-7.0436	-9.1760	-11.9551	-13.4959	-14.6345	-15.4888	-16.3200	-17.0346
2	-4.9315	-6.2444	-10.0978	-12.6201	-14.0077	-15.1439	-15.9927	-17.0032	-17.7675
3	-4.4667	-5.8248	-10.7197	-13.0399	-14.3747	-15.6419	-16.4676	-17.4536	-18.3376
4	-4.1418	-5.6678	-11.2892	-13.1518	-14.9025	-15.9102	-16.8676	-17.9663	-18.7442
5	-3.8927	-5.6459	-11.6185	-13.4404	-15.1746	-16.1567	-17.2802	-18.1071	-19.1205
6	-3.6637	-5.8251	-11.9179	-13.6993	-15.3293	-16.2498	-17.3705	-18.2973	-19.5200
7	-3.4763	-5.8073	-12.1619	-13.9412	-15.6313	-16.5623	-17.8611	-18.7494	-19.9467
8	-3.3077	-5.8313	-12.3797	-14.0268	-15.8945	-16.9531	-18.2082	-19.1049	-20.2683
9	-3.1645	-5.4435	-13.1122	-14.6914	-16.6319	-17.7256	-18.9843	-20.2458	-21.7628
10	-3.0559	-3.0740	-23.3764	-27.4116	-29.5493	-30.7114	-31.7364	-32.7950	-33.7117
11	-3.0125	-3.0799	-26.3132	-30.1892	-31.6396	-33.1165	-34.6654	-35.0586	-35.8137
12	-2.7630	-6.9710	-12.3660	-13.8933	-15.7999	-16.7505	-18.0893	-19.0441	-20.3155
13	-2.4386	-7.6143	-12.5674	-14.0519	-15.9130	-16.8989	-18.3608	-19.4226	-20.8063
14	-2.1435	-8.3534	-12.6688	-14.1526	-16.1377	-16.9458	-18.7366	-20.1023	-21.4947
15	-1.8463	-9.1804	-12.9220	-14.4208	-16.1596	-16.9468	-19.4151	-20.9301	-22.1039
16	-1.5519	-10.2885	-13.2476	-14.5470	-16.1456	-16.9571	-20.0712	-21.5804	-22.8181
17	-1.2575	-11.1967	-13.4713	-15.1009	-16.4475	-17.8847	-21.7399	-23.3346	-24.3640
18	-0.8685	-11.8709	-14.0599	-17.7533	-20.7734	-22.7718	-24.6602	-26.0331	-27.1441
19	-0.3608	-13.8737	-17.6892	-24.3753	-26.6442	-28.0377	-29.3528	-30.5015	-31.3952
20	-0.1577	-15.8112	-26.2492	-31.5799	-33.7033	-34.8700	-36.1906	-37.3643	-38.1964

Table 6.4-7: Averaged DIP profiles for weighted average throughput gain study (Samsung)

#	DIP1 [dB]	DIP2 [dB]	DIP3 [dB]	DIP4 [dB]	DIP5 [dB]	DIP6 [dB]	DIP7 [dB]	DIP8 [dB]
1	-5.84	-6.82	-8.72	-11.20	-12.90	-14.03	-14.90	-15.89
2	-4.81	-5.84	-9.69	-12.17	-13.60	-14.90	-15.90	-16.99
3	-4.35	-5.76	-10.34	-12.58	-14.09	-15.35	-16.42	-17.42
4	-4.05	-5.68	-10.66	-12.98	-14.56	-15.81	-16.85	-17.54
5	-3.83	-5.52	-11.12	-13.18	-14.88	-16.22	-16.96	-17.83
6	-3.63	-5.61	-11.21	-13.22	-14.95	-16.11	-17.26	-18.25
7	-3.46	-5.47	-11.43	-13.75	-15.35	-16.36	-17.84	-18.95
8	-3.31	-5.52	-11.53	-13.93	-15.72	-16.80	-17.82	-18.77
9	-3.16	-4.96	-12.61	-14.47	-16.42	-17.74	-19.32	-20.36
10	-3.05	-3.79	-16.25	-18.63	-20.17	-21.42	-22.73	-23.54
11	-2.94	-4.99	-13.21	-15.22	-17.24	-18.56	-19.66	-20.59
12	-2.64	-6.98	-11.89	-13.62	-15.50	-16.47	-17.87	-18.85
13	-2.32	-7.43	-12.10	-13.72	-15.64	-17.11	-18.18	-19.61
14	-2.02	-8.40	-12.31	-14.08	-15.82	-16.92	-18.27	-19.62
15	-1.71	-9.24	-12.47	-14.24	-16.16	-17.24	-18.84	-20.67
16	-1.43	-10.03	-12.95	-14.78	-16.28	-17.19	-19.63	-21.52
17	-1.16	-10.83	-13.48	-15.40	-16.85	-18.09	-20.80	-22.88
18	-0.75	-11.29	-14.47	-18.43	-20.75	-22.72	-24.75	-26.31
19	-0.34	-13.73	-18.05	-23.41	-25.78	-27.06	-28.50	-29.75
20	-0.16	-15.50	-24.17	-29.66	-31.91	-33.13	-34.41	-35.66

Table 6.4-8: Averaged DIP profiles for weighted average throughput gain study (Nokia, Nokia Siemens network)

#	DIP1 [dB]	DIP2 [dB]	DIP3 [dB]	DIP4 [dB]	DIP5 [dB]	DIP6 [dB]	DIP7 [dB]	DIP8 [dB]	DIP9 [dB]
1	-6.2407	-7.5592	-9.7475	-11.9808	-13.5248	-14.6192	-15.6522	-16.6735	-17.3987
2	-5.1667	-6.8679	-10.28	-12.6933	-14.0734	-15.3187	-16.1827	-17.1004	-17.9932
3	-4.633	-6.3385	-10.5515	-12.7274	-14.449	-15.5141	-16.4882	-17.6692	-18.3592
4	-4.2846	-6.0834	-11.1279	-12.9679	-14.7784	-15.8254	-17.133	-17.9058	-19.1298
5	-3.971	-6.1871	-11.4565	-13.2176	-15.1321	-15.992	-17.2162	-18.0042	-19.3268
6	-3.7204	-6.0274	-11.4842	-13.9178	-16.1162	-17.5866	-18.6354	-19.5758	-20.5095
7	-3.5402	-5.9913	-12.381	-14.31	-15.8298	-16.7635	-17.955	-19.2207	-20.6276
8	-3.341	-6.0667	-12.2684	-14.6174	-16.5011	-17.6511	-18.9175	-19.9996	-21.007
9	-3.1848	-5.5284	-14.1191	-16.5949	-18.6389	-19.7514	-21.0141	-22.1437	-23.1744
10	-3.0786	-4.5058	-18.8836	-22.2462	-24.778	-25.9614	-27.2171	-28.29	-29.0102
11	-3.0206	-4.0294	-26.8727	-30.5606	-32.5056	-33.5762	-34.7361	-35.7986	-36.4452
12	-2.8282	-7.2005	-12.507	-14.4949	-16.3858	-17.3392	-18.7773	-20.0923	-21.3562
13	-2.4538	-7.7076	-13.0857	-14.4816	-16.3256	-17.0214	-18.9062	-20.1413	-21.391
14	-2.1774	-8.2424	-12.5051	-14.4431	-16.6521	-17.7212	-19.4467	-20.6289	-21.777
15	-1.8481	-9.3719	-12.7835	-14.535	-16.2892	-17.1516	-19.7342	-20.7438	-22.0134
16	-1.5165	-10.0593	-13.1832	-15.3912	-16.9401	-18.2791	-20.7637	-22.2226	-23.4954
17	-1.2082	-10.8927	-14.0176	-16.2183	-17.8699	-19.5667	-22.7735	-24.6554	-25.5008
18	-0.8082	-11.8627	-14.6144	-19.1934	-21.126	-23.434	-25.3881	-26.8631	-27.7896
19	-0.3866	-13.7034	-18.6701	-24.7807	-27.4187	-28.6705	-30.1705	-31.3037	-32.2756
20	-0.1779	-15.4269	-26.1048	-31.8715	-34.1994	-35.2751	-36.5001	-37.6414	-38.5364

Table 6.4-9: Averaged DIP profiles for weighted average throughput gain study (Ericsson, ST-Ericsson)

#	DIP1 [dB]	DIP2 [dB]	DIP3 [dB]	DIP4 [dB]	DIP5 [dB]	DIP6 [dB]	DIP7 [dB]	DIP8 [dB]	DIP9 [dB]
1	-6.213	-7.1383	-8.9969	-10.9965	-13.1147	-14.6155	-15.8355	-16.7794	-17.7265
2	-5.1159	-6.861	-9.4339	-11.3914	-13.961	-15.1213	-16.6035	-17.6962	-18.5537
3	-4.6711	-6.408	-10.0659	-12.2611	-14.1322	-15.4957	-16.8239	-17.8502	-18.8451
4	-4.2915	-6.1979	-10.2094	-12.6791	-14.7442	-16.0228	-17.1936	-18.8606	-20.0437
5	-4.0541	-6.17	-11.2617	-13.1923	-14.5144	-15.7216	-16.8918	-18.2625	-19.5565
6	-3.8426	-6.055	-11.0147	-13.2864	-15.0134	-16.4658	-17.7555	-18.8063	-20.188
7	-3.6123	-6.1555	-11.0628	-14.005	-15.6856	-17.1201	-18.4592	-19.617	-20.5712
8	-3.3881	-6.1193	-11.5838	-14.0054	-15.6612	-17.3465	-18.6023	-19.866	-21.0943
9	-3.2015	-6.7318	-11.9764	-14.3366	-16.187	-17.7134	-18.9575	-20.4128	-21.3968
10	-3.0543	-5.0764	-19.8148	-22.9153	-24.4543	-26.168	-27.2281	-28.6871	-29.416
11	-2.9497	-5.7946	-18.1387	-20.7744	-22.8762	-24.6453	-25.6338	-26.8546	-27.8943
12	-2.7043	-7.0489	-15.8326	-18.3487	-19.8285	-21.5027	-22.939	-23.9216	-25.0896
13	-2.4317	-7.2002	-15.3419	-18.2996	-20.1298	-21.5246	-22.7268	-23.8021	-24.7903
14	-2.1417	-7.505	-16.1587	-18.7568	-20.4297	-21.7792	-23.434	-24.4833	-25.3289
15	-1.9022	-8.1877	-15.9649	-18.9637	-20.711	-22.0019	-23.1935	-24.5648	-25.7809
16	-1.6126	-8.9666	-16.8318	-19.2871	-21.1167	-22.6883	-24.2588	-25.5367	-26.8926
17	-1.2746	-10.0438	-16.2709	-18.2937	-20.0613	-21.6552	-23.3034	-24.5813	-25.5787
18	-0.8848	-11.6853	-16.9014	-18.9897	-20.5568	-22.4786	-24.2277	-25.6468	-26.9273
19	-0.4505	-13.2655	-19.2315	-24.3682	-26.3203	-27.5637	-29.0276	-30.3315	-31.2689
20	-0.1614	-16.2675	-25.5136	-29.4815	-31.8823	-33.7171	-34.8286	-36.088	-36.8849

Table 6.4-10: Averaged DIP profiles for weighted average throughput gain study (Qualcomm)

#	DIP1 [dB]	DIP2 [dB]	DIP3 [dB]	DIP4 [dB]	DIP5 [dB]
1	-5.46501	-7.16119	-9.9449	-11.9441	-13.5065
2	-4.67128	-6.05788	-10.6582	-13.481	-13.8819
3	-4.31149	-6.73089	-11.1967	-12.6151	-14.2601
4	-4.00559	-5.5087	-11.5712	-13.6117	-14.8931
5	-3.73517	-6.09992	-11.9464	-13.217	-15.5597
6	-3.52709	-6.06197	-11.6569	-13.6725	-15.4177
7	-3.35687	-5.83782	-12.3578	-14.2318	-15.741
8	-3.13203	-4.29144	-14.4695	-15.4992	-19.2052
9	-3.04889	-3.91933	-16.0679	-19.2565	-19.3959
10	-2.946	-5.7952	-12.9566	-14.0436	-16.723
11	-2.69019	-6.27852	-13.2615	-14.642	-16.5219
12	-2.3994	-7.77309	-11.9985	-13.3246	-16.0726
13	-2.21503	-7.9491	-12.0982	-14.5924	-16.6892
14	-1.97612	-8.65895	-12.7843	-14.5891	-15.927
15	-1.73663	-8.3731	-12.7544	-14.9349	-17.8638
16	-1.54704	-9.58577	-12.0772	-14.4672	-17.5624
17	-1.37321	-10.8444	-12.9147	-14.8326	-16.4487
18	-1.03864	-11.1205	-13.4548	-16.5789	-17.9631
19	-0.48525	-12.8628	-16.3747	-21.0118	-23.966
20	-0.18772	-15.7827	-22.3299	-26.4224	-29.5023

6.4.4 -3 dB geometry

Table 6.4-11 to 6.4-18 present the evaluation results generated by various interested companies to show the contribution of the strongest interfering cells to the total interference in the system. Here, the term total interference refers to I_{oc} as defined in Clause 6.2.

Table 6.4-11: Averaged DIP profiles for weighted average throughput gain study (Renesas Mobile Europe Ltd)

#	DIP1 [dB]	DIP2 [dB]	DIP3 [dB]	DIP4 [dB]	DIP5 [dB]	DIP6 [dB]	DIP7 [dB]	DIP8 [dB]	DIP9 [dB]
1	-4.71	-6.06	-9.76	-12.01	-13.53	-14.93	-16.01	-16.97	-17.9
2	-3.57	-5.47	-11.18	-13.64	-15.05	-16.65	-17.57	-18.66	-19.82
3	-3.16	-3.62	-16.02	-18.75	-20.93	-22.11	-23.49	-24.52	-25.24
4	-3.09	-3.33	-19.02	-21.52	-23.04	-24.45	-25.91	-27.03	-28.27
5	-3.06	-3.15	-21.53	-24.77	-26.65	-28.31	-29.1	-30.61	-31.5
6	-3.04	-3.09	-24.33	-27.74	-29.54	-30.74	-31.65	-32.43	-32.86
7	-3.03	-3.08	-24.69	-29.32	-30.69	-31.38	-31.94	-32.9	-33.26
8	-3.02	-3.05	-26.42	-30.55	-33.47	-34.2	-35.78	-36.9	-37.5
9	-3.02	-3.02	-32.74	-36.35	-38.27	-39.67	-40.59	-41.63	-42.57
10	-3.01	-3.01	-37.12	-40.74	-42.38	-43.27	-45.02	-45.89	-46.75
11	-2.89	-5	-14	-15.96	-17.32	-18.33	-19.46	-20.3	-21.49
12	-2.52	-6.78	-12.55	-14.42	-15.9	-17.13	-18.2	-19.21	-20.09
13	-2.17	-7.14	-12.67	-14.58	-16.68	-17.78	-19.09	-20.01	-20.89
14	-1.87	-8.22	-13.21	-14.82	-16.67	-17.64	-18.67	-19.56	-20.66
15	-1.6	-8.88	-13.38	-14.73	-16.98	-17.88	-19.47	-20.52	-21.88
16	-1.34	-9.85	-13.97	-15.26	-17.24	-17.98	-19.97	-21.27	-22.4
17	-1.08	-11.05	-14.28	-15.67	-17.49	-18.43	-20.7	-22.23	-23.66
18	-0.8	-12.01	-14.82	-16.83	-18.25	-19.52	-22.73	-24.87	-25.95
19	-0.4	-13.41	-16.92	-22.13	-24.55	-26.14	-27.83	-29.11	-30.19
20	-0.13	-16.64	-24.05	-29.46	-31.98	-33.2	-34.4	-35.3	-35.98

Table 6.4-12: Averaged DIP profiles for weighted average throughput gain study (Huawei)

#	DIP1 [dB]	DIP2 [dB]	DIP3 [dB]	DIP4 [dB]	DIP5 [dB]
1	-5.8283	-6.8922	-9.5263	-12.39	-13.2028
2	-4.6005	-6.2802	-10.2509	-12.9594	-14.3707
3	-4.2161	-5.7565	-10.2873	-12.8084	-14.1505
4	-3.8324	-5.4359	-11.2982	-13.941	-14.9584
5	-3.4141	-5.623	-12.3508	-14.2719	-15.4566
6	-3.176	-3.524	-16.7884	-19.3307	-21.1121
7	-3.1196	-3.4414	-18.3441	-21.0554	-22.4374
8	-3.087	-3.2683	-19.7636	-22.3462	-24.0694
9	-3.063	-3.2455	-20.8648	-23.9478	-25.1882
10	-3.0475	-3.0475	-25.4692	-29.5841	-31.918
11	-3.0372	-3.0805	-23.7958	-27.9438	-31.5107
12	-3.03	-3.0703	-26.076	-28.4274	-31.1073
13	-3.0237	-3.0239	-30.6622	-33.8871	-36.3219
14	-3.0191	-3.0204	-31.9476	-35.4273	-37.3782
15	-3.0154	-3.0549	-28.77	-29.696	-33.4925
16	-3.0126	-3.0158	-34.9985	-39.8178	-42.3843
17	-2.9323	-4.6738	-14.9184	-16.7106	-18.0823
18	-2.6738	-6.9425	-12.0575	-14.0684	-15.7901
19	-2.3553	-7.4162	-12.6658	-14.6243	-16.1349
20	-2.089	-7.8228	-13.0559	-14.421	-16.6435

Table 6.4-13: Averaged DIP profiles for weighted average throughput gain study (NTT DOCOMO)

#	DIP1 [dB]	DIP2 [dB]	DIP3 [dB]	DIP4 [dB]	DIP5 [dB]	DIP6 [dB]	DIP7 [dB]	DIP8 [dB]
1	-4.82	-6.31	-9.82	-12.75	-14.23	-15.53	-16.69	-17.75
2	-3.50	-5.40	-11.97	-14.45	-15.88	-17.16	-18.32	-19.30
3	-3.16	-3.44	-17.15	-20.67	-22.43	-23.76	-24.93	-26.01
4	-3.10	-3.24	-19.58	-23.14	-24.96	-26.29	-27.42	-28.49
5	-3.07	-3.17	-21.28	-24.74	-26.61	-27.97	-29.16	-30.16
6	-3.05	-3.12	-23.07	-26.47	-28.35	-29.65	-30.78	-31.79
7	-3.04	-3.08	-24.92	-28.38	-30.34	-31.59	-32.71	-33.79
8	-3.03	-3.06	-26.71	-29.85	-31.72	-33.02	-34.06	-35.08
9	-3.02	-3.04	-28.58	-31.71	-33.47	-34.69	-35.86	-36.81
10	-3.02	-3.04	-30.23	-32.97	-34.66	-35.84	-36.76	-37.79
11	-2.97	-3.66	-17.96	-20.36	-21.89	-23.23	-24.34	-25.31
12	-2.66	-6.24	-12.83	-14.98	-16.58	-17.89	-18.98	-19.94
13	-2.26	-7.14	-12.96	-15.01	-16.74	-17.97	-19.07	-20.01
14	-1.92	-7.83	-13.30	-15.24	-17.09	-18.31	-19.45	-20.47
15	-1.62	-8.69	-13.66	-15.48	-17.40	-18.51	-19.80	-20.96
16	-1.34	-9.71	-14.05	-15.75	-17.67	-18.66	-20.22	-21.68
17	-1.07	-10.80	-14.52	-16.19	-18.07	-18.93	-21.03	-22.81
18	-0.81	-12.12	-15.08	-17.02	-18.60	-19.70	-22.65	-24.63
19	-0.45	-13.56	-16.66	-20.42	-22.42	-24.41	-26.87	-28.35
20	-0.16	-16.38	-22.36	-27.96	-30.58	-32.07	-33.29	-34.47

Table 6.4-14: Averaged DIP profiles for weighted average throughput gain study (LG Electronics)

#	DIP1 [dB]	DIP2 [dB]	DIP3 [dB]	DIP4 [dB]	DIP5 [dB]	DIP6 [dB]	DIP7 [dB]	DIP8 [dB]	DIP9 [dB]
1	-4.7643	-6.5326	-9.8138	-12.8463	-14.1669	-15.3941	-16.485	-17.5255	-18.2743
2	-3.6197	-5.6355	-12.3593	-14.259	-15.7324	-16.687	-17.6984	-18.634	-19.5075
3	-3.1721	-3.1821	-17.557	-22.3138	-24.5515	-25.9221	-27.0752	-28.2436	-29.0766
4	-3.0999	-3.1027	-21.5157	-25.834	-28.0358	-29.2949	-30.3734	-31.4269	-32.2483
5	-3.0654	-3.0664	-23.9707	-28.1387	-30.2512	-31.4344	-32.4608	-33.5959	-34.335
6	-3.0455	-3.0459	-26.034	-30.1923	-32.3608	-33.588	-34.5504	-35.5686	-36.2972
7	-3.033	-3.0331	-28.1743	-32.1223	-34.2727	-35.5153	-36.4633	-37.447	-38.2622
8	-3.0246	-3.0247	-30.2085	-34.066	-36.3355	-37.5446	-38.4535	-39.4153	-40.1746
9	-3.0184	-3.0185	-32.9483	-36.5528	-38.5781	-39.8728	-40.8068	-41.7562	-42.5069
10	-3.0138	-3.0138	-37.0069	-40.5672	-42.5571	-43.633	-44.4738	-45.5953	-46.3819
11	-2.939	-3.1984	-20.5193	-25.3784	-27.552	-28.8187	-30.0968	-31.2489	-32.3817
12	-2.5611	-6.7955	-13.1398	-14.7664	-16.5154	-17.3704	-18.4984	-19.3857	-20.4504
13	-2.1954	-7.5551	-13.2913	-14.9753	-16.7207	-17.623	-18.6871	-19.6664	-20.9721
14	-1.8924	-8.4039	-13.4885	-15.0953	-16.9667	-17.8447	-19.054	-20.142	-21.5765
15	-1.6074	-9.2277	-13.862	-15.3477	-17.1403	-18.008	-19.5074	-20.9369	-22.2167
16	-1.3313	-10.3506	-14.0772	-15.5351	-17.3012	-18.0262	-20.3443	-21.9346	-23.1267
17	-1.0754	-11.6634	-14.4565	-15.8666	-17.5821	-18.4159	-21.6461	-23.3075	-24.4146
18	-0.8047	-12.9068	-14.968	-16.8028	-18.007	-20.3663	-23.9016	-25.4162	-26.5584
19	-0.3947	-14.1814	-16.9989	-23.0348	-25.5422	-27.0674	-28.5483	-29.6667	-30.5752
20	-0.1441	-16.9332	-25.0485	-30.5422	-32.7985	-34.0198	-35.2789	-36.4503	-37.3597

Table 6.4-15: Averaged DIP profiles for weighted average throughput gain study (Samsung)

#	DIP1 [dB]	DIP2 [dB]	DIP3 [dB]	DIP4 [dB]	DIP5 [dB]	DIP6 [dB]	DIP7 [dB]	DIP8 [dB]
1	-4.6654	-6.1770	-9.6749	-12.2110	-13.5760	-14.7440	-15.9380	-17.1720
2	-3.4303	-5.1679	-11.8850	-14.4470	-16.0220	-16.9490	-18.1780	-18.9840
3	-3.1503	-3.5261	-16.5210	-19.1940	-21.4460	-22.5710	-24.0020	-25.1010
4	-3.0929	-3.2919	-18.5550	-21.8350	-23.6630	-24.9050	-26.9800	-28.1490
5	-3.0622	-3.1826	-21.3020	-23.9150	-25.6620	-27.7130	-28.8070	-29.6860
6	-3.0449	-3.0633	-24.2760	-28.3550	-29.8850	-30.7360	-33.5690	-34.6910
7	-3.0323	-3.1152	-24.0590	-26.3370	-28.6330	-29.6330	-30.5570	-31.8450
8	-3.0247	-3.0373	-28.2170	-32.0570	-33.8130	-35.1490	-35.7870	-36.4580
9	-3.0187	-3.0569	-28.6770	-30.5220	-32.3580	-33.1220	-33.8430	-34.7340
10	-3.0141	-3.0346	-30.2020	-32.6300	-35.6200	-35.9070	-36.4110	-37.3240
11	-2.9598	-3.8077	-16.8220	-19.4050	-20.5430	-21.9640	-22.8860	-24.1510
12	-2.6473	-6.3489	-12.2560	-14.4030	-15.9550	-17.3770	-18.4720	-19.6680
13	-2.2494	-7.1334	-12.9800	-14.7740	-16.4860	-17.4910	-18.5410	-19.5050
14	-1.9004	-7.9687	-13.0820	-14.8270	-16.7240	-17.7520	-18.9630	-19.9560
15	-1.6221	-8.7205	-13.1880	-15.1940	-17.0690	-18.3290	-19.5090	-20.6140
16	-1.3832	-9.6512	-13.7870	-15.2280	-17.1650	-17.9490	-19.4740	-21.2760
17	-1.1365	-10.4420	-13.9790	-16.0080	-17.6930	-18.4580	-20.5800	-22.1330
18	-0.8710	-11.9310	-14.3140	-16.5750	-18.0390	-19.1170	-22.3030	-24.1830
19	-0.4734	-13.4190	-16.0980	-20.2730	-22.0150	-24.3030	-26.5130	-27.8280
20	-0.1494	-16.3980	-22.8470	-28.4380	-30.9700	-32.2370	-33.7150	-34.7560

Table 6.4-16: Averaged DIP profiles for weighted average throughput gain study (Nokia, Nokia Siemens network)

#	DIP1 [dB]	DIP2 [dB]	DIP3 [dB]	DIP4 [dB]	DIP5 [dB]	DIP6 [dB]	DIP7 [dB]	DIP8 [dB]	DIP9 [dB]
1	-5.392	-6.8495	-9.8254	-12.5059	-13.9405	-15.0082	-16.1151	-17.2234	-18.1211
2	-3.7385	-6.1893	-12.2371	-13.9491	-15.4314	-16.6603	-17.9768	-18.7593	-19.7517
3	-3.2336	-4.9016	-15.4861	-18.7416	-20.0484	-21.4996	-22.9214	-24.4216	-25.273
4	-3.1137	-3.4042	-20.8414	-24.8684	-26.5475	-27.7002	-28.7728	-29.7764	-30.7359
5	-3.0726	-3.1956	-23.7028	-27.9787	-29.7875	-31.1362	-32.2048	-33.2251	-33.9159
6	-3.0482	-3.1748	-25.431	-29.5575	-31.7321	-32.8755	-33.8728	-34.839	-35.5882
7	-3.0338	-3.0987	-27.7462	-31.7981	-34.0034	-35.1251	-36.2273	-37.7	-38.4881
8	-3.0253	-3.0486	-30.2269	-33.6843	-35.6488	-36.5414	-37.7719	-38.7782	-39.6799
9	-3.0185	-3.2351	-32.7304	-36.0915	-37.8988	-38.8993	-39.6819	-40.6964	-41.6166
10	-3.0138	-3.052	-36.754	-40.2442	-42.5867	-43.5161	-44.4472	-45.4911	-46.4736
11	-2.9371	-4.6345	-25.8009	-29.0231	-30.5709	-32.0442	-33.265	-34.259	-35.1089
12	-2.5764	-7.8197	-12.6902	-14.3934	-15.9859	-17.2697	-18.8532	-19.7656	-20.6667
13	-2.2308	-8.0219	-12.8676	-14.5299	-16.7468	-17.9906	-19.4427	-20.3036	-21.505
14	-1.8768	-8.907	-13.6424	-15.127	-16.9831	-18.1962	-19.5312	-20.6658	-21.8103
15	-1.56	-9.9968	-13.6436	-15.4386	-17.4368	-18.3638	-19.7739	-21.1588	-22.4361
16	-1.2955	-10.6117	-14.1445	-15.7417	-17.5307	-18.7315	-21.2895	-22.5682	-24.1274
17	-1.0255	-11.6837	-14.7973	-16.9256	-18.339	-19.7094	-22.6223	-24.3926	-25.5607
18	-0.7566	-12.4332	-16.0277	-18.8628	-20.413	-22.7264	-25.3188	-26.7132	-27.7652
19	-0.3419	-14.778	-19.3463	-25.1823	-27.5699	-29.0454	-30.3424	-31.6595	-32.3701
20	-0.1416	-16.6914	-25.7652	-31.4983	-33.5805	-35.1575	-36.2675	-37.4665	-38.2079

Table 6.4-17: Averaged DIP profiles for weighted average throughput gain study (Ericsson, ST-Ericsson)

#	DIP1 [dB]	DIP2 [dB]	DIP3 [dB]	DIP4 [dB]	DIP5 [dB]	DIP6 [dB]	DIP7 [dB]	DIP8 [dB]	DIP9 [dB]
1	-5.8677	-7.1428	-8.6273	-10.4515	-12.3388	-14.0114	-15.5336	-16.7787	-17.9149
2	-4.4906	-6.1856	-8.2153	-11.1464	-14.5904	-17.1839	-18.963	-20.0864	-21.2066
3	-4.1803	-6.2904	-9.8567	-12.2766	-14.4571	-15.8563	-17.0488	-18.4436	-19.4269
4	-3.8679	-6.4528	-9.7748	-12.5505	-14.8304	-16.5126	-17.9345	-19.2204	-19.9653
5	-3.4573	-6.3029	-10.2647	-13.9225	-15.7244	-17.7837	-18.988	-20.4838	-21.5411
6	-3.0801	-5.0333	-18.6087	-22.9157	-25.4422	-27.4121	-28.6306	-29.6289	-30.5853
7	-3.0207	-3.031	-31.3366	-34.3722	-35.908	-37.6706	-38.9567	-40.019	-41.2796
8	-2.9806	-4.4785	-24.7736	-28.0989	-30.619	-32.0424	-33.5203	-34.7522	-35.4484
9	-2.8252	-6.0065	-17.1215	-20.6644	-22.368	-23.9755	-25.2726	-26.7533	-27.8506
10	-2.5302	-7.1095	-13.0451	-16.3515	-18.4141	-19.964	-20.7369	-21.8691	-23.0109
11	-2.192	-7.0968	-14.5731	-17.7746	-20.3808	-21.8042	-23.0922	-24.4226	-25.7011
12	-1.8896	-7.7448	-14.2922	-17.5761	-20.1096	-22.114	-23.5282	-24.6956	-25.8253
13	-1.6585	-8.267	-13.9422	-17.1478	-19.5727	-21.5038	-23.0277	-24.0357	-25.0588
14	-1.4246	-9.2622	-14.8	-17.8028	-19.8359	-21.7787	-22.8837	-24.0097	-25.1998
15	-1.2146	-9.5896	-15.8045	-18.491	-20.3519	-21.8102	-23.2596	-24.558	-25.5568
16	-1.0321	-10.1727	-16.9482	-19.9313	-21.6003	-23.1282	-24.6996	-25.9659	-26.8643
17	-0.8434	-10.6448	-17.7268	-20.6128	-22.9563	-24.6595	-26.2547	-28.2719	-29.5016
18	-0.6314	-11.7499	-19.3821	-22.3893	-23.9848	-25.2969	-26.8858	-28.0669	-28.8963
19	-0.3875	-13.8403	-20.9325	-24.3568	-26.2844	-27.5411	-28.9403	-29.8351	-30.9223
20	-0.1607	-17.5633	-24.9932	-27.8219	-30.4978	-32.2575	-33.6094	-34.8986	-36.069

Table 6.4-18: Averaged DIP profiles for weighted average throughput gain study (Qualcomm)

#	DIP1 [dB]	DIP2 [dB]	DIP3 [dB]	DIP4 [dB]	DIP5 [dB]
1	-6.05786	-7.12753	-9.54064	-11.7873	-13.6815
2	-5.55456	-6.6704	-9.79932	-10.5338	-13.0037
3	-4.2951	-6.4676	-11.6633	-13.9927	-14.4914
4	-3.89766	-5.36371	-11.3837	-13.6358	-14.3061
5	-3.61793	-5.86338	-12.2973	-13.6625	-15.7768
6	-3.38973	-5.44349	-12.8302	-15.0977	-16.9091
7	-3.2223	-5.33672	-14.0109	-17.076	-18.8337
8	-3.15096	-3.94933	-15.2334	-20.2864	-21.56
9	-3.12366	-4.57389	-13.9546	-19.1298	-20.4646
10	-3.10147	-3.69686	-19.0083	-20.4153	-22.7601
11	-3.08441	-3.76987	-18.3291	-20.638	-20.843
12	-3.06018	-3.5098	-18.8214	-21.0943	-21.4796
13	-3.04717	-3.05177	-25.1745	-29.9758	-31.9793
14	-3.03714	-3.3664	-22.7952	-23.1339	-26.8825
15	-3.02859	-3.03342	-29.4381	-32.506	-36.2823
16	-3.02276	-3.02762	-30.7326	-33.9663	-36.8169
17	-3.0185	-3.02334	-31.9333	-35.1739	-37.7413
18	-3.01421	-3.01919	-35.1907	-38.9432	-40.8957
19	-2.97666	-4.58664	-15.1554	-18.7368	-20.7473
20	-2.82991	-7.91434	-14.192	-16.0012	-16.9251

Note that according to the discussion and analysis, abnormally large proportion of UEs conditioned to G ≈ -3dB and having DIP1 ≈ DIP2 ≈ -3dB are observed. The root cause for such phenomenon was found to be an unfortunate combination of agreed simulation assumptions together with 3D antenna modelling in 3GPP. This behaviour is purely a simulation artifact and not representative of any real antenna deployments in the field. References R4-120311and R4-120525 provide a detailed analysis of the issue.

6.4.5 -2.5 dB geometry

Table 6.4-19 to 6.4-27 present the evaluation results generated by various interested companies to show the contribution of the strongest interfering cells to the total interference in the system. Here, the term total interference refers to I_{oc} as defined in Clause 6.2.

Table 6.4-19 Averaged DIP profiles for weighted average throughput gain study (Renesas Mobile Europe Ltd)

#	DIP1	DIP2	DIP3	DIP4	DIP5	DIP6	DIP7	DIP8	DIP9
	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]
1	-5.19	-6.44	-9.08	-11.72	-13.24	-14.41	-15.45	-16.71	-17.40
2	-4.02	-5.33	-10.84	-13.24	-14.78	-16.03	-16.98	-18.22	-19.01
3	-3.52	-5.64	-11.40	-13.70	-15.53	-16.70	-17.58	-18.38	-19.33
4	-3.15	-5.09	-12.63	-14.85	-16.43	-17.87	-19.08	-20.01	-21.13
5	-2.93	-5.38	-12.99	-14.85	-16.60	-17.87	-19.25	-20.05	-21.00
6	-2.70	-6.58	-12.12	-14.24	-15.70	-16.94	-18.01	-18.90	-19.72
7	-2.46	-6.93	-12.34	-14.31	-15.94	-17.23	-18.35	-19.32	-20.15
8	-2.27	-7.43	-12.19	-14.40	-16.03	-17.30	-18.34	-19.33	-20.16
9	-2.08	-7.47	-12.94	-14.94	-16.47	-17.24	-18.51	-19.54	-20.86
10	-1.90	-7.99	-12.91	-14.67	-16.85	-17.78	-18.73	-19.95	-20.87
11	-1.71	-8.82	-12.73	-14.53	-16.74	-17.63	-19.07	-20.42	-21.67
12	-1.54	-9.39	-13.30	-15.00	-17.12	-17.89	-18.84	-20.35	-21.52
13	-1.38	-9.70	-13.49	-15.27	-17.31	-18.10	-19.40	-21.12	-22.41
14	-1.23	-10.18	-13.79	-15.58	-17.24	-18.14	-20.10	-22.35	-23.26
15	-1.06	-11.37	-13.96	-15.62	-17.39	-18.26	-21.23	-22.61	-23.70
16	-0.87	-12.17	-14.26	-16.33	-17.94	-19.16	-22.31	-24.20	-25.03
17	-0.62	-12.88	-15.17	-18.51	-19.92	-21.91	-25.15	-26.76	-27.58
18	-0.30	-14.79	-17.98	-23.63	-26.64	-27.67	-28.82	-29.87	-30.63
19	-0.17	-15.85	-22.56	-27.62	-29.96	-31.38	-32.82	-33.86	-34.75
20	-0.11	-16.88	-27.54	-32.24	-34.74	-35.69	-37.05	-38.26	-39.40

Table 6.4-20 Averaged DIP profiles for weighted average throughput gain study (Qulacomm)

#	DIP1	DIP2	DIP3	DIP4	DIP5
	[dB]	[dB]	[dB]	[dB]	[dB]
1	-6.75489	-7.57132	-9.87039	-12.0067	-13.2917
2	-4.98848	-6.71589	-9.16326	-11.412	-13.2938
3	-4.67683	-6.62406	-9.44577	-11.8072	-13.3791
4	-4.33103	-6.34741	-8.82377	-12.0773	-13.6654
5	-4.08551	-6.62255	-8.86234	-12.181	-14.0806
6	-3.89266	-6.71073	-8.75772	-12.5508	-14.0243
7	-3.71338	-6.73642	-8.49185	-12.3181	-13.7011
8	-3.4772	-6.94152	-8.39678	-12.1876	-13.5226
9	-3.34487	-6.91394	-8.95482	-12.8076	-13.3858
10	-3.19686	-6.74172	-8.68439	-13.4937	-14.1789
11	-3.08963	-6.8996	-8.96806	-13.4641	-13.8927
12	-3.00235	-6.35055	-9.0553	-13.185	-13.5392
13	-2.83088	-6.25902	-9.01159	-13.5236	-13.7328
14	-2.69033	-6.20157	-9.28017	-13.8534	-14.0795
15	-2.64151	-6.08843	-8.95001	-13.758	-13.9791
16	-2.578	-6.73855	-8.87012	-13.3065	-13.7938
17	-2.52605	-6.78137	-9.45277	-12.9922	-13.9851
18	-2.45806	-6.5956	-9.75264	-13.1369	-14.1677
19	-2.37092	-6.71744	-10.1982	-13.544	-14.5193
20	-2.31873	-6.50177	-10.9635	-13.6399	-14.9651

Table 6.4-21 Averaged DIP profiles for weighted average throughput gain study (NTT DOCOMO)

#	DIP1	DIP2	DIP3	DIP4	DIP5	DIP6	DIP7	DIP8
	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]
1	-5.64	-6.86	-9.14	-12.08	-13.74	-15.00	-16.12	-17.14
2	-4.22	-5.90	-10.38	-13.33	-14.68	-16.00	-17.17	-18.25
3	-3.65	-5.51	-11.61	-14.08	-15.52	-16.82	-17.94	-18.93
4	-3.29	-5.30	-12.41	-14.88	-16.38	-17.65	-18.81	-19.79
5	-3.06	-4.14	-15.39	-17.76	-19.28	-20.59	-21.71	-22.66
6	-2.85	-6.23	-12.37	-14.61	-16.14	-17.47	-18.61	-19.54
7	-2.58	-6.65	-12.58	-14.70	-16.34	-17.62	-18.71	-19.64
8	-2.34	-7.03	-12.84	-14.83	-16.57	-17.82	-18.91	-19.85
9	-2.12	-7.45	-13.05	-15.02	-16.80	-18.02	-19.14	-20.12
10	-1.92	-7.94	-13.26	-15.12	-16.98	-18.16	-19.34	-20.40
11	-1.73	-8.42	-13.45	-15.25	-17.16	-18.28	-19.54	-20.73
12	-1.55	-8.97	-13.70	-15.43	-17.36	-18.39	-19.79	-21.12
13	-1.38	-9.64	-13.89	-15.60	-17.50	-18.47	-20.06	-21.60
14	-1.21	-10.29	-14.16	-15.84	-17.70	-18.58	-20.51	-22.19
15	-1.05	-11.01	-14.47	-16.17	-17.96	-18.83	-21.16	-23.04
16	-0.88	-11.83	-14.81	-16.70	-18.25	-19.30	-22.20	-24.25
17	-0.68	-12.59	-15.29	-17.79	-19.34	-20.99	-24.29	-26.17
18	-0.41	-13.58	-16.93	-21.57	-24.09	-26.05	-27.73	-29.04
19	-0.21	-15.64	-20.24	-25.91	-28.61	-30.07	-31.32	-32.51
20	-0.12	-16.84	-26.02	-31.31	-33.82	-35.25	-36.46	-37.58

Table 6.4-22 Averaged DIP profiles for weighted average throughput gain study (LG Electronics)

#	DIP1	DIP2	DIP3	DIP4	DIP5	DIP6	DIP7	DIP8	DIP9
	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]
1	-5.40	-6.72	-9.18	-12.45	-14.29	-15.27	-15.97	-17.05	-17.86
2	-4.19	-5.77	-11.51	-13.56	-14.92	-16.30	-17.08	-18.37	-19.04
3	-3.63	-5.50	-12.47	-14.38	-15.93	-16.68	-17.79	-18.96	-19.77
4	-3.28	-5.23	-13.47	-14.89	-16.69	-17.49	-18.53	-19.22	-20.81
5	-3.05	-4.81	-14.90	-16.20	-18.33	-19.75	-20.85	-21.71	-22.86
6	-2.81	-6.47	-12.75	-14.57	-16.26	-17.19	-18.17	-18.88	-19.86
7	-2.56	-6.92	-13.21	-14.72	-16.55	-17.46	-18.50	-19.27	-20.46
8	-2.35	-7.33	-13.29	-14.81	-16.65	-17.32	-18.37	-19.31	-20.41
9	-2.16	-7.78	-13.43	-14.79	-16.97	-17.57	-18.92	-20.04	-21.01
10	-1.98	-8.21	-13.64	-15.12	-16.91	-17.73	-18.85	-19.97	-21.31
11	-1.80	-8.73	-13.66	-15.02	-17.01	-17.75	-19.04	-20.30	-21.50
12	-1.61	-9.54	-13.73	-15.24	-16.97	-18.07	-19.38	-21.26	-22.12
13	-1.42	-10.09	-14.00	-15.14	-17.16	-17.78	-19.91	-21.92	-23.03
14	-1.25	-11.09	-14.08	-15.53	-17.08	-17.67	-20.36	-22.57	-23.67
15	-1.08	-12.01	-14.31	-15.68	-17.06	-17.63	-21.61	-23.52	-24.63
16	-0.94	-12.77	-14.64	-16.27	-17.29	-18.69	-22.40	-24.33	-25.60
17	-0.73	-13.10	-15.21	-17.05	-18.74	-22.01	-24.91	-26.29	-27.28
18	-0.43	-13.77	-16.77	-23.09	-25.31	-26.78	-27.94	-29.13	-30.15
19	-0.20	-15.77	-21.82	-28.29	-30.07	-31.51	-32.75	-33.79	-34.86
20	-0.11	-17.15	-29.12	-34.01	-36.38	-37.40	-38.67	-39.37	-40.46

Table 6.4-23 Averaged DIP profiles for weighted average throughput gain study (Samsung)

#	DIP1	DIP2	DIP3	DIP4	DIP5	DIP6	DIP7	DIP8
	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]
1	-5.4579	-6.5825	-8.7433	-11.523	-13.075	-14.312	-15.37	-16.325
2	-4.1765	-5.6774	-10.966	-12.761	-13.906	-15.528	-16.765	-17.601
3	-3.6647	-5.4785	-11.054	-13.489	-15.119	-16.551	-17.627	-18.621
4	-3.3124	-5.1804	-12.249	-14.153	-15.666	-17.215	-18.475	-19.499
5	-3.0783	-4.2948	-14.669	-16.766	-18.222	-19.465	-20.618	-21.298
6	-2.9137	-5.378	-12.658	-14.791	-16.818	-17.935	-19.095	-20.209
7	-2.6062	-6.5506	-12.297	-14.121	-15.989	-17.341	-18.371	-19.52
8	-2.3817	-6.8613	-12.454	-14.601	-16.215	-17.284	-18.779	-19.561
9	-2.1653	-7.2565	-12.833	-14.712	-16.744	-17.754	-18.608	-19.629
10	-1.9664	-8.0308	-12.724	-14.429	-16.309	-17.635	-18.974	-20.033
11	-1.7495	-8.3973	-13.15	-15.026	-16.971	-17.968	-19.249	-20.255
12	-1.5709	-8.873	-13.267	-14.962	-17.023	-17.883	-19.682	-20.979
13	-1.3906	-10.061	-13.473	-15.111	-16.983	-17.742	-19.344	-20.992
14	-1.2194	-10.611	-13.816	-15.475	-17.222	-17.908	-19.945	-21.689
15	-1.049	-11.064	-13.887	-16.05	-17.639	-18.647	-21.234	-22.875
16	-0.86859	-11.751	-14.081	-16.838	-18.424	-19.706	-22.591	-24.341
17	-0.63101	-12.26	-15.238	-19.042	-20.5	-22.762	-24.906	-26.165
18	-0.32541	-14.321	-18.039	-22.753	-25.916	-27.016	-28.127	-29.689
19	-0.17148	-15.866	-22.072	-28.284	-30.327	-31.693	-32.854	-34.08
20	-0.10793	-16.939	-27.336	-32.473	-34.74	-35.794	-37.007	-38.347

Table 6.4-24 Averaged DIP profiles for weighted average throughput gain study (Nokia, Nokia Simence Network)

#	DIP1	DIP2	DIP3	DIP4	DIP5	DIP6	DIP7	DIP8	DIP9
	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]
1	-6.2722	-7.3119	-9.5679	-11.9581	-13.5498	-15.1613	-16.0622	-17.3053	-18.1828
2	-4.6551	-6.341	-10.2217	-13.2601	-14.371	-15.8215	-16.9366	-17.9552	-18.834
3	-3.9869	-6.218	-11.5674	-13.4101	-14.7843	-16.0957	-17.2958	-18.436	-19.0906
4	-3.5737	-5.8021	-12.478	-14.1696	-15.73	-17.1669	-18.555	-19.7699	-20.7752
5	-3.2165	-5.8537	-13.6183	-15.7434	-17.2377	-18.2434	-19.4281	-20.5703	-21.6489
6	-2.9905	-5.0692	-20.8614	-24.1741	-25.9761	-27.1096	-27.8995	-28.9174	-30.1361
7	-2.6819	-6.9918	-13.3328	-14.714	-16.1644	-17.7734	-19.2356	-20.1735	-21.4079
8	-2.4113	-7.7275	-13.2486	-15.1668	-16.2579	-17.841	-19.0379	-20.2515	-21.3009
9	-2.2366	-7.5552	-13.5554	-15.151	-16.9176	-18.152	-19.0494	-20.0847	-21.442
10	-2.0035	-8.1294	-13.3251	-15.3618	-16.9691	-18.8319	-20.1381	-21.3601	-22.4059
11	-1.7768	-8.8649	-13.5245	-15.7136	-17.2044	-18.7439	-20.5662	-22.0883	-22.9478
12	-1.6015	-9.7844	-13.5988	-15.392	-17.2319	-18.6292	-19.6958	-21.2706	-22.2639
13	-1.4376	-10.5773	-13.845	-15.8111	-17.1471	-18.6393	-20.4479	-22.1696	-23.1838
14	-1.2668	-10.7354	-14.1576	-16.2701	-17.72	-18.5844	-21.3352	-23.0653	-24.1896
15	-1.0874	-11.6758	-14.2042	-16.4075	-17.8418	-19.0058	-21.4157	-23.3843	-24.6953
16	-0.8798	-12.6505	-15.21	-17.1595	-18.6871	-19.8473	-23.1356	-25.256	-26.7443
17	-0.7077	-12.7955	-16.2695	-19.6888	-20.9829	-22.8925	-25.862	-27.6654	-28.8641
18	-0.4372	-13.5424	-17.8578	-24.1308	-26.1942	-27.6854	-29.137	-30.6043	-31.6217
19	-0.2237	-15.8377	-21.1636	-27.1428	-29.2613	-30.8058	-32.1847	-33.5479	-34.1369
20	-0.1199	-16.763	-28.0832	-33.3443	-35.5873	-36.8879	-38.1956	-39.363	-40.2067

Table 6.4-25 Averaged DIP profiles for weighted average throughput gain study (Huawei, HiSillicon)

#	DIP1	DIP2	DIP3	DIP4	DIP5
	[dB]	[dB]	[dB]	[dB]	[dB]
1	-5.7437	-6.9933	-9.3309	-12.6386	-13.4126
2	-4.3281	-5.9446	-10.3613	-13.4641	-14.5318
3	-3.8169	-5.5384	-11.5825	-13.3689	-15.0635
4	-3.4686	-5.4035	-11.7985	-14.0509	-16.0147
5	-3.2435	-5.2897	-12.4776	-14.6684	-15.9494
6	-3.0507	-4.2327	-15.5575	-17.3664	-18.8839
7	-2.8111	-6.5573	-12.2963	-13.7931	-15.914
8	-2.53	-6.6676	-13.0815	-14.6777	-16.5021
9	-2.329	-7.0187	-13.1764	-14.7481	-16.8608
10	-2.1477	-7.52	-12.8137	-14.4287	-16.4297
11	-1.8741	-8.3552	-13.175	-14.7246	-16.9149
12	-1.6463	-8.9513	-13.0903	-15.3328	-17.3467
13	-1.4789	-9.4427	-13.9849	-15.3862	-16.9918
14	-1.3251	-10.1508	-13.8981	-15.3191	-17.228
15	-1.1678	-10.5703	-13.8074	-15.8763	-17.1889
16	-0.9847	-11.4758	-14.2771	-16.2066	-17.4376
17	-0.7575	-11.9452	-14.9879	-17.7953	-19.0921
18	-0.4602	-13.0334	-16.5854	-20.9993	-24.0303
19	-0.2244	-15.3934	-20.4192	-26.0956	-27.9715
20	-0.1117	-16.8388	-27.4196	-32.8209	-35.2239

Table 6.4-26 Averaged DIP profiles for weighted average throughput gain study (Intel)

#	DIP1	DIP2	DIP3	DIP4	DIP5	DIP6	DIP7	DIP8	DIP9
	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]
1	-5.03477	-5.44522	-10.0035	-12.84	-15.4925	-16.5872	-17.1397	-17.8886	-19.2634
2	-3.61634	-5.22453	-12.899	-15.294	-16.6336	-17.0399	-17.4059	-17.9777	-18.1149
3	-3.26924	-4.3645	-15.0329	-16.056	-17.2946	-18.2731	-19.2737	-19.9674	-23.8127
4	-2.90873	-4.94094	-13.6343	-15.3372	-17.0041	-19.4202	-19.5176	-21.1474	-22.7283
5	-2.60071	-6.53446	-14.4682	-15.7764	-16.2713	-16.8951	-18.0123	-18.152	-19.8633
6	-2.35919	-6.9656	-13.3202	-14.3515	-15.9441	-17.4967	-18.4135	-18.8339	-20.8062
7	-2.12061	-6.94063	-14.2452	-16.2851	-19.0809	-19.0887	-21.1751	-21.7192	-22.462
8	-1.94657	-8.63085	-13.2278	-14.4889	-16.2306	-17.3613	-19.6039	-20.0315	-21.1982
9	-1.81403	-8.89757	-13.4748	-14.6355	-15.8778	-17.0023	-18.2621	-20.0056	-21.6966
10	-1.69896	-9.63288	-13.5963	-14.6751	-16.9722	-16.9722	-20.9616	-21.6322	-22.3906
11	-1.55397	-9.17584	-13.9261	-14.2613	-17.4815	-17.6943	-19.0132	-22.0464	-22.0464
12	-1.39628	-9.90067	-14.2813	-15.2671	-16.9419	-17.4153	-19.7944	-21.4606	-22.3767
13	-1.1614	-12.0827	-14.1341	-15.3556	-16.4557	-17.3614	-20.2922	-21.9252	-23.5591
14	-1.09759	-9.62092	-13.5866	-16.7653	-18.5205	-20.8057	-24.0905	-24.7772	-26.8605
15	-0.85105	-9.53628	-15.4435	-21.6623	-24.3507	-24.9724	-25.6158	-25.8711	-26.9735
16	-0.61935	-13.8063	-15.0312	-17.4694	-19.7695	-22.4385	-23.7509	-24.8385	-25.9692
17	-0.38465	-14.4698	-16.0284	-22.0677	-25.9871	-26.9633	-27.7576	-29.6281	-30.3137
18	-0.28457	-14.9624	-18.1812	-24.6917	-28.5166	-29.5598	-30.3486	-31.7566	-33.2797
19	-0.16936	-15.9988	-23.1712	-28.8461	-30.7035	-32.2004	-32.688	-32.943	-35.1091
20	-0.10554	-17.0572	-28.1053	-32.2742	-35.474	-36.697	-38.6148	-38.8385	-39.6356

Table 6.4-27 Averaged DIP profiles for weighted average throughput gain study (Ericsson, ST-Ericsson)

#	DIP1	DIP2	DIP3	DIP4	DIP5	DIP6	DIP7	DIP8	DIP9
	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]
1	-6.169	-7.4007	-8.6801	-10.1977	-11.6266	-13.2526	-15.144	-16.3558	-17.5642
2	-5.1039	-6.5015	-9.1618	-11.2267	-12.9511	-14.6859	-16.6374	-17.3684	-18.3838
3	-4.7093	-6.2051	-8.674	-11.5546	-13.9308	-16.0036	-17.5602	-19.029	-19.8926
4	-4.302	-6.9332	-9.1425	-12.1198	-13.8979	-15.3943	-16.5319	-17.5927	-19.2893
5	-3.9177	-6.7576	-10.1378	-12.7798	-14.1047	-15.7872	-16.9754	-18.4317	-19.592
6	-3.4852	-6.7865	-10.5679	-12.5805	-14.662	-16.2604	-18.4567	-19.7059	-20.6896
7	-3.1712	-6.9815	-10.1773	-13.374	-15.9919	-17.6431	-18.9474	-20.1565	-21.3329
8	-2.9341	-6.6572	-14.2522	-16.9048	-19.0189	-20.7103	-22.1269	-23.1677	-24.2985
9	-2.613	-5.8023	-18.2671	-21.8767	-23.8126	-25.3955	-26.9843	-28.1019	-29.5307
10	-2.397	-6.5813	-17.2659	-19.4768	-21.909	-23.4066	-24.9926	-26.083	-27.3
11	-2.041	-7.7252	-14.5258	-16.783	-18.3155	-20.1589	-21.3615	-22.6726	-24.0253
12	-1.8079	-7.5337	-15.7922	-19.3152	-20.9637	-22.8269	-24.0791	-25.1468	-26.3538
13	-1.6723	-8.4363	-16.1359	-18.3702	-20.6268	-22.4421	-23.912	-25.0132	-26.036
14	-1.4187	-9.3872	-14.9968	-17.7908	-19.5656	-20.8663	-22.4495	-23.4626	-24.6058
15	-1.1789	-9.5891	-16.123	-18.7017	-20.4567	-22.4369	-23.8859	-24.8053	-25.8833
16	-0.9653	-10.411	-16.8019	-20.1308	-22.2311	-23.7729	-25.025	-26.2314	-27.3562
17	-0.7579	-11.6385	-18.0695	-21.1636	-23.1629	-24.4371	-25.5557	-26.7285	-27.5929
18	-0.5312	-12.8618	-18.8984	-21.9744	-23.976	-25.8406	-27.2718	-28.2753	-29.3575
19	-0.3362	-15.1218	-20.9219	-23.6131	-25.5806	-27.3476	-28.6859	-29.7938	-30.9792
20	-0.152	-18.1526	-24.3241	-27.5359	-29.9548	-31.8853	-33.6859	-34.9748	-35.8654

6.5 Rank-1 transmission probability and PMI Time/Frequency Traces

This clause presents interference characterization results leading to the development of MIMO rank transmission probability on the interference cells. Table 6.5-1 – 6.5-3 show the evaluation results on the rank-1 transmission probability. Summary of the discussion for rank-1 transmission probability was agreed as 80 % for 2x2 MIMO configuration and 70% for 4x2 MIMO configuration, respectively.

Table 6.5-1: Rank-1 transmission probability (MIMO configuration)

	Ericsson, ST-Ericsson (R4-115789)	Renesas Mobile Europe Ltd (R4-115874)	NTT DOCOMO (R4-115911)	Nokia Siemens Networks (R4-116009)
	80.00%			
2x2			86.90%	
2x2 XPol				75.40%
2x2 ULA				98.30%
2x2 ULA (0.5λ)		87.58%		
2x2 ULA (4λ)		68.95%		
4x2 ULA				88.30%
4x2 ULA (0.5λ)		67.57%		
4x2 ULA (4λ)		64.11%		
4x2 XPol 0.5λ				65.50%

Table 6.5-2: Rank-1 transmission probability (DIP value based evaluation, R4-116068, Huawei, Hi-Silicon)

DIP1	DIP2	DIP3	DIP4	DIP5	DIP6	DIP7	DIP8
57.13%	57.73%	57.86%	58.09%	58.54%	58.49%	58.70%	57.13%

Table 6.5-3: Rank-1 transmission probability (Traffic based evaluation, R4-116155, Qualcomm Incorporated)

	No Tx	Single-layer transmission				Dual-layer transmission	
		Index=0	Index=1	Index=2	Index=3	Index=1	Index=2
Full buffer model	0	16.30%	15.80%	16.20%	15.70%	17.90%	18.10%
Partial loading (2 MB offered load)	11.80%	20.30%	19.80%	20.10%	19.80%	4.10%	4.20%

In Figures 6.5.1 and 6.5.2, traces of the Tx precoding index change for full buffer and partial loading are shown (R4-116155). In this reference it is observed that the Tx precoding indices are correlated in time. It is also observed that the Tx precoding indices are correlated in frequency. Since subband scheduling is enabled, there is a clear correlation of precoding indices within a subband (6RBs).

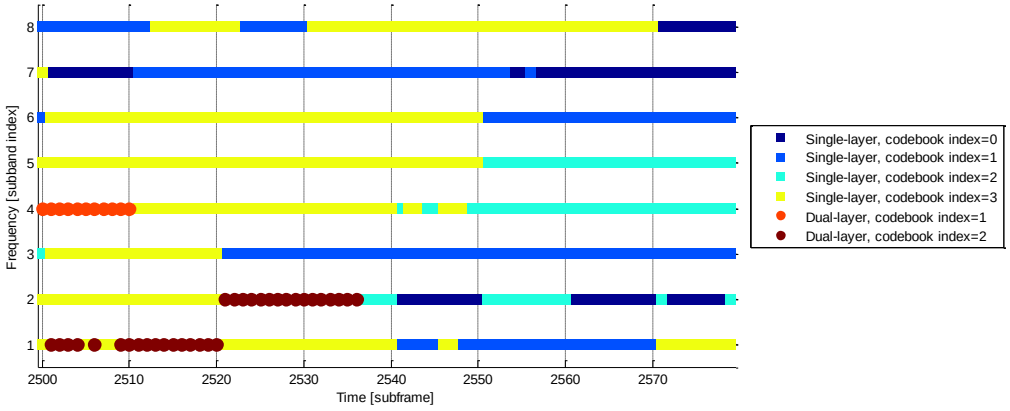


Figure 6.5-1: PMI time/frequency traces: Full buffer, TM4, MMSE-IRC, colliding-RS, PUSCH 1-2. (R4-116155, Qualcomm Incorporated)

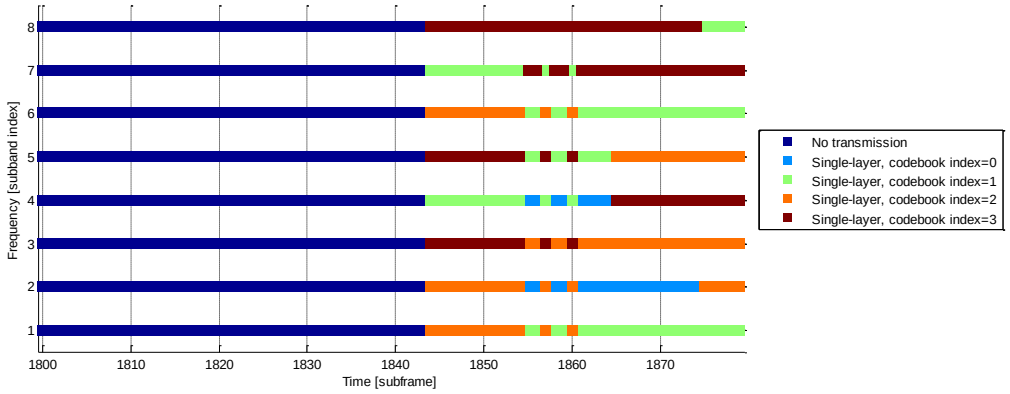


Figure 6.5-2: PMI time/frequency traces: Partial loading, TM9, MMSE-IRC, colliding-RS, PUSCH 1-2. (R4-116155, Qualcomm Incorporated)

6.6 Summary

In summary, Table 6.6-1 shows the interference profiles that have been defined as part of this feasibility study to assess link level performance of MMSE-IRC receivers. The top entry reflects the median DIP values, which are to be used for all geometries considered. The next entry defines the DIP profiles that were defined based on the weighted average throughput gain method for the 0 dB, -3 dB and -2.5 dB geometries, respectively. It is interesting to note when comparing these profiles that the median profile is actually quite close to both of the profiles conditioned on -3 dB geometry, and how really close the latter two are to each other. This suggests that the median profile probably should have only been used for the -3 dB geometry condition, and that it is important to condition the DIP ratios on geometry to obtain meaningful results.

Summary of the discussion for rank-1 transmission probability was agreed as baseline as 80 % for 2x2 MIMO configuration and 70% for 4x2 MIMO configuration, respectively. Summary of the discussion on PMI granularity in the interfering cell was agreed as baseline as randomly changing per sub-band from subframe to subframe. Moreover, an optional simulation assumption was considered by some companies as randomly changing per sub-band per 10ms periodicity.

Link level performance results based on these interference profiles are presented in clause 7.

Table 6.6-1: Summary of Defined Interference Profiles

Profile	Geometry	Synchronized NW		Asynchronized NW
		DIP1	DIP2	DIP
Based on conditional median values	0 dB geometry	-3.1	-5.4	-3.1
	-3 dB geometry	-2.8	-7.3	-2.8
	-2.5 dB geometry			
Based on weighted average throughput gain	0 dB geometry			
	-3 dB geometry			
	-2.5 dB geometry			

7 Link performance characterization

7.1 General

The purpose of this clause is to analyze the performance gain from link-level simulation results. Emphasis is on results that were based on agreed set of simulation assumption. This clause introduces an evaluation framework for link-level simulations. As described in clause 6, interference modelling was performed by interested companies in order to reach an agreement of link-level simulation assumptions.

7.2 Detail of simulation assumption for link-level simulation

The link-level assumptions are identical for each scenario, and are summarized in Table 7.2-1.

Table 7.2-1: Simulation assumption for the link-level simulation evaluation

Parameter	Scenario 1 (CRS based)	Scenario 2 (DM-RS based)
Carrier frequency	2 GHz	
System bandwidth	10 MHz	
Transmission mode on Serving cell	TM6	TM9 with 1-layer transmission
Transmission mode on interference cell	TM4	TM9
MIMO configuration	2x2 and low correlation	4x2 and low correlation
Channel model and Doppler frequency for target and interference cells	EVA, 3km/h, Use different channel seed for between cells	
CRS configuration	2 CRS ports with planning (non-colliding)	
CSI-RS configuration	None	4 CSI-RS ports, and 5 msec periodicity
MCS for target signal	Fixed MCS as follow: #10, #11, #12 for SINR = 0 dB, and #7, #8 ,#9 for SINR= -3 dB as baseline, and outer-loop link adaptation by interested companies	
PMI for target signal	Follow wideband PMI as baseline Fixed wideband PMI by interested companies	
H-ARQ	8 HARQ processes and max 4 transmissions	
Feedback periodicity for target signal	Feedback periodicity: 5 msec Feedback delay: 8 msec	Feedback periodicity: 5 msec Feedback delay: 8 msec
MCS/ PMI transmission granularity and Number of transmission ranks for interference signals (% of rank-1 and % of rank-2)	Randomly changing per sub-band from subframe to subframe as baseline. Randomly changing per sub-band per 10 msec periodicity by interested companies Frequency granularity is 6 RBs	
	80% for rank-1 and 20% for rank-2	70% for rank-1 and 30% for rank-2
PCFICH	CFI = 2	
PCFICH/PDCCH detection	Not considered	
Resource allocation	50 RBs	
Cyclic prefix	Normal	
Simulation length	10000 sub-frames at minimum	

Note: Other transmission modes are not precluded in WI.

7.3 Averaged simulation results

Table 7.3-1 provides the averaged simulation results for the agreed baseline scenarios for Conditional DIP for 0 dB, -3 dB and -2.5 dB geometry. Tables 7.3-1a and 7.3.1b show simulation results for non-baseline scenarios. Table 7.3-2 – 7.3-7 provide the averaged simulation results for weighted DIP for 0/-3/-2.5 dB geometry and CRS/ DM-RS based estimation results. The details of simulation result by interested companies provide in Clause 7.4 and 7.5 respectively.

Table 7.3-1: Averaged simulation results for agreed baseline link-level simulation scenario on Conditional DIP for synchronous NW

Transmission Mode	Covariance matrix estimation scheme	Geometry	MCS index#	Gain	Number of evaluating companies
2TX, TM6 (Scenario 1)	CRS based	0 dB	10	16.3%	7
			11	17.4%	
			12	16.9%	
		-3 dB	7	20.9%	6
			8	18.8%	
			9	16.1%	
		-2.5 dB	7	24.15%	10
			8	23.49%	
			9	19.43%	
4TX, TM9 (Scenario 2)	DM-RS based	0 dB	10	14.4%	7
			11	14.0%	
			12	12.5%	
		-3 dB	7	15.4%	6
			8	12.7%	
			9	13.5%	
		-2.5 dB	7	20.92%	9
			8	18.01%	
			9	14.74%	

Table 7.3-1a: Averaged simulation results for non-baseline link-level simulation on Conditional DIP for synchronous NW and OLLA

Transmission Mode	Covariance matrix estimation scheme	Geometry	MCS index#	Gain	Number of evaluating companies
2TX, TM6 (Scenario 1)	CRS based	0 dB	OLLA	11.5%	3
		-3 dB	OLLA	19.6%	3
		-2.5 dB	OLLA	33.10%	1
4TX, TM9 (Scenario 2)	DM-RS based	0 dB	OLLA	10.9%	2
		-3 dB	OLLA	18.2%	2
		-2.5 dB	OLLA	23.40 %	1

Table 7.3-1b: Averaged simulation results for non-baseline link-level simulation on Conditional DIP for asynchronous NW

Transmission Mode	Covariance matrix estimation scheme	Geometry	MCS index#	Gain	Number of evaluating campanies
2TX, TM6 (Scenario 1)	CRS based	0 dB	10	6.51%	2
			11	9.61%	
			12	7.18%	
			OLLA	5.55%	1
		-3 dB	7	10.19%	2
			8	4.88%	
			9	5.58%	
			OLLA	6.63%	1
		-2.5 dB	7	18.70%	1
			8	14.30%	
			9	13.30%	
4TX, TM9 (Scenario 2)	DM-RS based	0 dB	10	2.35%	1
			11	3.49%	
			12	1.24%	
			OLLA	-	
		-3 dB	7	4.70%	1
			8	5.12%	
			9	2.26%	
			OLLA	-	
		-2.5 dB	7	14.90%	1
			8	12.60%	
			9	13.50%	

Table 7.3-2: Averaged simulation results for link-level simulation results on weighted DIP for 0 dB geometry and Scenario 1 (CRS-based transmission)

Geometry	DIP set#	Gain		
		MCS#10 (4 companies)	MCS#11 (4 companies)	MCS#12 (5 companies)
0 dB	1	1.09%	2.05%	3.44%
	2	5.14%	5.24%	6.09%
	3	7.79%	8.63%	7.42%
	4	9.31%	11.53%	12.23%
	5	11.09%	12.79%	11.81%
	6	14.27%	15.13%	14.51%
	7	15.02%	16.58%	16.81%
	8	17.09%	19.58%	19.65%
	9	18.83%	21.80%	22.42%
	10	22.49%	25.57%	27.71%
	11	21.12%	23.80%	23.25%
	12	18.96%	19.54%	20.32%
	13	19.95%	21.51%	24.04%
	14	20.81%	24.81%	25.60%
	15	25.08%	28.58%	28.94%
	16	28.13%	32.52%	33.89%
	17	32.10%	34.91%	41.11%
	18	36.66%	42.93%	50.25%
	19	41.64%	50.73%	64.90%
	20	44.15%	53.03%	69.16%
	Ave.	20.54%	23.56%	26.18%

Table 7.3-3: Averaged simulation results for link-level simulation results on weighted DIP for -3 dB geometry and Scenario 1 (CRS-based transmission)

Geometry	DIP set#	Gain		
		MCS#7 (4 companies)	MCS#8 (4 companies)	MCS#9 (4 companies)
-3 dB	1	5.55%	5.16%	4.58%
	2	11.94%	11.41%	11.41%
	3	20.02%	18.17%	18.06%
	4	25.04%	25.34%	22.90%
	5	26.63%	25.15%	23.38%
	6	30.18%	28.77%	26.41%
	7	31.85%	31.23%	29.56%
	8	31.82%	30.51%	29.40%
	9	32.81%	30.75%	28.01%
	10	32.54%	33.65%	30.10%
	11	29.27%	28.92%	28.46%
	12	27.30%	26.30%	24.91%
	13	28.49%	30.84%	26.35%
	14	33.48%	33.96%	28.85%
	15	35.15%	36.75%	33.40%
	16	38.27%	39.74%	38.10%
	17	40.28%	43.54%	42.51%
	18	45.45%	49.18%	50.74%
	19	51.79%	55.93%	60.65%
	20	55.16%	62.25%	65.64%
	Ave.	31.65%	32.38%	31.17%

Table 7.3-4: Averaged simulation results for link-level simulation results on weighted DIP for 0 dB geometry and Scenario 2 (DM RS-based transmission)

Geometry	DIP set#	Gain		
		MCS#10 (4 companies)	MCS#11 (4 companies)	MCS#12 (5 companies)
0 dB	1	-2.13%	-1.02%	1.38%
	2	1.37%	2.98%	3.91%
	3	4.26%	5.77%	6.13%
	4	6.70%	6.60%	7.85%
	5	7.94%	8.56%	9.29%
	6	9.69%	10.73%	11.88%
	7	10.25%	13.17%	12.98%
	8	13.52%	14.48%	16.47%
	9	14.54%	18.15%	17.43%
	10	18.46%	21.89%	22.84%
	11	15.97%	18.79%	18.89%
	12	14.55%	15.14%	15.67%
	13	16.55%	18.27%	19.20%
	14	18.33%	21.01%	21.36%
	15	20.73%	24.72%	24.25%
	16	23.14%	27.81%	28.83%
	17	26.78%	32.04%	33.36%
	18	31.76%	40.22%	42.97%
	19	37.86%	49.25%	56.39%
	20	39.50%	50.57%	56.13%
	Ave.	16.49%	19.95%	21.36%

Table 7.3-5: Averaged simulation results for link-level simulation results on weighted DIP for -3 dB geometry and Scenario 2 (DM RS-based transmission)

Geometry	DIP set#	Gain		
		MCS#7 (4 companies)	MCS#8 (4 companies)	MCS#9 (4 companies)
-3 dB	1	2.40%	2.16%	4.13%
	2	8.79%	8.09%	9.50%
	3	15.85%	14.87%	16.09%
	4	20.11%	19.26%	18.69%
	5	22.12%	20.21%	21.00%
	6	24.96%	20.61%	22.69%
	7	25.28%	23.87%	23.60%
	8	27.43%	24.24%	25.17%
	9	25.46%	25.12%	23.73%
	10	25.99%	25.96%	25.95%
	11	25.09%	23.80%	23.89%
	12	23.56%	22.04%	19.95%
	13	25.54%	24.48%	22.80%
	14	28.82%	27.31%	25.96%
	15	31.26%	29.76%	27.01%
	16	34.86%	33.04%	32.13%
	17	37.36%	38.26%	35.39%
	18	43.82%	44.42%	40.63%
	19	49.69%	51.75%	49.45%
	20	57.75%	56.66%	52.87%
	Ave.	27.81%	26.80%	26.03%

Table 7.3-6 Averaged simulation results for link-level simulation results on weighted DIP for -2.5 dB geometry and Scenario 1 (CRS-based transmission)

Geometry	DIP set#	Gain		
		MCS #7 (7 companies)	MCS #8 (7 companies)	MCS #9 (7 companies)
-2.5 dB	1	3.69%	3.67%	2.30%
	2	8.64%	9.75%	6.96%
	3	14.29%	12.75%	9.11%
	4	15.19%	13.95%	12.44%
	5	19.04%	18.13%	14.36%
	6	17.49%	18.53%	14.58%
	7	20.21%	18.87%	15.79%
	8	20.77%	20.72%	14.69%
	9	22.67%	21.24%	18.79%
	10	24.81%	25.30%	19.08%
	11	25.13%	26.18%	21.59%
	12	30.07%	29.61%	23.16%
	13	31.76%	30.22%	28.13%
	14	34.58%	35.55%	31.02%
	15	37.20%	40.12%	34.54%
	16	39.86%	42.28%	40.03%
	17	43.38%	48.66%	45.84%
	18	47.60%	56.92%	54.77%
	19	52.92%	61.19%	62.74%
	20	55.92%	63.29%	64.08%
	Ave.	28.18%	29.76%	26.63%

Table 7.3-7 Averaged simulation results for link-level simulation results on weighted DIP for -2.5 dB geometry and Scenario 2 (DM RS-based transmission)

Geometry	DIP set#	Gain		
		MCS #7 (7 companies)	MCS #8 (7 companies)	MCS #9 (7 companies)
-2.5 dB	1	1.36%	1.02%	2.15%
	2	7.44%	6.48%	5.32%
	3	11.10%	9.57%	7.11%
	4	12.86%	11.41%	9.29%
	5	15.58%	12.63%	10.65%
	6	16.73%	14.61%	10.21%
	7	16.16%	14.05%	10.77%
	8	17.65%	14.23%	11.82%
	9	19.68%	17.88%	13.08%
	10	22.94%	18.27%	13.72%
	11	23.77%	21.19%	16.10%
	12	25.64%	24.48%	17.75%
	13	27.78%	25.69%	19.29%
	14	31.30%	28.05%	22.22%
	15	35.54%	31.76%	23.62%
	16	37.95%	34.52%	26.35%
	17	42.29%	40.70%	30.40%
	18	47.16%	44.58%	35.98%
	19	53.20%	49.84%	39.38%
	20	50.92%	50.11%	41.35%
	Ave.	25.47%	23.48%	18.28%

7.4 Simulation results for conditional median DIPs

This section presents the evaluation results generated by various interested companies to show the contribution. Here, the term total interference refers to I_{oc} as defined in Clause 6.2.

7.4.1 Scenario 1 (CRS based transmission)

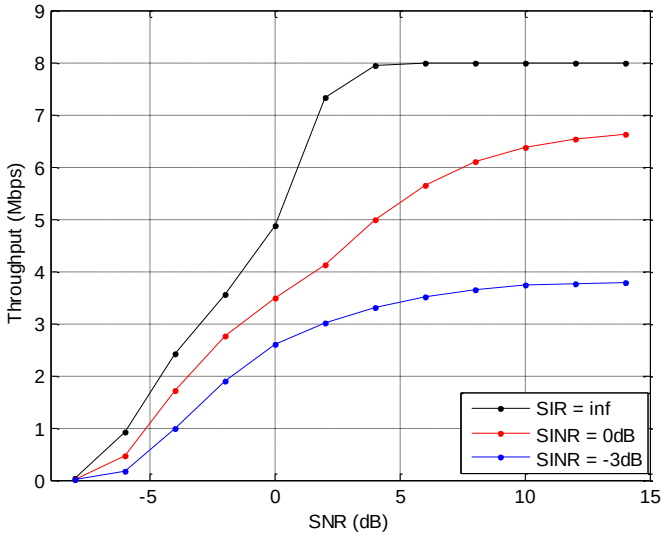
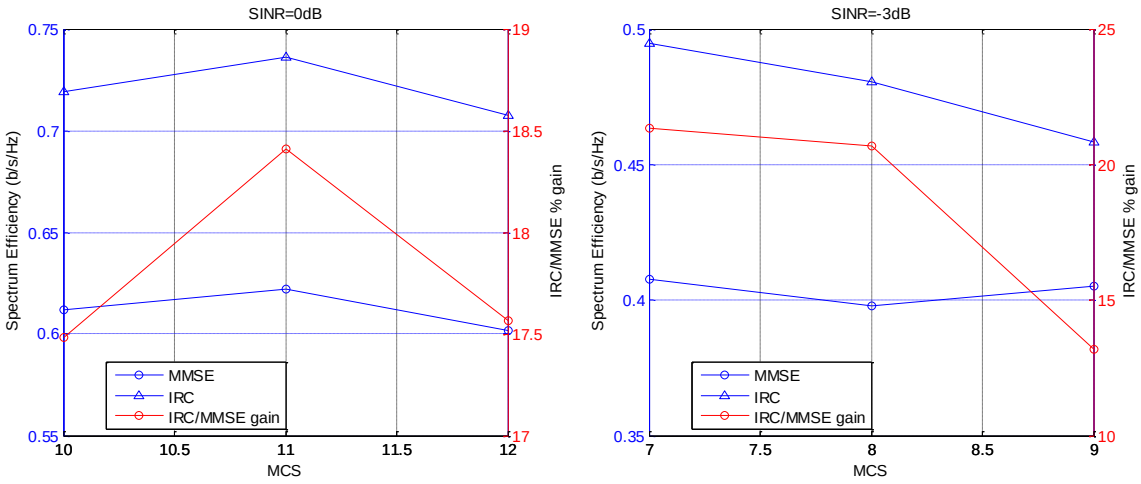


Figure 7.4-1: MMSE throughput of TM6 and MCS=10 (Synchronous network, R4- 120374, Huawei, HiSilicon)

Table 7.4-1: Throughput performance based on conditional median DIP (Synchronous network, CRS based covariance matrix estimation, R4-120374 and R4-121932, Huawei, Hi-Silicon)

Geometry	MCS	MMSE			MMSE-IRC			IRC/MMSE gain
		Throughput (Mbps)	Spectrum efficiency (b/s/Hz)	1st TX BLER	Throughput (Mbps)	Spectrum efficiency (b/s/Hz)	1st TX BLER	
SINR=0dB SNR=5.4dB	10	5.5089	0.6121	0.4314	6.4719	0.7191	0.2302	17.5%
	11	5.5968	0.6219	0.5377	6.6278	0.7364	0.3143	18.4%
	12	5.4159	0.6018	0.7661	6.3675	0.7075	0.5425	17.6%
	CQI	6.1704	0.6856	0.1005	7.0368	0.7819	0.1007	14.0%
SINR=-3dB SNR=3.54dB	7	3.6698	0.4078	0.6341	4.4535	0.4948	0.3799	21.4%
	8	3.5822	0.398	0.8339	4.3236	0.4804	0.5884	20.7%
	9	3.6452	0.405	0.9537	4.1255	0.4584	0.8699	13.2%
	CQI	3.6866	0.4096	0.1005	4.5898	0.51	0.1006	24.5%
SINR=-2.5dB	10	3.9767	-	-	4.9774	-	-	25.164081 %
	11	3.893	-	-	4.9006	-	-	25.88235 %
	12	3.821	-	-	3.821	-	-	21.35567 %



(a) SINR = 0 dB **(b) SINR = -3 dB**

Figure 7.4-2: Throughput of MMSE vs. MMSE-IRC (Synchronous network, 2TX, TM6, R4- 120374, Huawei, HiSilicon)

Table 7.4-2: Throughput performance based on conditional median DIP for TM6 (Synchronous network – baseline, R4-120937, LG Electronics)

Geometry	MCS #	MMSE	MMSE-IRC	Gain [%]
-3 dB	7	3595.4	4370.5	21.56%
	8	3671.0	4202.5	14.48%
	9	3713.0	4158.2	11.99%
0 dB	10	5521.3	6579.4	19.16%
	11	5540.4	6542.3	18.08%
	12	5540.3	6292.5	13.58%
-2.5 dB	7	3831.86	4906.01	28.03%
	8	3869.39	4445.89	14.90%
	9	3789.72	4441.26	17.19%

Table 7.4-3: Throughput performance based on conditional median DIP for TM9 (Synchronous network – baseline, R4-120937, LG Electronics)

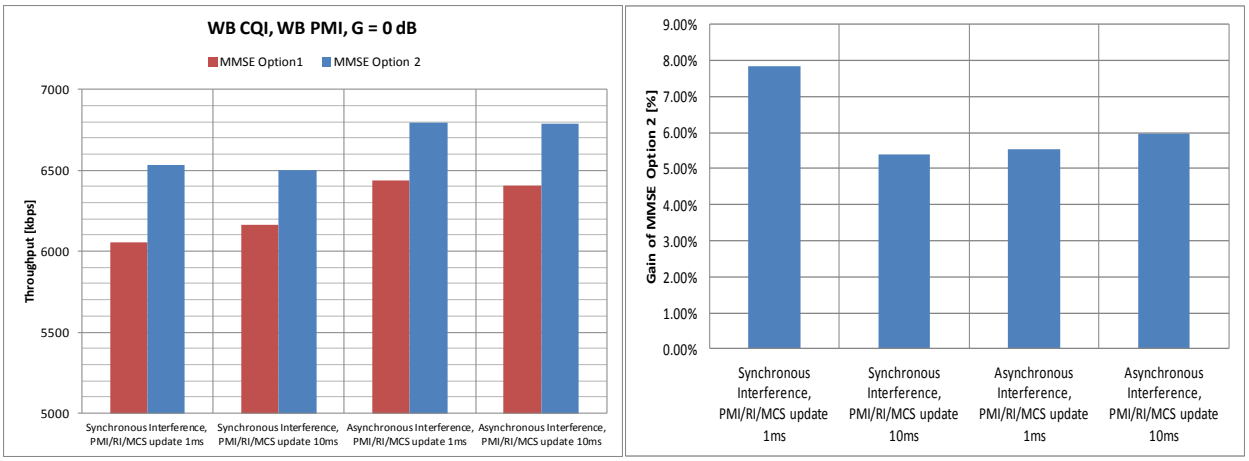
Geometry	MCS #	MMSE	MMSE-IRC	Gain [%]
-3 dB	7	3837.1	3957.4	3.13%
	8	3571.5	3888.1	8.86%
	9	3743.0	4034.6	7.79%
0 dB	10	5167.9	6028.0	16.64%
	11	4899.7	5486.7	11.98%
	12	4993.9	5138.1	2.89%

Table 7.4-4: Throughput performance based on conditional median DIP for TM6 (Synchronous network with randomly changing interferer cells per sub-band per 10 msec, R4-120937, LG Electronics)

Geometry	MCS #	MMSE	MMSE-IRC	Gain [%]
-3 dB	7	3923.1	4449.7	13.42%
	8	3706.7	4168.9	12.47%
	9	3742.2	4153.4	10.99%
0 dB	10	5576.7	6179.9	10.82%
	11	5569.4	6511.5	16.91%
	12	5622.4	6077.7	8.10%

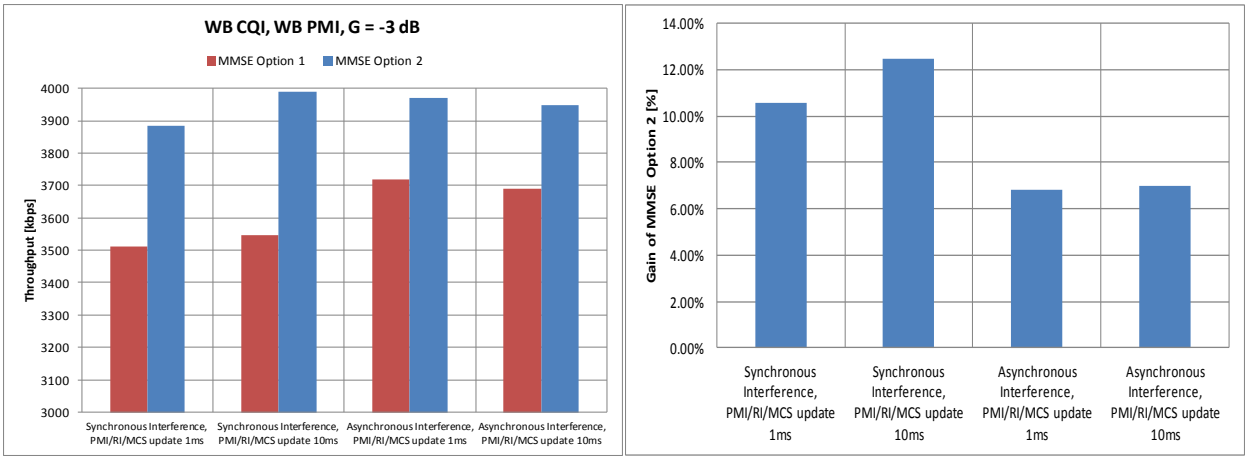
Table 7.4-5: Throughput performance based on conditional median DIP for TM6 (Asynchronous network, R4-120937, LG Electronics)

Geometry	MCS #	MMSE	MMSE-IRC	Gain [%]
-3 dB	7	3585.4	4076.4	13.69%
	8	3674.5	3780.2	2.88%
	9	3796.0	3963.1	4.40%
0 dB	10	5685.2	5967.1	4.96%
	11	5352.0	5885.5	9.97%
	12	5362.4	5827.7	8.68%



(a) Throughput performance **(b) Gain of MMSE option 2**

Figure 7.4-3: MMSE Option 1 and Option 2 in Synchronous and Asynchronous Interference – Geometry = 0 dB (R4- 120431, Qualcomm Incorporated)



(a) Throughput performance **(b) Gain of MMSE option 2**

Figure 7.4-4: MMSE Option 1 and Option 2 in Synchronous and Asynchronous Interference – Geometry = -3 dB (R4- 120431, Qualcomm Incorporated)

In the results above from reference R4-120431 two different MMSE options have been assumed. In MMSE option 1, the estimate of the covariance matrix $\mathbf{R}_{nn}$ is assumed to be diagonal but not necessarily the identity matrix. In MMSE option 2 the estimate of the covariance matrix $\mathbf{N}_t$ generally has non-zero non-diagonal elements (MMSE-IRC).

Table 7.4-6: Throughput performance based on conditional median DIP (Synchronous network, 0 dB geometry case, covariance matrix estimation period: 1RB, R4-120509, NTT DOCOMO)

	Rel.8 baseline (MMSE) receiver	MMSE-IRC receiver	
		CRS based covariance matrix estimation	Data signal based covariance matrix estimation
MCS index#10	4.51 Mbps	5.40 Mbps (+19.7%)	3.49 Mbps (-22.6%)
MCS index#11	4.49 Mbps	5.39 Mbps (+19.9%)	3.57 Mbps (-20.5%)
MCS index#12	4.20 Mbps	4.95 Mbps (+17.7%)	3.52 Mbps (-16.2%)
Outer-loop link adaptation	5.33 Mbps	6.00 Mbps (+12.5%)	4.60 Mbps (-13.7%)

Table 7.4-7: Throughput performance based on conditional median DIP (Synchronous network, -3 dB geometry case, covariance matrix estimation period: 1RB, R4-120509, NTT DOCOMO)

	Rel.8 baseline (MMSE) receiver	MMSE-IRC receiver	
		CRS based covariance matrix estimation	Data signal based covariance matrix estimation
MCS index#7	2.77 Mbps	3.42 Mbps (+23.5%)	2.64 Mbps (-4.6%)
MCS index#8	2.71 Mbps	3.28 Mbps (+20.9%)	2.63 Mbps (-3.1%)
MCS index#9	2.64 Mbps	3.09 Mbps (+17.0%)	2.61 Mbps (-1.4%)
Outer-loop link adaptation	2.81 Mbps	3.50 Mbps (+24.7%)	2.77 Mbps (-1.2%)

Table 7.4-7a Throughput performance based on conditional median DIP (Synchronous network, -2.5 dB geometry case, covariance matrix estimation period: 1RB, R4-121557, NTT DOCOMO)

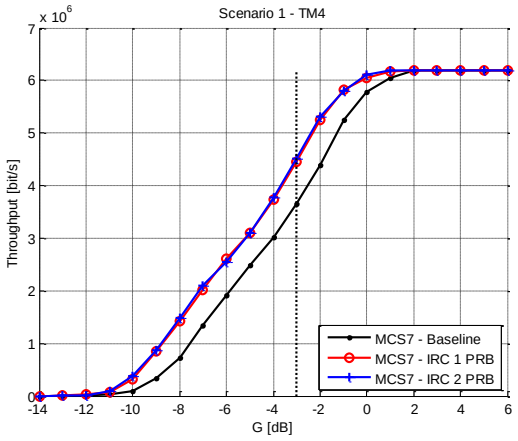
		Rel.8 baseline (MMSE) receiver	MMSE-IRC receiver
MCS index #7	DIP set #12	3.08 Mbps	4.30 Mbps
			(+39.9%)
MCS index #8	DIP set #13	2.98 Mbps	4.28 Mbps
			(+43.6%)
MCS index #9	DIP set #13	2.85 Mbps	3.88 Mbps
			(+36.2%)
Outer-loop link adaptation	DIP set #13	3.01 Mbps	4.34 Mbps
			(+44.3%)

Table 7.4-8: Throughput performance based on conditional median DIP (Synchronous network, CRS based covariance matrix estimation, R4-120944 and R4-121436, Renesas Mobile Europe Ltd.)

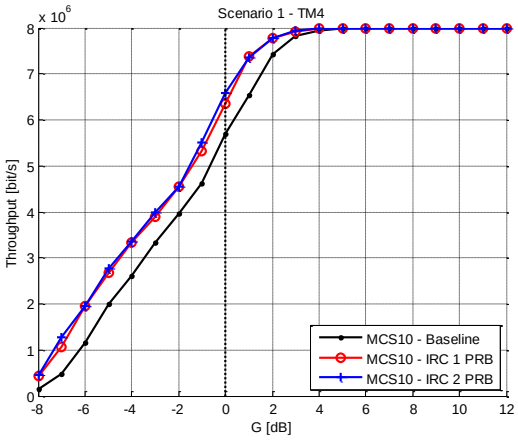
		Rel-8/9 baseline WB / [NB]		MMSE-IRC – 1 PRB wrt. WB / [NB]		MMSE-IRC – 2 PRB wrt. WB / [NB]	
G = -3 dB	MCS#7	3.6580 [3.9901]	+0.0% [+0.0%]	4.4532	+21.7% [+11.6%]	4.5185	+23.5% [+13.2%]
	MCS#8	3.5843 [3.7991]	+0.0% [+0.0%]	4.3466	+21.3% [+14.4%]	4.4706	+24.7% [+17.7%]
	MCS#9	3.6249 [3.8749]	+0.0% [+0.0%]	4.1486	+14.4% [+7.1%]	4.2261	+16.6% [+9.1%]
G = 0 dB	MCS#10	5.6864 [6.0170]	+0.0% [+0.0%]	6.3440	+11.6% [+5.4%]	6.5892	+15.9% [+9.5%]
	MCS#11	5.7909 [6.0039]	+0.0% [+0.0%]	6.6881	+15.5% [+11.4%]	6.7193	+16.0% [+11.9%]
	MCS#12	5.5845 [5.9525]	+0.0% [+0.0%]	6.2979	+12.8% [+5.8%]	6.5817	+17.9% [+10.6%]
G = -2.5 dB	MCS#7	4.0196 [4.3704]	+0.0% [+0.0%]	5.1643	+28.5% [+18.2%]	5.1869	+29.0% [+18.7%]
	MCS#8	3.9616 [4.3192]	+0.0% [+0.0%]	5.1022	+28.8% [+18.1%]	5.1734	+30.6% [+19.8%]
	MCS#9	3.9339 [4.1682]	+0.0% [+0.0%]	4.6913	+19.3% [+12.6%]	4.7676	+21.2% [+14.4%]

In the above set of results from reference R4-120944, the following two variants of Rel-8/9 baseline receiver have been considered:

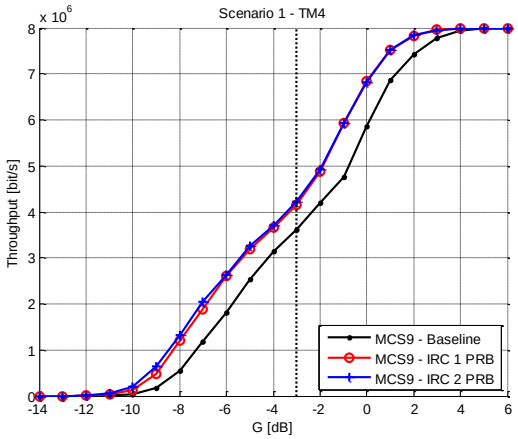
- WB-MRC: performs maximum-ratio-combining with per-branch SNR weighting, where per-branch noise variance estimates are obtained as wideband (WB) sample averages.
- NB-MRC: performs maximum-ratio-combining with per-branch SNR weighting, where per-branch noise variance estimates are obtained as narrowband (NB) sample averages over 1 PRB.



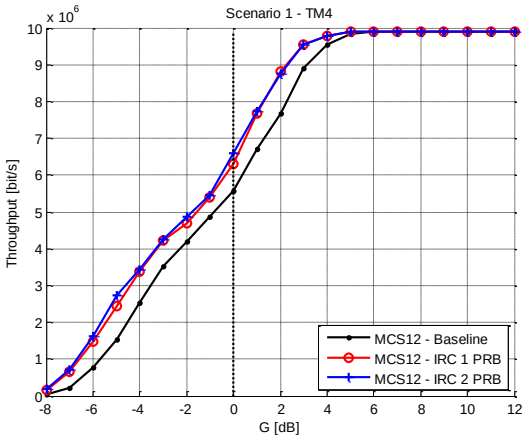
(a) MCS #8



(b) MCS #11



(c) MCS #9



(d) MCS #12

Figure 7.4-5: Simulation results with fixed MCS & median DIPs (Synchronous network, R4-120944, Renesas Mobile Europe Ltd.)

Table 7.4-9: Throughput performance based on conditional median DIP (Synchronous network, CRS based covariance matrix estimation, R4-120657 and R4-121410, Motorola Mobility)

G=0dB	Throughput (Mbps)		Relative throughput (% of max throughput)		Throughput gain
I_{MCS} / Payload (bits)	MMSE	MMSE-IRC	MMSE	MMSE-IRC	
10 / 7992	5.225	6.202	65.4	77.6	18.7%
11 / 8760	5.355	6.382	61.1	72.9	19.2%
12 / 9912	5.232	6.141	52.8	62.0	17.4%
G=0dB	**Throughput (Mbps)**		**Relative throughput (% of max throughput)**		**Throughput gain**
I_{MCS} / Payload (bits)	**MMSE**	**MMSE-IRC**	**MMSE**	**MMSE-IRC**	
7 / 6200	3.926	4.800	63.3	77.4	22.3%
8 / 6968	3.990	4.827	57.3	69.3	21.0%
9 / 7992	3.958	4.532	56.7	49.5	14.5%

Table 7.4-10: Throughput performance with MMSE and IRC receivers and gains based on conditional median DIP (Synchronous network, R4-120919 and R4-121778, ST-Ericsson/Ericsson)

Geometry	MCS	Scenario1		
		MMSE	MMSE-IRC	IRC/MMSE gain
		Throughput (bps)	Throughput (bps)	
G=0dB	10	5386234,372	5809497,789	7,86%
	11	5256874,975	5956366,131	13,31%
	12	4365449,347	5342912,864	22,39%
Average gain				14,52%
G=-3dB	7	3712880,503	4053348,442	9,17%
	8	3748229,447	4242115,879	13,18%
	9	3323517,99	4086786,533	22,97%
Average gain				15,10%
G=-2.5dB	5	4409005	14,41%	4779766
	6	4241422	38,54%	4879793
	7	4095177	52,79%	4634545
	8	4255181	62,23%	4815289
	9	4060548	71,36%	4866747
Average gain				13,93%

Table 7.4-11: Throughput performance based on conditional median DIP (Synchronous network, R4-120855 and R4-121894, Intel Corporation)

	DIP case 1 (G=0dB)			DIP case 2 (G=-3dB)			DIP case 3 (G=-2.5)		
MCS index	10	11	12	7	8	9	7	8	9
Scenario 1 CRS-based	10.28%	9.01%	9.51%	10.62%	11.97%	11.27%	22.5 %	24.9 %	20.1%

Table 7.4-12: Throughput performance based on conditional median DIP (Asynchronous network, R4-120855 and R4-121894, Intel Corporation)

	DIP case 1 (G=0dB)			DIP case 2 (G=-3dB)			DIP case 3 (G=-2.5)		
MCS index	10	11	12	7	8	9	7	8	9
Scenario 1 CRS-based	8.07%	9.25%	5.68%	6.69%	6.89%	6.75%	18.7 %	14.3 %	13.3 %

Table 7.4-13: Throughput performance based on conditional median DIP (Synchronous network, CRS based covariance matrix estimation, R4-120911 and R4-121339, Nokia Siemens Networks, Nokia)

		"MMSE"		"MMSE-MRC"		"MMSE-IRC"	
G = -3 dB	MCS#7	3.7593	+0.0%	4.2617	13.36%	4.844	28.85%
	MCS#8	3.7916	+0.0%	4.0769	7.52%	4.6482	22.59%
	MCS#9	3.7680	+0.0%	3.9776	5.56%	4.435	17.70%
G = 0 dB	MCS#10	5.7025	+0.0%	6.3940	12.13%	6.8577	20.26%
	MCS#11	5.8983	+0.0%	6.2549	6.05%	6.9567	17.94%
	MCS#12	5.7304	+0.0%	6.0776	6.06%	6.7872	18.44%
G=-2.5dB	MCS#7	4.2101	+0.0%	4.787	13.70%	5.4231	28.81%
	MCS#8	4.1097	+0.0%	4.4673	8.70%	5.3327	29.76%
	MCS#9	4.0116	+0.0%	4.3813	9.22%	4.9416	23.18%

Table 7.4-13a: Throughput performance based on conditional median DIP (Synchronous network, CRS based covariance matrix estimation, R4-121164, NEC, G=-2.5dB)

MCS Index	Baseline Tput (Mb/s)	Adv Rx Tput (Mb/s)	Tput gain %
7	3.8	4.7	24.9
8	3.8	4.6	23.7
9	3.7	4.4	17.7

Table 7.4-13b: Throughput performance based on conditional median DIP (Synchronous network, CRS based covariance matrix estimation, R4-121873, MStar Semiconductor, G=-2.5dB)

	MMSE	MMSE-IRC	Gain
MCS#7	3.9977 Mbps	4.9214 Mbps	23.11%
MCS#8	4.1142 Mbps	4.9774 Mbps	20.98%
MCS#9	4.0608 Mbps	4.6851 Mbps	15.37%

7.4.2 Scenario 2 (DM-RS based transmission)

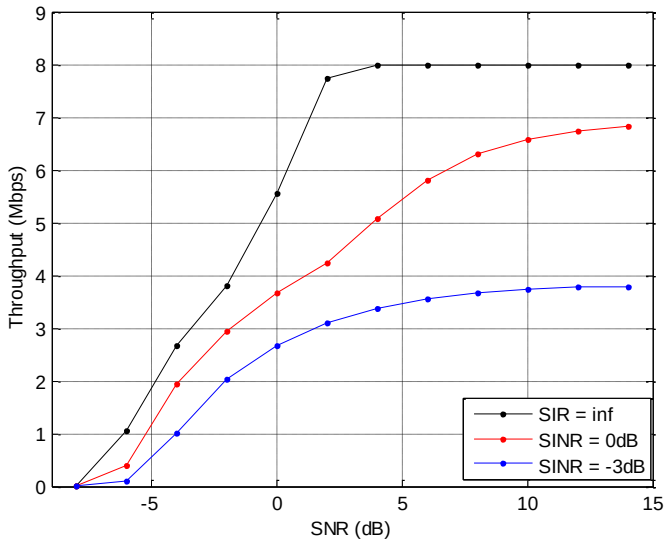
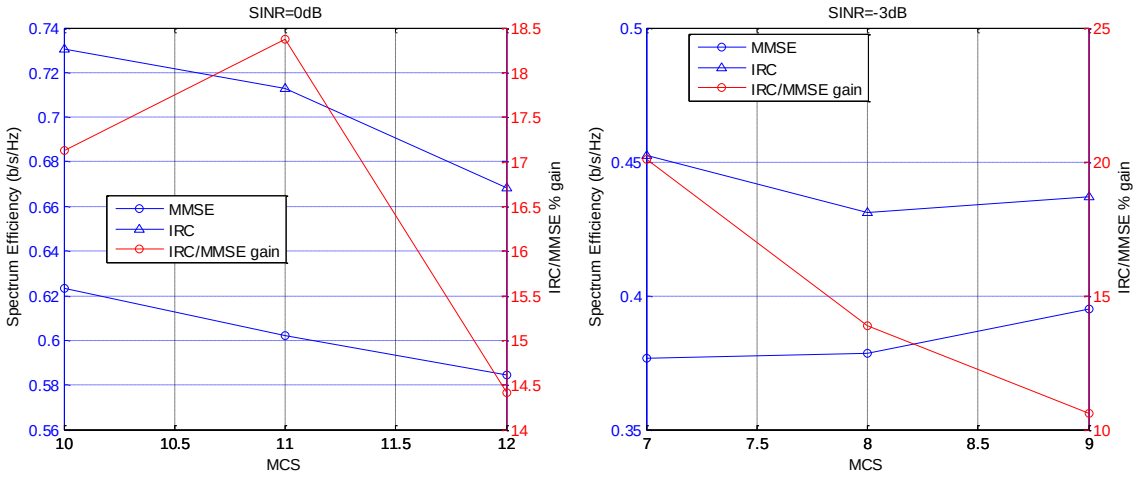


Figure 7.4-6: MMSE throughput of TM9 and MCS=10 (Synchronous network, R4- 120374, Huawei, HiSilicon)

Table 7.4-14: Throughput performance based on conditional median DIP (Synchronous network, DM-RS based covariance matrix estimation, R4-120374 and R4-121932, Huawei, Hi-Silicon)

Geometry	MCS	MMSE			MMSE-IRC			IRC/MMSE gain
		Throughput (Mbps)	Spectrum efficiency (b/s/Hz)	1st TX BLER	Throughput (Mbps)	Spectrum efficiency (b/s/Hz)	1st TX BLER	

SINR=0dB SNR=5.4dB	10	5.6112	0.6235	0.422	6.5726	0.7303	0.216	17.1%
	11	5.4189	0.6021	0.6062	6.4141	0.7127	0.3651	18.4%
	12	5.2583	0.5843	0.8451	6.0166	0.6685	0.6429	14.4%
	CQI	5.896	0.6551	0.1002	6.6723	0.7414	0.1003	13.2%
SINR=-3dB SNR=3.54dB	7	3.3914	0.3768	0.7745	4.0722	0.4525	0.5165	20.1%
	8	3.406	0.3784	0.931	3.8784	0.4309	0.7713	13.9%
	9	3.5564	0.3952	0.9861	3.9337	0.4371	0.9539	10.6%
	CQI	3.5385	0.3932	0.1005	4.2249	0.4694	0.1008	19.4%
SINR=-2.5dB	7	3.6989			4.6469			25.629241 %
	8	3.615			4.3898			21.43292 %
	9	3.7411			4.1878			11.94034 %



(a) SINR = 0 dB **(b) SINR = -3 dB**

Figure 7.4-7: Throughput of MMSE vs. MMSE-IRC (Synchronous network, 4TX, TM9 R4- 120374, Huawei, HiSilicon)

Table 7.4-15: Throughput performance based on conditional median DIP (Synchronous network, 0 dB geometry case, covariance matrix estimation period: 1RB, R4-120509, NTT DOCOMO)

	Rel.8 baseline (MMSE) receiver	MMSE-IRC receiver	
		DM-RS based covariance matrix estimation	Data signal based covariance matrix estimation
MCS index#10	4.87 Mbps	5.55 Mbps (+14.0%)	3.79 Mbps (-22.2%)
MCS index#11	4.60 Mbps	5.22 Mbps (+13.5%)	3.72 Mbps (-19.1%)
MCS index#12	4.28 Mbps	4.79 Mbps (+11.8%)	3.60 Mbps (-16.0%)
Outer-loop link adaptation	5.39 Mbps	5.84 Mbps (+8.3%)	4.70 Mbps (-12.9%)

Table 7.4-16: Throughput performance based on conditional median DIP (Synchronous network, -3 dB geometry case, covariance matrix estimation period: 1RB, R4-120509, NTT DOCOMO)

	Rel.8 baseline (MMSE) receiver	MMSE-IRC receiver	
		DM-RS based covariance matrix estimation	Data signal based covariance matrix estimation
MCS index #7	2.88 Mbps	3.30 Mbps (+14.6%)	2.74 Mbps (-4.8%)
MCS index #8	2.77 Mbps	3.13 Mbps (+13.0%)	2.67 Mbps (-3.5%)
MCS index #9	2.71 Mbps	2.98 Mbps (+9.7%)	2.65 Mbps (-2.4%)
Outer-loop link adaptation	2.94 Mbps	3.43 Mbps (+16.7%)	2.88 Mbps (-1.9%)

Table 7.4-18a: Throughput performance based on conditional median DIP (Synchronous network, -2.5 dB geometry case, covariance matrix estimation period: 1RB, R4-121557, NTT DOCOMO)

		Rel.8 baseline (MMSE) receiver	MMSE-IRC receiver
MCS index #7	DIP set #12	3.08 Mbps	4.30 Mbps (+39.9%)
MCS index #8	DIP set #13	2.98 Mbps	4.28 Mbps (+43.6%)
MCS index #9	DIP set #13	2.85 Mbps	3.88 Mbps (+36.2%)
Outer-loop link adaptation	DIP set #13	3.01 Mbps	4.34 Mbps (+44.3%)

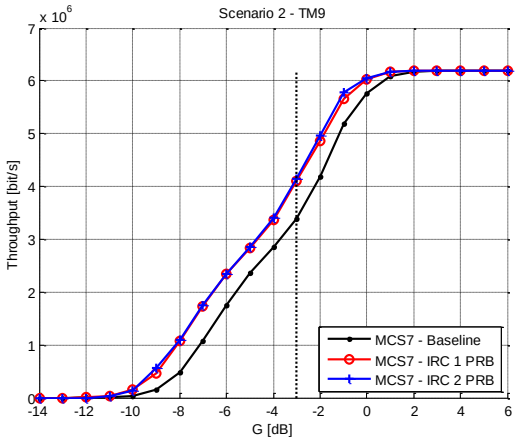
Table 7.4-17: Throughput performance based on conditional median DIP (Synchronous network, DM-RS based covariance matrix estimation, R4-120944 and R4-121436, Renesas Mobile Europe Ltd.)

		Rel-8/9 baseline WB / [NB]		MMSE-IRC – 1 PRB wrt. WB / [NB]		MMSE-IRC – 2 PRB wrt. WB / [NB]	
G = -3 dB	**MCS#7**	3.3865 [3.6744]	+0.0% [+0.0%]	4.0962	+21.0% [+11.5%]	4.1521	+22.6% [+13.0%]
	MCS#8	3.4317 [3.5642]	+0.0% [+0.0%]	3.8123	+11.1% [+7.0%]	3.9322	+14.6% [+10.3%]
	MCS#9	3.5262 [3.7344]	+0.0% [+0.0%]	3.9391	+11.7% [+5.5%]	3.9270	+11.4% [+5.2%]
G = 0 dB	**MCS#10**	5.7203 [6.0237]	+0.0% [+0.0%]	6.5734	+14.9% [+9.1%]	6.5577	+14.6% [+8.9%]
	MCS#11	5.7099 [5.7856]	+0.0% [+0.0%]	6.3629	+11.4% [+10.0%]	6.4074	+12.2% [+10.7%]
	MCS#12	5.4786 [5.6153]	+0.0% [+0.0%]	5.9923	+9.4% [+6.7%]	6.0080	+9.7% [+7.0%]
G=-2.5 dB	MCS #7	3.7564 [4.1856]	+0.0% [+0.0%]	4.6483	+23.7% [+11.1%]	4.7805	+27.3% [+14.2%]
	MCS#8	3.6620 [3.9163]	+0.0% [+0.0%]	4.4288	+20.9% [+13.1%]	4.5539	+24.4% [+16.3%]
	MCS#9	3.6883 [3.9146]	+0.0% [+0.0%]	4.2572	+15.4% [+8.8%]	4.2412	+15.0% [+8.3%]

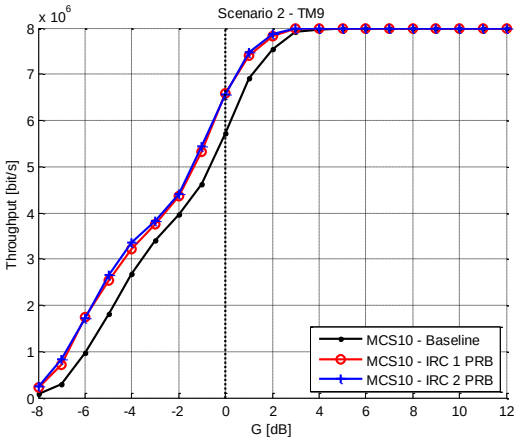
In the above set of results from reference R4-120944, the following two variants of Rel-8/9 baseline receiver have been considered:

- WB-MRC: performs maximum-ratio-combining with per-branch SNR weighting, where per-branch noise variance estimates are obtained as wideband (WB) sample averages.

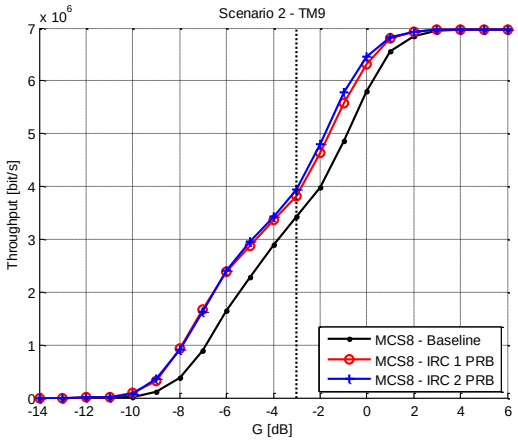
- NB-MRC: performs maximum-ratio-combining with per-branch SNR weighting, where per-branch noise variance estimates are obtained as narrowband (NB) sample averages over 1 PRB.



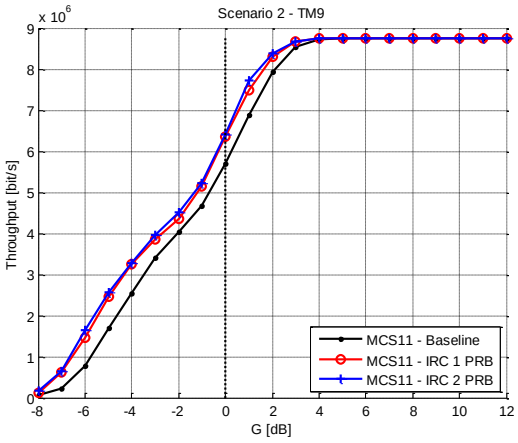
(a) MCS #7



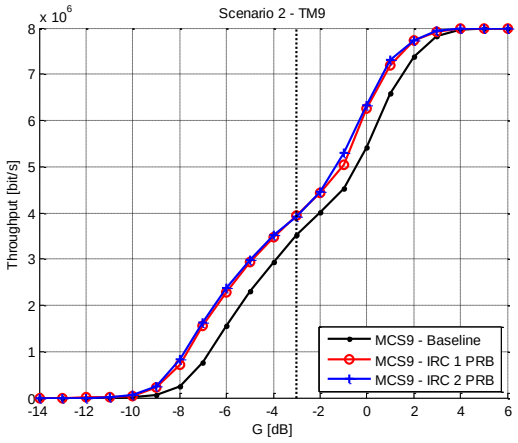
(b) MCS #10



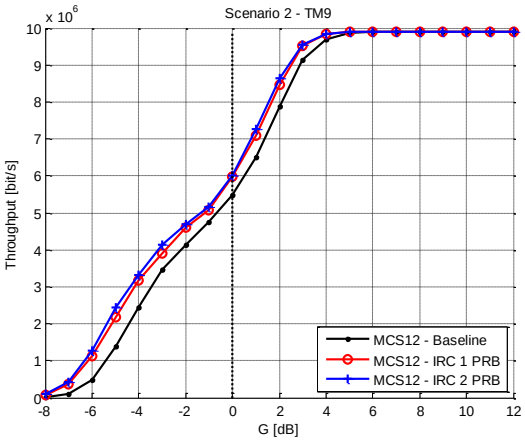
(c) MCS #8



(d) MCS #11



(e) MCS #9



(f) MCS #12

Figure 7.4-8: Simulation results with fixed MCS & median DIPs (Synchronous network, R4-120944, Renesas Mobile Europe Ltd.)

Table 7.4-18: Throughput performance based on conditional median DIP (Synchronous network, DM-RS based covariance matrix estimation, R4-120657 and R4-121410, Motorola Mobility)

	Throughput (Mbps)		Relative throughput (% of max throughput)		Throughput gain
I_{MCS} / Payload (bits)	MMSE	MMSE-IRC	MMSE	MMSE-IRC	
10 / 7992	5.191	5.983	65.0	74.9	15.3%
11 / 8760	5.238	5.849	59.8	66.8	11.7%
12 /9912	4.962	5.596	50.1	56.5	12.8%
G=0dB	**Throughput (Mbps)**		**Relative throughput (% of max throughput)**		**Throughput gain**
I_{MCS} / Payload (bits)	MMSE	MMSE-IRC	MMSE	MMSE-IRC	
7 / 6200	3.497	4.228	56.4	68.2	20.9%
8 / 6968	3.538	3.952	50.8	56.7	11.7%
9 / 7992	3.650	4.066	45.7	50.9	11.4%

Table 7.4-19: Throughput performance with MMSE and IRC receivers and gains based on conditional median DIP (Synchronous network, R4-120919 and R4-121778, ST-Ericsson/Ericsson)

Geometry	MCS		Scenario2	
		MMSE	MMSE-IRC	IRC/MMSE gain
		Throughput (bps)	Throughput (bps)	
G=0dB	10	4937420,302	5379129,246	8,95%
	11	4608486,332	5215879,196	13,18%
	12	4007983,92	4943568,844	23,34%
Average gain				15,16%
G=-3dB	7	3030181,005	3386641,106	11,76%
	8	3008562,01	3514149,749	16,80%
	9	2447345,93	3209112,06	31,13%
Average gain				19,90%
G=-2.5dB	5	3513942	3976121	13,15%
	6	3366662	3841604	14,11%
	7	3353010	3793593	13,14%
	8	3471178	4008598	15,48%
	9	3149635	3977631	26,29%
Average gain				16,43%

Table 7.4-20: Throughput performance based on conditional median DIP (Synchronous network, R4-120855 and R4-121894, Intel Corporation)

	DIP case 1 (G=0dB)			DIP case 2 (G=-3dB)			DIP case 3 (G=-2.5dB)		
MCS index	**MCS10**	**MCS11**	**MCS12**	**MCS7**	**MCS8**	**MCS9**	**MCS7**	**MCS8**	**MCS9**
Scenario 2 CRS-based	8.26%	10.09%	9.92%	10.55%	9.06%	11.17%			
Scenario 2 DMRS-based	7.90%	10.09%	9.31%	11.93%	11.31%	13.07%	18.3%	16.4%	12.3%

Table 7.4-21: BLER of the TX mode 9, MMSE-IRC with covariance estimation using CRS and DMRS (Synchronous network, R4-120855 and R4-121894, Intel Corporation)

	DIP case 1 (G=0dB)			DIP case 2 (G=-3dB)		
MCS index	**MCS10**	**MCS11**	**MCS12**	**MCS7**	**MCS8**	**MCS9**
Baseline MMSE	0.471378	0.529261	0.581321	0.487776	0.54329	0.594301
Scenario 2 CRS-based	0.427698864	0.4817472	0.5397727	0.433732	0.50193	0.548989
Scenario 2 DMRS-based	0.4296165	0.4803547	0.5423295	0.426654	0.491636	0.541268

Table 7.4-22: Throughput performance based on conditional median DIP (Asynchronous network, R4-120855 and R4-121894, Intel Corporation)

	DIP case 1 (G=0dB)			DIP case 2 (G=-3dB)			DIP case 3 (G=-2.5dB)		
MCS index	**10**	**11**	**12**	**7**	**8**	**9**	**7**	**8**	**9**
Scenario 2 CRS-based	2.58%	2.88%	1.17%	5.24%	4.41%	2.13%			
Scenario 2 DMRS-based	2.35%	3.49%	1.24%	4.70%	5.12%	2.26%	14.9%	12.6%	13.5%

Table 7.4-23: Throughput performance based on conditional median DIP (Synchronous network, DM-RS based covariance matrix estimation, R4-120911 and R4-121340, Nokia Siemens Networks, Nokia)

		"MMSE"		"MMSE-MRC"		"MMSE-IRC"	
G = -3 dB	**MCS#7**	3.6782	+0.0%	3.9775	8.14%	4.5091	22.59%
	MCS#8	3.6567	+0.0%	3.8511	5.32%	4.1425	13.29%
	MCS#9	3.5984	+0.0%	3.787	5.24%	4.1201	14.50%
G = 0 dB	**MCS#10**	6.1131	+0.0%	6.6079	8.09%	6.9318	13.39%
	MCS#11	5.9461	+0.0%	6.2002	4.27%	6.9694	17.21%
	MCS#12	5.6641	+0.0%	5.9989	5.91%	6.5044	14.84%
G=-2.5dB	**MCS#7**	3.9953	0%	4.4398	11.12%	5.1185	28.11%
	MCS#8	3.8405	0%	4.2172	9.81%	4.8166	25.42%
	MCS#9	3.8511	0%	4.1968	8.98%	4.484	16.43%

Table 7.4-24: Throughput performance based on conditional median DIP (Synchronous network, CRS based covariance matrix estimation, R4-121164, NEC, G=-2.5dB)

MCS Index	Baseline Tput (Mb/s)	Adv Rx Tput (Mb/s)	Tput gain %
7	3.6	4.3	18.7
8	3.6	4.1	14.8
9	3.6	4.1	11.5

Table 7.4-25: Throughput performance based on conditional median DIP (Synchronous network, CRS based covariance matrix estimation, R4-122017 and R4-122018, LG Electronics, G=-2.5dB)

Median DIP		MMSE	MMSE-IRC	Gain (%)
G = -2.5 dB	MCS7	3831.86	4433.13	15.69%
	MCS8	3671.59	4196.00	14.28%
	MCS9	3786.49	4185.32	10.53%
G = 0 dB	MCS10	5494.05	6083.41	10.73%
	MCS11	5231.75	6003.42	14.75%
	MCS12	5201.82	5725.51	10.07%

7.5 Simulation results for DIPs based on weighted average throughput gain

This section presents the evaluation results generated by various interested companies to show the contribution. Here, the term total interference refers to I_{oc} as defined in Clause 6.2.

7.5.1 Scenario 1 (CRS based transmission)

Table 7.5-1: Throughput performance for DIPs based on weighted average throughput gain (0 dB geometry case, CRS based covariance matrix estimation, R4-120911, Nokia Siemens Networks, Nokia)

DIP set#	Throughput (kbps)								
	MCS #10			MCS #11			MCS #12		
	Rel.8 baseline receiver	MMSE-IRC receiver	Gain	Rel.8 baseline receiver	MMSE-IRC receiver	Gain	Rel.8 baseline receiver	MMSE-IRC receiver	Gain
1	5510	5607	1.76%	5464	5715	4.59%	5343	5470	2.38%
2	5627	6029	7.14%	5675	6081	7.15%	5581	5881	5.38%
3	5672	6295	10.98%	5779	6328	9.50%	5612	5980	6.56%
4	5650	6455	14.25%	5820	6691	14.97%	5544	6281	13.29%
5	5699	6485	13.79%	5791	6654	14.90%	5623	6321	12.41%
6	5640	6637	17.68%	5689	6924	21.71%	5801	6439	11.00%
7	5733	6806	18.72%	5798	6930	19.52%	5632	6783	20.44%
8	5754	6928	20.40%	5802	7077	21.98%	5754	6859	19.20%
9	5708	7182	25.82%	5970	7351	23.13%	5742	7257	26.38%
10	5763	7228	25.42%	5995	7733	28.99%	5866	7666	30.69%
11	5749	7117	23.80%	5948	7487	25.87%	5768	7398	28.26%
12	5546	6980	25.86%	5978	7180	20.11%	5553	7011	26.26%
13	5841	7019	20.17%	5838	7232	23.88%	5665	7249	27.96%
14	5829	7020	20.43%	5806	7503	29.23%	5754	7521	30.71%
15	5700	7315	28.33%	6009	7762	29.17%	5696	7641	34.15%
16	5696	7381	29.58%	5851	7955	35.96%	5825	8137	39.69%
17	5770	7565	31.11%	6010	8146	35.54%	5945	8420	41.63%
18	5812	7712	32.69%	5918	8371	41.45%	5915	8881	50.14%
19	5645	7806	38.28%	5807	8575	47.67%	5788	9381	62.08%
20	5506	7490	36.03%	5735	8334	45.32%	5590	9052	61.93%
Ave.	5693	6953	22.11%	5834	7301	25.03%	5700	7281	27.53%

Table 7.5-2: Throughput performance for DIPs based on weighted average throughput gain (-3 dB geometry case, CRS based covariance matrix estimation, R4-120911, Nokia Siemens Networks, Nokia)

DIP set#	Throughput (kbps)								
	MCS #7			MCS #8			MCS #9		
	Rel.8 baseline receiver	MMSE-IRC receiver	Gain	Rel.8 baseline receiver	MMSE-IRC receiver	Gain	Rel.8 baseline receiver	MMSE-IRC receiver	Gain
1	3678	4046	10.01%	3676	3876	5.44%	3759	3855	2.55%
2	3826	4386	14.64%	3738	4183	11.90%	3756	4062	8.15%
3	3880	4901	26.31%	3808	4673	22.72%	3719	4446	19.55%
4	3818	5073	32.87%	3762	5059	34.48%	3718	4739	27.46%
5	3820	5067	32.64%	3775	4981	31.95%	3758	4738	26.08%
6	3705	5250	41.70%	3709	5198	40.15%	3741	4866	30.07%
7	3829	5300	38.42%	3732	5260	40.94%	3625	4955	36.69%
8	3750	5170	37.87%	3743	5211	39.22%	3724	4946	32.81%
9	3759	5290	40.73%	3773	5206	37.98%	3700	4868	31.57%
10	3744	5223	39.50%	3692	5190	40.57%	3721	5027	35.10%
11	3883	5161	32.91%	3737	4975	33.13%	3691	4787	29.69%
12	3820	5031	31.70%	3767	4798	27.37%	3751	4506	20.13%
13	3837	4933	28.56%	3728	4936	32.40%	3752	4568	21.75%
14	3704	5213	40.74%	3763	5160	37.12%	3764	4672	24.12%
15	3772	5228	38.60%	3743	5196	38.82%	3712	4889	31.71%
16	3743	5398	44.22%	3714	5221	40.58%	3713	4951	33.34%
17	3853	5376	39.53%	3788	5447	43.80%	3745	5082	35.70%
18	3819	5519	44.51%	3756	5614	49.47%	3718	5281	42.04%
19	3727	5678	52.35%	3733	5891	57.81%	3639	5691	56.39%
20	3806	5879	54.47%	3715	6068	63.34%	3683	5923	60.82%
Ave.	3789	5156	36.11%	3743	5107	36.46%	3719	4843	30.29%

Table 7.5-2a: Throughput performance for DIPs based on weighted average throughput gain (-2.5 dB geometry case, CRS based covariance matrix estimation, R4-121339, Nokia Siemens Networks, Nokia)

DIP Profile #	MCS-7			MCS-8			MCS-9		
	MMSE	MMSE-IRC	Gain (%)	MMSE	MMSE-IRC	Gain (%)	MMSE	MMSE-IRC	Gain (%)
1	4260	4298	0.91%	4053	4135	2.02%	3979	4040	1.53%
2	4193	4631	10.46%	3988	4586	15.00%	3972	4256	7.15%
3	4074	4914	20.63%	4160	4731	13.74%	4076	4497	10.34%
4	4282	4917	14.83%	4024	4744	17.88%	3978	4455	11.99%
5	4110	5023	22.22%	4095	5029	22.80%	4022	4634	15.22%
6	4336	5114	17.95%	4139	4959	19.80%	3960	4695	18.57%
7	4139	5064	22.34%	4111	4995	21.51%	3979	4606	15.76%
8	4190	5188	23.82%	4098	5125	25.08%	4064	4684	15.25%
9	4106	5259	28.09%	4134	5181	25.32%	3985	4919	23.43%
10	4186	5376	28.43%	4162	5283	26.95%	4044	4964	22.76%
11	4246	5470	28.82%	4145	5310	28.08%	4039	5085	25.89%
12	4109	5424	32.00%	4252	5517	29.75%	3999	5132	28.34%
13	4138	5574	34.71%	4156	5649	35.93%	3938	5194	31.89%
14	4156	5622	35.27%	4049	5742	41.82%	4046	5552	37.23%
15	4232	5661	33.78%	4125	5909	43.27%	4055	5716	40.97%
16	4203	5832	38.75%	4209	6051	43.79%	4016	5854	45.77%
17	4303	5917	37.52%	4027	6160	52.98%	4032	6128	51.98%
18	4206	5947	41.40%	3950	6353	60.85%	3970	6356	60.08%
19	4069	5976	46.87%	3913	6338	61.96%	3944	6459	63.75%
20	3986	5878	47.48%	3959	6311	59.42%	4021	6363	58.23%
Average	4176	5354	28.31%	4087	5406	32.40%	4006	5179	29.31%

Table 7.5-3: Throughput performance for DIPs based on weighted average throughput gain (0 dB geometry case, CRS based covariance matrix estimation, R4-120511, NTT DOCOMO)

DIP set#	Throughput (Mbps)								
	MCS #10			MCS #11			MCS #12		
	Rel.8 baseline receiver	MMSE-IRC receiver	Gain	Rel.8 baseline receiver	MMSE-IRC receiver	Gain	Rel.8 baseline receiver	MMSE-IRC receiver	Gain
1	4.527	4.514	-0.29%	4.493	4.471	-0.49%	4.204	4.192	-0.29%
2	4.525	4.75	4.97%	4.494	4.712	4.85%	4.203	4.369	3.95%
3	4.523	4.887	8.05%	4.496	4.852	7.92%	4.203	4.475	6.47%
4	4.523	5.018	10.94%	4.495	4.991	11.03%	4.201	4.596	9.40%
5	4.521	5.097	12.74%	4.499	5.071	12.71%	4.202	4.663	10.97%
6	4.52	5.19	14.82%	4.496	5.169	14.97%	4.204	4.753	13.06%
7	4.517	5.288	17.07%	4.495	5.274	17.33%	4.203	4.852	15.44%
8	4.514	5.451	20.76%	4.497	5.454	21.28%	4.204	5.028	19.60%
9	4.514	5.566	23.31%	4.494	5.577	24.10%	4.206	5.154	22.54%
10	4.51	5.773	28.00%	4.495	5.82	29.48%	4.207	5.411	28.62%
11	4.512	5.665	25.55%	4.493	5.693	26.71%	4.205	5.269	25.30%
12	4.511	5.516	22.28%	4.494	5.518	22.79%	4.206	5.075	20.66%
13	4.504	5.682	26.15%	4.493	5.699	26.84%	4.207	5.252	24.84%
14	4.502	5.852	29.99%	4.495	5.895	31.15%	4.212	5.446	29.30%
15	4.49	6.069	35.17%	4.49	6.132	36.57%	4.214	5.698	35.22%
16	4.492	6.313	40.54%	4.491	6.426	43.09%	4.217	6.017	42.68%
17	4.485	6.605	47.27%	4.486	6.778	51.09%	4.221	6.434	52.43%
18	4.473	7.031	57.19%	4.481	7.344	63.89%	4.22	7.183	70.21%
19	4.451	7.506	68.64%	4.47	8.025	79.53%	4.223	8.318	96.97%
20	4.436	7.674	72.99%	4.463	8.284	85.62%	4.224	8.851	109.54%
Ave.	4.5025	5.7724	28.31%	4.4905	5.8593	30.52%	4.2093	5.5518	31.85%

Note that the throughput filled in pink is closest to the average throughput

Table 7.5 -4: Throughput performance for DIPs based on weighted average throughput gain (-3 dB geometry case, CRS based covariance matrix estimation, R4-120511, NTT DOCOMO)

DIP set#	Throughput (Mbps)								
	MCS #7			MCS #8			MCS #9		
	Rel.8 baseline receiver	MMSE-IRC receiver	Gain	Rel.8 baseline receiver	MMSE-IRC receiver	Gain	Rel.8 baseline receiver	MMSE-IRC receiver	Gain
1	2.817	2.916	3.51%	2.763	2.853	3.26%	2.697	2.778	3.00%
2	2.793	3.139	12.39%	2.737	3.032	10.78%	2.672	2.912	8.98%
3	2.769	3.433	23.98%	2.711	3.292	21.43%	2.643	3.101	17.33%
4	2.757	3.574	29.63%	2.699	3.425	26.90%	2.629	3.197	21.61%
5	2.752	3.633	32.01%	2.694	3.483	29.29%	2.623	3.24	23.52%
6	2.741	3.774	37.69%	2.682	3.631	35.38%	2.61	3.354	28.51%
7	2.734	3.862	41.26%	2.676	3.724	39.16%	2.603	3.429	31.73%
8	2.735	3.872	41.57%	2.676	3.736	39.61%	2.601	3.439	32.22%
9	2.736	3.822	39.69%	2.678	3.683	37.53%	2.605	3.395	30.33%
10	2.732	3.861	41.33%	2.676	3.725	39.20%	2.602	3.431	31.86%
11	2.745	3.728	35.81%	2.686	3.583	33.40%	2.615	3.313	26.69%
12	2.757	3.577	29.74%	2.697	3.424	26.96%	2.626	3.193	21.59%
13	2.748	3.681	33.95%	2.688	3.526	31.18%	2.616	3.272	25.08%
14	2.74	3.765	37.41%	2.681	3.606	34.50%	2.607	3.332	27.81%
15	2.735	3.882	41.94%	2.674	3.725	39.30%	2.599	3.423	31.70%
16	2.724	4.005	47.03%	2.665	3.851	44.50%	2.588	3.523	36.13%
17	2.716	4.128	51.99%	2.656	3.976	49.70%	2.577	3.623	40.59%
18	2.703	4.315	59.64%	2.648	4.177	57.74%	2.562	3.788	47.85%
19	2.679	4.665	74.13%	2.625	4.577	74.36%	2.538	4.16	63.91%
20	2.658	4.971	87.02%	2.607	4.957	90.14%	2.512	4.554	81.29%
Ave.	2.7386	3.8302	40.09%	2.681	3.6993	38.22%	2.6063	3.4229	31.59%

Note that the throughput filled in pink is closest to the average throughput

Table 7.5-4a: Throughput performance for DIPs based on weighted average throughput gain (-2.5 dB geometry case, CRS based covariance matrix estimation, R4-121557, NTT DOCOMO)

DIP set #	MCS #7			MCS #8			MCS #9		
	Rel.8 baseline (MMSE) receiver	MMSE-IRC Receiver	Gain	Rel.8 baseline (MMSE) receiver	MMSE-IRC Receiver	Gain	Rel.8 baseline (MMSE) receiver	MMSE-IRC Receiver	Gain
	(Mbps)	(Mbps)	(%)	(Mbps)	(Mbps)	(%)	(Mbps)	(Mbps)	(%)
1	3.170	3.224	1.7	3.066	3.108	1.4	2.945	2.986	1.4
2	3.151	3.463	9.9	3.047	3.313	8.7	2.920	3.133	7.3
3	3.140	3.59	14.3	3.033	3.434	13.2	2.910	3.217	10.6
4	3.132	3.696	18.0	3.026	3.536	16.9	2.901	3.290	13.4
5	3.122	3.801	21.8	3.020	3.632	20.3	2.892	3.360	16.2
6	3.120	3.815	22.3	3.018	3.646	20.8	2.891	3.372	16.6
7	3.117	3.845	23.4	3.016	3.675	21.9	2.888	3.393	17.5
8	3.108	3.915	26.0	3.011	3.742	24.3	2.881	3.444	19.5
9	3.102	4.013	29.4	3.007	3.839	27.7	2.875	3.518	22.4
10	3.096	4.083	31.9	3.001	3.913	30.4	2.869	3.575	24.6
11	3.085	4.198	36.1	2.995	4.030	34.6	2.862	3.671	28.3
12	3.077	4.304	39.9	2.984	4.144	38.9	2.854	3.763	31.9
13	3.067	4.423	44.2	2.977	4.275	43.6	2.846	3.877	36.2
14	3.057	4.551	48.9	2.969	4.420	48.9	2.838	4.008	41.2
15	3.045	4.713	54.8	2.958	4.608	55.8	2.830	4.182	47.8
16	3.034	4.876	60.7	2.948	4.814	63.3	2.818	4.384	55.6
17	3.019	5.084	68.4	2.934	5.082	73.2	2.806	4.679	66.8
18	2.995	5.343	78.4	2.917	5.455	87.0	2.787	5.131	84.1
19	2.979	5.507	84.9	2.901	5.709	96.8	2.774	5.485	97.7
20	2.965	5.591	88.6	2.893	5.852	102.3	2.763	5.704	106.4
Avg.	3.0791	4.3018	39.7	2.9861	4.2114	41.0	2.8575	3.9086	36.8

Table 7.5-5: Gain of MMSE-IRC receiver (0 dB geometry case, CRS based covariance matrix estimation, R4-120511, NTT DOCOMO)

		Rel.8 baseline (MMSE) receiver	MMSE-IRC receiver
MCS index#10	DIP set#10	4.51 Mbps	5.77 Mbps (+28.0%)
MCS index#11	DIP set#14	4.50 Mbps	5.90 Mbps (+31.1%)
MCS index#12		4.21 Mbps	5.45 Mbps (+29.3%)

Table 7.5-6: Gain of MMSE-IRC receiver (-3 dB geometry case, CRS based covariance matrix estimation, R4-120511, NTT DOCOMO)

		Rel.8 baseline (MMSE) receiver	MMSE-IRC receiver
MCS index #7	DIP set #9	2.74 Mbps	3.82 Mbps (+39.7%)
MCS index #8		2.68 Mbps	3.68 Mbps (+37.5%)
MCS index #9	DIP set #15	2.60 Mbps	3.42 Mbps (+31.7%)

Table 7.5-7: Throughput performance for DIPs based on weighted average throughput gain (0 dB geometry case, CRS based covariance matrix estimation, R4-120657, Motorola Mobility)

DIP set#	Throughput (Mbps)		
	MCS #12		
	Rel.8 baseline receiver	MMSE-IRC receiver	Gain
1	5.146	5.436	5.6%
2	5.423	5.611	3.5%
3	5.187	5.532	6.6%
4	5.281	5.877	11.4%
5	5.253	5.712	8.7%
6	5.221	5.799	11.1%
7	5.281	5.865	11.1%
8	5.296	6.081	14.8%
9	5.228	6.264	19.8%
10	5.303	6.563	23.8%
11	5.377	6.244	16.1%
12	5.4	6.316	17.0%
13	5.291	6.313	19.3%
14	5.385	6.358	18.1%
15	5.627	6.587	17.1%
16	5.3	6.782	27.9%
17	5.337	7.399	38.6%
18	5.431	8.02	47.7%
19	5.343	8.718	63.2%
20	5.548	9.129	64.5%

Table 7.5-7a: Throughput performance for DIPs based on weighted average throughput gain (-2.5 dB geometry case, CRS based covariance matrix estimation, R4-121410, Motorola Mobility)

#	DIP1 [dB]	DIP2 [dB]	Throughput (Mbps)		Relative throughput (%of max throughput)		Throughput Gain (%)
			MMSE	MMSE-IRC	MMSE	MMSE-IRC	
1	-5.71	-6.77	3.924	3.936	49.1	49.3	0.3
2	-4.34	-5.91	3.941	4.143	49.3	51.8	5.1
3	-3.86	-5.63	3.889	4.185	48.7	52.4	7.6
4	-3.49	-5.54	3.906	4.284	48.9	53.6	9.7
5	-3.22	-5.42	3.927	4.334	49.1	54.2	10.4
6	-2.99	-5.95	3.921	4.376	49.1	54.8	11.6
7	-2.72	-6.80	3.783	4.379	47.3	54.8	15.8
8	-2.50	-7.21	3.957	4.348	49.5	54.4	9.9
9	-2.30	-7.28	3.993	4.445	50.0	55.6	11.3
10	-2.12	-7.78	4.002	4.466	50.1	55.9	11.6
11	-1.90	-8.33	3.997	4.536	50.0	56.8	13.5
12	-1.73	-8.66	3.958	4.495	49.5	56.2	13.6
13	-1.55	-9.31	3.702	4.721	46.3	59.1	27.5
14	-1.39	-9.55	3.909	4.988	48.9	62.4	27.6
15	-1.21	-9.92	4.047	5.118	50.6	64.0	26.4
16	-1.03	-10.99	3.816	5.208	47.7	65.2	36.5
17	-0.83	-11.44	3.835	5.367	48.0	67.2	40.0
18	-0.58	-12.12	3.890	5.808	48.7	72.7	49.3
19	-0.41	-13.21	3.865	6.123	48.4	76.6	58.4
20	-0.31	-13.73	3.919	5.945	49.0	74.4	51.7

Table 7.5-8: Throughput performance for DIPs based on weighted average throughput gain (0 dB geometry, scenario 1, R4-120919, ST-Ericsson/Ericsson)

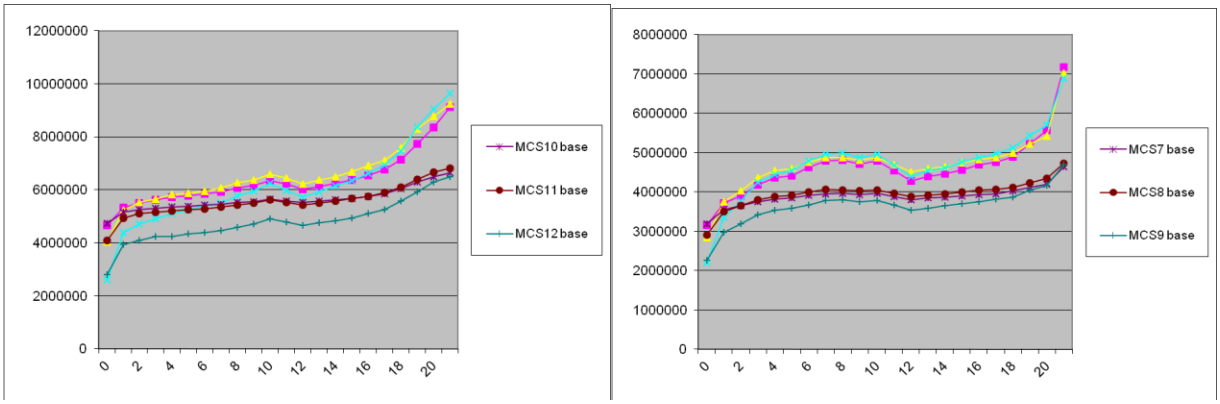
DIP Profile #	MCS-10			MCS-11			MCS-12		
	MMSE	MMSE-IRC	Gain (%)	MMSE	MMSE-IRC	Gain (%)	MMSE	MMSE-IRC	Gain (%)
1	5152553,2	5333763,4	3,52%	4939415,6	5233184,9	5,95%	3927156,3	4373817,6	11,37%
2	5244575,2	5497988,4	4,83%	5094775,2	5515109,2	8,25%	4097860,3	4704297,4	14,80%
3	5291714,5	5618761,2	6,18%	5144137,1	5652701,3	9,89%	4241744	4894413,5	15,39%
4	5357595,6	5717458,4	6,72%	5204274,6	5819707,2	11,83%	4237669,7	5101935,9	20,39%
5	5375683	5770937	7,35%	5249568,8	5870106,3	11,82%	4341773,2	5227583,4	20,40%
6	5422133,2	5845224,8	7,80%	5268793,9	5950129,4	12,93%	4382911,6	5419961,7	23,66%
7	5457429,7	5930718,4	8,67%	5344476,8	6072312,4	13,62%	4458174,4	5496210,6	23,28%
8	5524052,2	6058502,2	9,67%	5421679,6	6260649,9	15,47%	4590114	5773901,8	25,79%
9	5553181,2	6159567,9	10,92%	5488127,6	6369100,7	16,05%	4716401,5	5956389,9	26,29%
10	5646021,7	6336317,2	12,23%	5613077,8	6592271,2	17,44%	4897903,6	6231525	27,23%
11	5576023,1	6225501,2	11,65%	5529816,2	6438819,5	16,44%	4780918,3	5980360,1	25,09%
12	5529573	6031000,4	9,07%	5428828,6	6223793,7	14,64%	4661480,9	5731539,3	22,96%
13	5572087,1	6128931,3	9,99%	5492918,3	6364111,4	15,86%	4747939,9	5919653,5	24,68%
14	5620044,9	6245974,6	11,14%	5581966,1	6493307	16,33%	4834931	6136292,1	26,92%
15	5671232,2	6369434,4	12,31%	5665301,6	6695691	18,19%	4929416	6344082,4	28,70%
16	5759318,2	6541394,4	13,58%	5748038,9	6900747,4	20,05%	5101720	6602659,4	29,42%
17	5848205,3	6754206,5	15,49%	5892350,4	7119011,8	20,82%	5242273,6	6930259,2	32,20%
18	6034859,2	7128143,6	18,12%	6090331,7	7571568,5	24,32%	5568031,5	7446319,2	33,73%
19	6281348,3	7732532,5	23,10%	6399646,4	8307673,6	29,81%	5910909,3	8371076,1	41,62%
20	6484315,7	8344965	28,69%	6667681,5	8771299,3	31,55%	6283163,7	9050160,1	44,04%
AWGN	4721925,4	4667887	-1,14%	4090434,3	4046544,4	-1,07%	2800209	2600902,5	-7,12%
1 strong cell, no AWGN	6629049,9	9110658,2	37,44%	6812307,1	9242074,1	35,67%	6499270,3	9628705,1	48,15%
Average gain			11,55%			16,56%			25,90%

Table 7.5-9: Throughput performance for DIPs based on weighted average throughput gain (-3 dB geometry, scenario 1, R4-120919, ST-Ericsson/Ericsson)

	MCS-7			MCS-8			MCS-9		
DIP Profile #	MMSE	MMSE-IRC	Gain (%)	MMSE	MMSE-IRC	Gain (%)	MMSE	MMSE-IRC	Gain (%)
1	3556657,1	3718397,3	4,55%	3504908,7	3745448,1	6,86%	2968049	3357182,2	13,11%
2	3652791,5	3902115,2	6,83%	3642319,7	4033996,9	10,75%	3186611,2	3757488,7	17,91%
3	3753127,3	4176414,9	11,28%	3804525,9	4360855	14,62%	3416739,5	4241897,7	24,15%
4	3813207,4	4364056,5	14,45%	3883061,5	4535587,9	16,80%	3540470,3	4434912,6	25,26%
5	3840079	4410355,7	14,85%	3913441,1	4595933	17,44%	3585783,1	4546075	26,78%
6	3907266,8	4621402,3	18,28%	3988959,9	4760068,4	19,33%	3673056,7	4785173,8	30,28%
7	3955139,1	4782553,3	20,92%	4055629,7	4865922,4	19,98%	3777548,6	4958982,2	31,28%
8	3962099	4805257	21,28%	4051985	4880489,9	20,45%	3799481,8	4982607,6	31,14%
9	3923201,1	4703036,6	19,88%	4025698,4	4808234,8	19,44%	3750325,3	4867322	29,78%
10	3957949	4786884,7	20,94%	4054048,5	4873424,6	20,21%	3784400,1	4960461,1	31,08%
11	3882098,3	4549831,5	17,20%	3959398,3	4685278,8	18,33%	3662311,6	4675786	27,67%
12	3801864,5	4275885,8	12,47%	3874156,8	4505555,4	16,30%	3532896,3	4387792,7	24,20%
13	3843460,3	4396426,9	14,39%	3921840,8	4588901,7	17,01%	3586374,7	4541096,8	26,62%
14	3856757,2	4461833,4	15,69%	3953600,2	4635711	17,25%	3643467,1	4601376,6	26,29%
15	3899995,5	4562843,7	17,00%	3994230,3	4731976,5	18,47%	3705044,8	4758624,4	28,44%
16	3937181,4	4689679,2	19,11%	4048026,3	4825527,8	19,21%	3742373,2	4869030,5	30,11%
17	3951957,2	4751159,8	20,22%	4065532,2	4873436	19,87%	3812231,2	4967246,3	30,30%
18	4027747,4	4893203,5	21,49%	4120438,5	4994485,4	21,21%	3866465,9	5114783,5	32,29%
19	4120077	5220511,4	26,71%	4230138,6	5213100,7	23,24%	4041868	5434288,2	34,45%
20	4199333,8	5567955	32,59%	4337865	5410285,5	24,72%	4159898,1	5692593,5	36,84%
AWGN	3193666,9	3157388,5	-1,14%	2904664,3	2847246,2	-1,98%	2262283,5	2198142,4	-2,84%
1 strong cell, no AWGN	4635934	7175572,4	54,78%	4718249,6	7025205	48,89%	4683179	6880595,9	46,92%
Average gain			17,51%			18,08%			27,90%

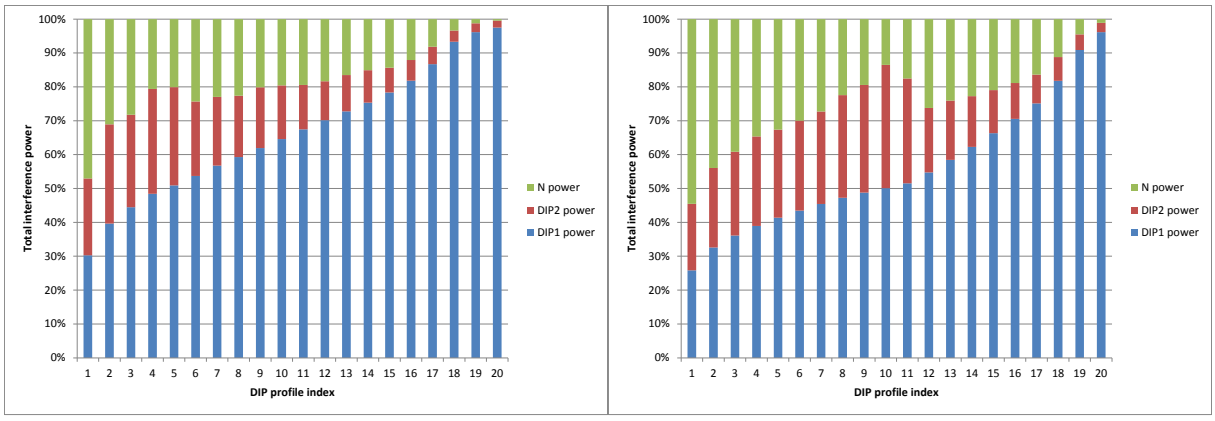
Table 7.5-9a: Throughput performance for DIPs based on weighted average throughput gain (-2.5 dB geometry, scenario 1, R4-121778, ST-Ericsson/Ericsson)

DIP Profile #	MCS-5			MCS-6			MCS-7			MCS-8			MCS-9		
	MMSE-MRC	MMSE-IRC	Gain (%)	MMSE-MRC	MMSE-IRC	Gain (%)	MMSE-MRC	MMSE-IRC	Gain (%)	MMSE-MRC	MMSE-IRC	Gain (%)	MMSE-MRC	MMSE-IRC	Gain (%)
AWGN	3965325	3920500	-1,13%	3576925	3547531	-0,82%	3492064	3473571	-0,53%	3403967	3363796	-1,18%	2840604	2749075	-3,22%
1	4255891	4379644	2,91%	3923472	4082948	4,06%	3812396	3925995	2,98%	3854195	4098626	6,34%	3521988	3825359	8,61%
2	4312191	4534245	5,15%	4039896	4327776	7,13%	3887252	4132883	6,32%	4002944	4325966	8,07%	3743556	4191771	11,97%
3	4330332	4597172	6,16%	4084117	4461204	9,23%	3935384	4252214	8,05%	4082152	4451535	9,05%	3822040	4332145	13,35%
4	4354951	4657275	6,94%	4118428	4564754	10,84%	3972129	4348252	9,47%	4107429	4561336	11,05%	3872348	4487306	15,88%
5	4374575	4693303	7,29%	4158375	4647806	11,77%	4011347	4451701	10,98%	4158523	4626840	11,26%	3947973	4611744	16,81%
6	4380404	4703151	7,37%	4166777	4657533	11,78%	4002866	4442666	10,99%	4155439	4642137	11,71%	3935010	4603250	16,98%
7	4383192	4703694	7,31%	4171255	4677598	12,14%	4024099	4444369	10,44%	4174840	4667560	11,80%	3960935	4635731	17,04%
8	4390360	4728172	7,69%	4181061	4731636	13,17%	4033730	4499512	11,55%	4197516	4702819	12,04%	3965585	4698590	18,48%
9	4405677	4754820	7,92%	4218435	4801170	13,81%	4065608	4590874	12,92%	4226909	4771418	12,88%	4037136	4793422	18,73%
10	4409840	4773793	8,25%	4256435	4865557	14,31%	4082113	4633429	13,51%	4243136	4803514	13,21%	4050493	4858959	19,96%
11	4429029	4820971	8,85%	4270038	4949381	15,91%	4136876	4727367	14,27%	4298603	4884146	13,62%	4115915	4976611	20,91%
12	4438985	4848742	9,23%	4313234	5050894	17,10%	4171875	4829587	15,77%	4336138	4955448	14,28%	4156858	5083584	22,29%
13	4460203	4883971	9,50%	4338071	5125050	18,14%	4211517	4925392	16,95%	4367270	5016601	14,87%	4236213	5166783	21,97%
14	4470486	4920758	10,07%	4372178	5237105	19,78%	4251080	5061677	19,07%	4415896	5111318	15,75%	4277632	5304857	24,01%
15	4492355	4958488	10,38%	4431412	5372586	21,24%	4304875	5263015	22,26%	4467695	5220805	16,86%	4340902	5461463	25,81%
16	4507561	4992666	10,76%	4479665	5507333	22,94%	4364886	5445520	24,76%	4536608	5329732	17,48%	4403351	5598995	27,15%
17	4532255	5026485	10,90%	4543853	5670321	24,79%	4458694	5740648	28,75%	4583507	5521601	20,47%	4511737	5799188	28,54%
18	4555898	5079820	11,50%	4629714	5890018	27,22%	4585893	6185427	34,88%	4699802	5868263	24,86%	4654066	6116278	31,42%
19	4578203	5104078	11,49%	4693468	6052031	28,95%	4685848	6546670	39,71%	4770935	6174822	29,43%	4794440	6319051	31,80%
20	4588087	5118453	11,56%	4733608	6152037	29,97%	4748738	6772362	42,61%	4848876	6423291	32,47%	4863280	6472289	33,08%
1 strong cell, no AWGN	4637690	5140286	10,84%	4822338	6430877	33,36%	4997878	7501350	50,09%	5067256	7536552	48,73%	5092291	7203978	41,47%
Average gain			8,56%			16,71%			17,81%			15,37%			21,24%



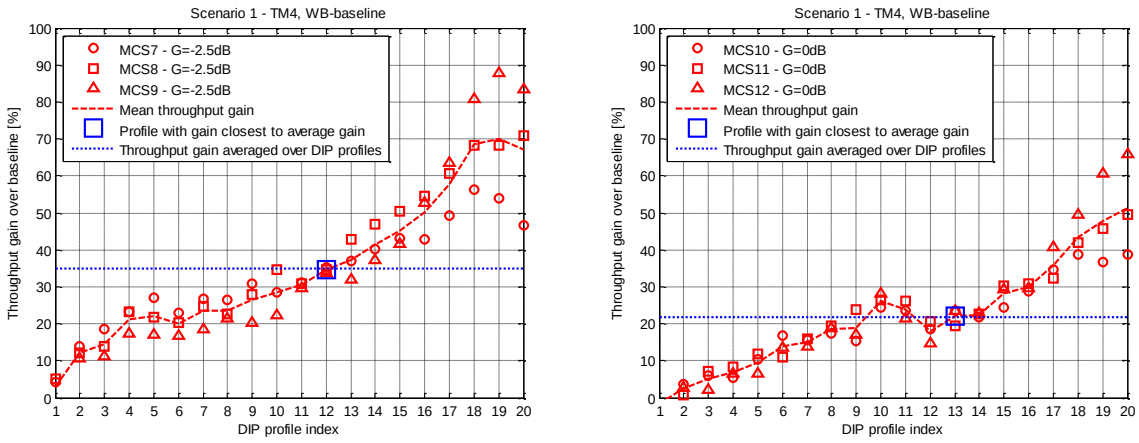
(a) Geometry = 0 dB for Scenario 1 (b) Geometry = -3 dB for Scenario 1

Figure 7.5-1: throughput behaviour (R4-120919, ST-Ericsson/Ericsson)



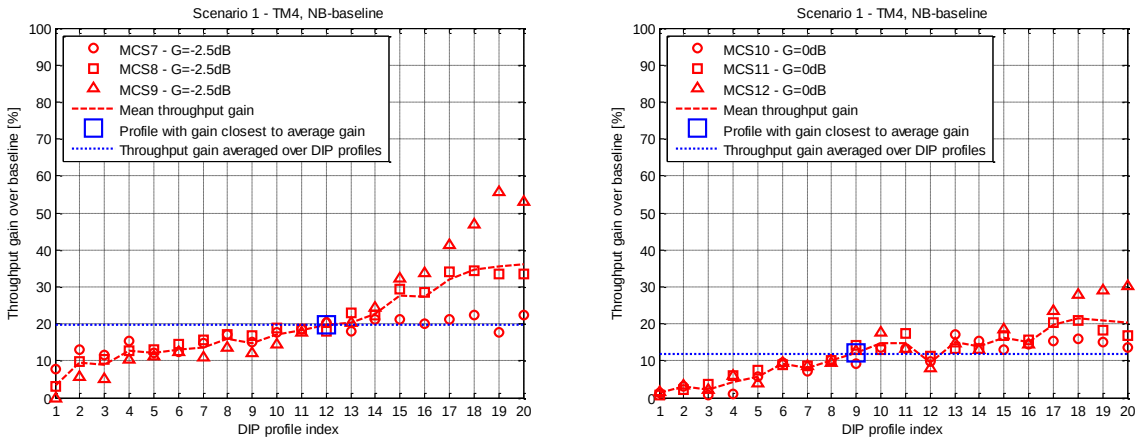
(a) Geometry = -2.5 dB (b) Geometry = 0 dB

Figure 7.5-2: Fraction of interfering cells and AWGN power for each DIP profile (R4- 120944, Renesas Mobile Europe Ltd.)



(a) Geometry = -2.5 dB (b) Geometry = 0 dB

Figure 7.5-3: Fixed MCS throughput gain of IRC (1 PRB) vs. WB-baseline for each DIP profile (R4-120944, Renesas Mobile Europe Ltd.)



(a) Geometry = -2.5 dB **(b) Geometry = 0 dB**

Figure 7.5-4: Fixed MCS throughput gain of IRC (1 PRB) vs. NB-baseline for each DIP profile (R4-120944, Renesas Mobile Europe Ltd.)

Table 7.5-10: Fixed MCS throughput gain of IRC (1 PRB) vs. baseline for each DIP profile (R4- 120944, Renesas Mobile Europe Ltd.)

DIP profile index	G = -2.5 dB								
	MCS#7			MCS#8			MCS#9		
	WB-Baseline	NB-Baseline	IRC-1 PRB	WB-Baseline	NB-Baseline	IRC-1 PRB	WB-Baseline	NB-Baseline	IRC-1 PRB
1	4.0610	3.9262	4.2292	3.8783	3.9586	4.0752	3.9003	3.8949	3.8876
2	4.0413	4.0713	4.6035	3.9443	4.0346	4.4263	3.8138	3.9936	4.2182
3	3.9614	4.2127	4.6951	3.9348	4.0657	4.4822	3.8870	4.1116	4.3229
4	4.0436	4.3236	4.9816	3.9243	4.2869	4.8333	3.9082	4.1504	4.5827
5	3.9328	4.4490	4.9948	3.9543	4.2711	4.8211	3.9330	4.1383	4.6069
6	4.0131	4.3940	4.9389	3.9696	4.1634	4.7715	3.9124	4.0662	4.5688
7	3.9267	4.3438	4.9797	3.9871	4.3070	4.9768	3.8531	4.1159	4.5682
8	4.0051	4.3245	5.0685	4.0119	4.2067	4.9251	3.8822	4.1468	4.7141
9	3.9060	4.4419	5.1145	3.9243	4.3027	5.0254	3.9258	4.2109	4.7244
10	4.0864	4.4607	5.2465	3.8493	4.3640	5.1817	3.9155	4.1819	4.7916
11	4.0535	4.4865	5.3160	3.9976	4.4099	5.2292	3.8767	4.2794	5.0307
12	4.0126	4.5128	5.4292	3.9691	4.5223	5.3411	3.8731	4.2987	5.1797
13	3.9793	4.6242	5.4546	3.9010	4.5334	5.5696	4.0021	4.3932	5.2808
14	4.0469	4.6721	5.6688	3.9052	4.6886	5.7386	3.9942	4.4065	5.4800
15	3.9995	4.7214	5.7214	3.9538	4.5915	5.9466	4.0741	4.3690	5.7754
16	4.0488	4.8186	5.7787	3.9807	4.7958	6.1572	3.9137	4.4689	5.9813
17	3.9882	4.9210	5.9572	3.9971	4.7910	6.4264	3.9591	4.5821	6.4717
18	3.9112	4.9943	6.1084	4.0140	5.0238	6.7553	3.9124	4.8158	7.0735
19	3.9924	5.2207	6.1465	4.0414	5.0961	6.8017	3.9651	4.7849	7.4483
20	4.2047	5.0403	6.1624	4.0187	5.1473	6.8640	4.0293	4.8346	7.3987
	G = 0 dB								
	MCS#10			MCS#11			MCS#12		
	WB-	NB-	IRC-1	WB-	NB-	IRC-1	WB-	NB-	IRC-1

1	5.5466	5.4376	5.5121	5.7278	5.5779	5.6210	5.5507	5.3570	5.4463
2	5.6071	5.6344	5.8099	5.7643	5.6734	5.8055	5.5395	5.5072	5.6964
3	5.5254	5.8039	5.8535	5.5785	5.7637	5.9814	5.6123	5.6040	5.7287
4	5.6198	5.8572	5.9201	5.6980	5.8267	6.1705	5.5590	5.5898	5.9284
5	5.5266	5.7736	6.1048	5.7139	5.9422	6.3842	5.5860	5.7189	5.9517
6	5.3922	5.7506	6.2961	5.8606	5.9760	6.5003	5.5312	5.7475	6.2911
7	5.5617	5.9988	6.4311	5.7205	6.0968	6.6264	5.5417	5.8113	6.3069
8	5.5647	5.9280	6.5395	5.6787	6.1619	6.7903	5.5605	6.0298	6.6103
9	5.6979	6.0128	6.5674	5.6442	6.1260	6.9934	5.6543	5.8729	6.6193
10	5.5605	6.0836	6.9113	5.8194	6.5076	7.3538	5.5965	6.0899	7.1742
11	5.5956	6.0993	6.9101	5.7312	6.1559	7.2310	5.5905	6.0013	6.7920
12	5.4891	5.9353	6.5123	5.6529	6.1333	6.8182	5.6671	6.0200	6.5006
13	5.5938	5.8983	6.9070	5.8546	6.1771	6.9947	5.5425	5.9592	6.8400
14	5.6780	5.9946	6.9094	5.8214	6.2939	7.1328	5.6874	6.1942	6.9947
15	5.6156	6.1914	6.9924	5.6947	6.3503	7.4254	5.6656	6.1897	7.3386
16	5.5914	6.2876	7.2031	5.8048	6.5673	7.6033	5.7587	6.5216	7.4715
17	5.5139	6.4293	7.4174	5.9721	6.5567	7.8946	5.5875	6.3617	7.8620
18	5.5871	6.6872	7.7456	5.8354	6.8560	8.2888	5.7407	6.7049	8.5814
19	5.8130	6.9040	7.9381	5.9309	7.3119	8.6532	5.8331	7.2545	9.3691
20	5.7409	7.0154	7.9732	5.8188	7.4493	8.7076	5.8518	7.4430	9.7032

Table 7.5-10a: Fixed MCS throughput gain of IRC (1 PRB) vs. baseline for each DIP profile (R4-121436, Renesas Mobile Europe Ltd.)

DIP profile index	G = -2.5 dB								
	MCS#7			MCS#8			MCS#9		
	WB-Baseline	NB-Baseline	IRC-1 PRB	WB-Baseline	NB-Baseline	IRC-1 PRB	WB-Baseline	NB-Baseline	IRC-1 PRB
1	4.0368	4.0046	4.0602	3.8824	3.9154	3.9163	3.8834	3.9070	3.9059
2	4.0184	4.1450	4.3369	3.9382	4.0079	4.2815	3.8678	3.9931	4.1362
3	3.9776	4.1726	4.5128	3.8951	4.0465	4.4861	3.8652	4.0498	4.2002
4	4.0348	4.3014	4.7436	3.8793	4.1599	4.4478	3.8783	4.0076	4.4036
5	4.0077	4.3155	4.7754	3.9040	4.1650	4.6882	3.9695	4.1464	4.5431
6	3.9801	4.3208	4.8845	3.9033	4.2204	4.7595	3.9313	4.0174	4.4396
7	4.0148	4.2388	4.8008	3.9629	4.1621	4.8152	3.9186	4.0683	4.4519
8	4.0537	4.3321	4.8845	3.8900	4.1925	4.8557	3.9520	4.1348	4.5416
9	4.1033	4.3256	4.9690	3.9249	4.2340	4.9425	3.9375	4.2042	4.6895
10	4.0455	4.4093	5.1423	3.9005	4.3433	5.1170	3.8830	4.2118	4.7196
11	4.0762	4.4079	5.1936	3.9426	4.3750	5.1028	3.8943	4.2038	4.8402
12	3.9897	4.4217	5.2770	4.0098	4.3769	5.2656	3.9382	4.2111	4.9336
13	4.0224	4.5212	5.3624	4.0076	4.4579	5.3356	3.9215	4.3197	5.1196
14	4.0280	4.5463	5.5431	3.9708	4.5621	5.5253	3.9186	4.3829	5.3114
15	4.0097	4.5998	5.6240	3.9673	4.5248	5.8088	3.8779	4.3531	5.5388
16	4.0210	4.7143	5.6970	3.9448	4.6622	5.9180	3.9037	4.3745	5.8244
17	3.9683	4.7117	5.8686	4.0288	4.7294	6.2687	3.9818	4.5663	6.1255
18	4.0771	4.8374	6.0154	4.0148	4.7975	6.4723	3.9971	4.6986	6.5037
19	4.0838	4.9662	6.0977	4.0551	4.9561	6.6354	3.9902	4.7825	6.9821
20	3.9736	5.0178	6.1197	3.9711	4.9995	6.6956	3.9531	4.7734	7.0326

Table 7.5-10b: IRC throughput gain of DMRS based TM6 for MCS=10, 11 and 12 at G=0 dB (R4-121932, Huawei, HiSillicon)

#	DIP1 [dB]	DIP2 [dB]	TM9(Mbps)								
			MCS10			MCS11			MCS12		
			MMSE	MMSE-IRC	Gain (%)	MMSE	MMSE-IRC	Gain (%)	MMSE	MMSE-IRC	Gain (%)
1	-5.709	-6.77	3.8279	4.0393	5.52261	3.6735	3.7962	3.340139	3.825	3.9041	2.067974
2	-4.345	-5.907	3.7826	4.2377	12.03141	3.6533	3.9704	8.679824	3.7938	3.9896	5.161052
3	-3.855	-5.632	3.7659	4.3301	14.98181	3.6464	4.061	11.37012	3.7794	4.0136	6.196751
4	-3.489	-5.538	3.7591	4.3915	16.82318	3.6443	4.1425	13.67066	3.7698	4.0463	7.334607
5	-3.221	-5.421	3.7417	4.4479	18.87377	3.6408	4.2087	15.59822	3.7642	4.0847	8.514425
6	-2.985	-5.951	3.7485	4.4646	19.10364	3.6352	4.2142	15.9276	3.7666	4.0895	8.572718
7	-2.724	-6.803	3.7336	4.4776	19.92715	3.631	4.2205	16.2352	3.769	4.0927	8.588485
8	-2.497	-7.215	3.7225	4.5334	21.78375	3.6255	4.2658	17.66101	3.757	4.1175	9.595422
9	-2.299	-7.281	3.7113	4.5886	23.63862	3.6241	4.3264	19.3786	3.7522	4.1491	10.57779
10	-2.116	-7.783	3.7033	4.6271	24.94532	3.6192	4.3717	20.79189	3.7419	4.1758	11.59571
11	-1.905	-8.326	3.6921	4.6835	26.85193	3.6073	4.4261	22.69842	3.7363	4.2142	12.79073
12	-1.726	-8.659	3.684	4.7511	28.9658	3.6066	4.4811	24.24721	3.7267	4.2485	14.00166
13	-1.55	-9.307	3.6729	4.81	30.95919	3.6045	4.5578	26.4475	3.7147	4.2925	15.55442
14	-1.39	-9.547	3.6642	4.8707	32.9267	3.6011	4.633	28.65513	3.6555	4.3453	18.8702
15	-1.213	-9.922	3.645	4.9439	35.63512	3.5927	4.7139	31.20773	3.6467	4.4084	20.88738
16	-1.034	-10.993	3.6072	5.0189	39.13562	3.5829	4.7898	33.685	3.634	4.4867	23.4645
17	-0.829	-11.443	3.5836	5.1057	42.47405	3.5321	4.8999	38.72484	3.6116	4.5906	27.1071
18	-0.583	-12.119	3.5817	5.1937	45.00656	3.5056	5.0086	42.87426	3.5788	4.7185	31.84587
19	-0.406	-13.213	3.5241	5.2471	48.89192	3.5237	5.0518	43.36635	3.5373	4.7792	35.1087
20	-0.313	-13.73	3.4987	5.2533	50.15006	3.4847	5.0748	45.6309	3.5796	4.7856	33.69092

Table 7.5-10c: IRC throughput gain of DMRS based TM6 for MCS=10, 11 and 12 at G=-2.5 dB (R4-121932, Huawei, HiSillicon)

#	DIP1 [dB]	DIP2 [dB]	TM6(Mbps)								
			MCS10			MCS11			MCS12		
			MMSE	MMSE-IRC	Gain (%)	MMSE	MMSE-IRC	Gain (%)	MMSE	MMSE-IRC	Gain (%)
1	-5.709	-6.77	4.004	4.2358	5.789211	3.8672	4.0881	5.712143	3.8529	3.976	3.194996
2	-4.345	-5.907	4.0077	4.4863	11.94201	3.9097	4.339	10.98038	3.8473	4.1327	7.418189
3	-3.855	-5.632	3.9996	4.6221	15.56406	3.909	4.479	14.58173	3.8521	4.2206	9.566211
4	-3.489	-5.538	3.9928	4.7176	18.15267	3.9125	4.5696	16.79489	3.8497	4.3373	12.66592
5	-3.221	-5.421	3.9978	4.7932	19.89594	3.9084	4.6658	19.37877	3.8442	4.4356	15.38422
6	-2.985	-5.951	3.9959	4.7982	20.07808	3.9104	4.6748	19.54787	3.8314	4.4436	15.97849
7	-2.724	-6.803	3.9891	4.8069	20.50086	3.9028	4.6783	19.87035	3.833	4.4436	15.93008
8	-2.497	-7.215	3.9804	4.854	21.94754	3.9021	4.7389	21.44486	3.829	4.4931	17.34395
9	-2.299	-7.281	3.986	4.9247	23.54992	3.8951	4.8309	24.02506	3.8306	4.573	19.38078
10	-2.116	-7.783	3.9823	4.9575	24.48836	3.8986	4.8846	25.29113	3.8266	4.6258	20.88538
11	-1.905	-8.326	3.9785	5.0301	26.43207	3.8923	4.9619	27.4799	3.8186	4.6953	22.95868
12	-1.726	-8.659	3.9773	5.1125	28.54198	3.893	5.0581	29.92808	3.8114	4.7616	24.93047
13	-1.55	-9.307	3.9655	5.1826	30.69222	3.8861	5.141	32.29202	3.7962	4.8384	27.45377
14	-1.39	-9.547	3.9581	5.2514	32.67477	3.877	5.2413	35.18958	3.793	4.9431	30.32165
15	-1.213	-9.922	3.9451	5.3394	35.34258	3.8665	5.3598	38.62149	3.7906	5.0573	33.41687
16	-1.034	-10.993	3.9407	5.4318	37.83846	3.8554	5.4866	42.30949	3.781	5.1884	37.22296
17	-0.829	-11.443	3.9227	5.5397	41.22161	3.838	5.6517	47.25638	3.7642	5.381	42.95202
18	-0.583	-12.119	3.8694	5.6749	46.66098	3.7983	5.8705	54.55599	3.7363	5.6487	51.18433
19	-0.406	-13.213	3.808	5.7462	50.89811	3.7578	6.0245	60.31987	3.6931	5.8342	57.97568
20	-0.313	-13.73	3.7566	5.7747	53.72145	3.7139	6.0859	63.86817	3.646	5.946	63.08283

Table 7.5-10d: Throughput gain of 0dB geometry DIP profiles for Scenario 1 (R4- 122018, LG Electronics)

DIP Profile (0 dB)	MCS10			MCS11			MCS12		
	MMSE	MMSE-IRC	Gain (%)	MMSE	MMSE-IRC	Gain (%)	MMSE	MMSE-IRC	Gain (%)
1	5396.36	5300.28	-1.78%	5304.32	5319.36	0.28%	5309.96	5279.92	-0.57%
2	5391.51	5804.88	7.67%	5224.67	5848.55	11.94%	5276.92	5322.98	0.87%
3	5251.84	5911.45	12.56%	5329.10	6086.60	14.21%	5404.09	5655.42	4.65%
4	5370.52	5685.39	5.86%	5607.85	5660.06	0.93%	5144.75	5821.64	13.16%
5	5269.60	5807.30	10.20%	5284.85	6056.51	14.60%	5318.98	5495.21	3.31%
6	5278.48	6244.89	18.31%	5649.44	6066.25	7.38%	5453.15	5690.46	4.35%
7	5776.62	6095.52	5.52%	5449.45	6192.80	13.64%	5190.81	5947.80	14.58%
8	5347.91	6489.51	21.35%	5605.20	6506.06	16.07%	5370.04	6187.11	15.22%
9	5439.15	6595.28	21.26%	5276.88	6567.12	24.45%	5293.94	6490.51	22.60%
10	5309.16	6417.66	20.88%	5424.67	6938.80	27.91%	5432.12	6837.97	25.88%
11	5606.27	6467.72	15.37%	5527.32	6712.25	21.44%	5464.17	6236.18	14.13%
12	5261.53	6512.93	23.78%	5415.82	6566.24	21.24%	5305.96	6301.26	18.76%
13	5281.71	6402.32	21.22%	5703.42	6728.18	17.97%	5291.94	6288.25	18.83%
14	5763.70	6483.05	12.48%	5636.17	6570.66	16.58%	5478.18	6540.58	19.39%
15	5185.64	6881.89	32.71%	5653.87	6729.95	19.03%	5604.35	6800.92	21.35%
16	5354.37	6952.13	29.84%	5545.91	7335.25	32.26%	5131.73	6952.12	35.47%
17	5527.15	6946.48	25.68%	5651.21	7472.42	32.23%	5389.07	7333.62	36.08%
18	5527.15	7373.57	33.41%	5337.95	7810.46	46.32%	5327.99	7450.77	39.84%
19	5348.72	7539.07	40.95%	5707.85	8021.96	40.54%	5531.25	8548.21	54.54%
20	5674.09	7626.27	34.41%	5531.75	8203.37	48.30%	5353.02	8768.50	63.80%
Average	5418.07	6476.88	19.58%	5493.38	6669.64	21.37%	5353.62	6497.47	21.31%

Table 7.5-10e: Throughput gain of -2.5 dB geometry DIP profiles for Scenario 1 (R4- 122018, LG Electronics)

DIP Profile (-2.5 dB)	MCS7			MCS8			MCS9		
	MMSE	MMSE-IRC	Gain (%)	MMSE	MMSE-IRC	Gain (%)	MMSE	MMSE-IRC	Gain (%)
1	3685.30	4060.47	10.18%	3709.60	3920.07	5.67%	3785.68	3805.06	0.51%
2	3821.84	4024.14	5.29%	3666.66	3925.70	7.06%	3815.56	3923.74	2.84%
3	3884.47	4417.48	13.72%	3799.70	4207.97	10.74%	3839.78	3981.06	3.68%
4	3885.10	4396.18	13.15%	3851.09	4097.46	6.40%	3744.51	4115.89	9.92%
5	3789.90	4554.64	20.18%	3899.66	4483.20	14.96%	3742.09	4194.21	12.08%
6	4027.90	4466.96	10.90%	3730.02	4378.32	17.38%	3852.69	4215.20	9.41%
7	3675.28	4593.47	24.98%	3769.44	4395.91	16.62%	3755.00	4314.50	14.90%
8	3819.96	4614.77	20.81%	3736.35	4358.61	16.65%	3885.80	4174.02	7.42%
9	3868.19	4678.65	20.95%	4038.33	4506.43	11.59%	3784.07	4433.99	17.18%
10	3799.29	4688.68	23.41%	3711.71	4631.72	24.79%	3802.64	4266.06	12.19%
11	3995.96	4706.21	17.77%	3853.90	4774.62	23.89%	3850.27	4439.64	15.31%
12	3746.06	4942.96	31.95%	3648.36	4868.94	33.46%	3819.59	4422.69	15.79%
13	3903.89	5103.30	30.72%	3815.89	4636.65	21.51%	3816.36	4631.79	21.37%
14	3840.00	5144.64	33.97%	3896.14	5161.06	32.47%	3879.34	4702.03	21.21%
15	3799.92	5197.25	36.77%	3820.82	5339.86	39.76%	3869.65	4819.10	24.54%
16	3900.13	5283.06	35.46%	3779.99	5170.92	36.80%	3781.65	4870.77	28.80%
17	3959.01	5405.19	36.53%	3951.75	5629.16	42.45%	3765.50	5150.92	36.79%
18	3992.20	5457.18	36.70%	3798.30	5812.88	53.04%	3807.48	5504.54	44.57%
19	3949.61	5760.32	45.85%	3789.85	5874.12	55.00%	3773.57	5833.13	54.58%
20	3890.74	5801.66	49.11%	3867.28	5919.17	53.06%	3720.29	5884.00	58.16%
Average	3861.74	4864.86	25.92%	3806.74	4804.64	26.16%	3804.58	4584.12	20.56%

7.5.2 Scenario 2 (DM-RS based transmission)

Table 7.5-11: Throughput performance for DIPs based on weighted average throughput gain (0 dB geometry case, DM-RS based covariance matrix estimation, R4-120912, Nokia Siemens Networks, Nokia)

DIP set#	Throughput (kbps)								
	MCS #10			MCS #11			MCS #12		
	Rel.8 baseline receiver	MMSE-IRC receiver	Gain	Rel.8 baseline receiver	MMSE-IRC receiver	Gain	Rel.8 baseline receiver	MMSE-IRC receiver	Gain
1	6048	5823	-3.72%	5758	5635	-2.14%	5260	5319	1.12%
2	6107	6139	0.52%	5809	5911	1.76%	5508	5710	3.67%
3	6047	6386	5.61%	5851	6167	5.40%	5629	5830	3.57%
4	6090	6553	7.60%	6007	6448	7.34%	5636	6036	7.10%
5	6109	6641	8.71%	5852	6453	10.27%	5693	6069	6.60%
6	6078	6809	12.03%	5957	6729	12.96%	5597	6329	13.08%
7	5998	6837	13.99%	5805	6924	19.28%	5647	6400	13.33%
8	6021	7081	17.61%	5953	7041	18.28%	5571	6835	22.69%
9	6187	7109	14.90%	5903	7227	22.43%	5787	6996	20.89%
10	6158	7350	19.36%	6018	7552	25.49%	5714	7301	27.77%
11	6215	7211	16.03%	6070	7332	20.79%	5754	7074	22.94%
12	6121	7120	16.32%	6063	7013	15.67%	5808	6730	15.87%
13	6068	7225	19.07%	5977	7185	20.21%	5747	6850	19.19%
14	6011	7225	20.20%	5963	7300	22.42%	5792	7056	21.82%
15	6159	7320	18.85%	5994	7532	25.66%	5834	7366	26.26%
16	6098	7501	23.01%	5946	7737	30.12%	5796	7644	31.88%
17	5962	7656	28.41%	6061	8021	32.34%	5863	8025	36.88%
18	6021	7789	29.36%	5938	8302	39.81%	5681	8490	49.45%
19	5844	7807	33.59%	5919	8363	41.29%	5834	9044	55.02%
20	5836	7485	28.26%	5832	8041	37.88%	5670	8478	49.52%
Ave.	6059	7053	16.48%	5934	7146	20.36%	5691	6979	22.43%

Table 7.5-12: Throughput performance for DIPs based on weighted average throughput gain (-3 dB geometry case, DM-RS based covariance matrix estimation, R4-120912, Nokia Siemens Networks, Nokia)

DIP set#	Throughput (kbps)								
	MCS #7			MCS #8			MCS #9		
	Rel.8 baseline receiver	MMSE-IRC receiver	Gain	Rel.8 baseline receiver	MMSE-IRC receiver	Gain	Rel.8 baseline receiver	MMSE-IRC receiver	Gain
1	3639	3724	2.34%	3613	3639	0.72%	3681	3730	1.33%
2	3716	4064	9.36%	3591	3855	7.35%	3656	3912	7.00%
3	3658	4459	21.90%	3528	4208	19.27%	3610	4139	14.65%
4	3653	4641	27.05%	3526	4297	21.87%	3641	4182	14.86%
5	3604	4695	30.27%	3538	4410	24.65%	3497	4237	21.16%
6	3572	4914	37.57%	3600	4514	25.39%	3546	4323	21.91%
7	3622	4826	33.24%	3426	4464	30.30%	3576	4343	21.45%
8	3526	4883	38.49%	3479	4485	28.92%	3485	4384	25.80%
9	3611	4786	32.54%	3590	4590	27.86%	3530	4289	21.50%
10	3628	4815	32.72%	3461	4533	30.97%	3526	4325	22.66%
11	3611	4780	32.37%	3574	4576	28.04%	3553	4385	23.42%
12	3675	4719	28.41%	3572	4315	20.80%	3618	4179	15.51%
13	3680	4715	28.13%	3650	4443	21.73%	3599	4231	17.56%
14	3623	4849	33.84%	3500	4468	27.66%	3538	4290	21.25%
15	3596	4864	35.26%	3477	4552	30.92%	3553	4353	22.52%
16	3537	4940	39.67%	3551	4679	31.77%	3501	4439	26.79%
17	3612	5009	38.68%	3573	4843	35.54%	3541	4516	27.53%
18	3609	5236	45.08%	3519	5041	43.25%	3568	4527	26.88%
19	3618	5282	45.99%	3522	5110	45.09%	3449	4823	39.84%
20	3504	5492	56.74%	3567	5283	48.11%	3473	4871	40.25%
Ave.	3615	4785	32.48%	3543	4515	27.51%	3557	4324	21.69%

Table 7.5-12a: Throughput performance for DIPs based on weighted average throughput gain (-2.5 dB geometry case, DM-RS based covariance matrix estimation, R4-121340, Nokia Siemens Networks, Nokia)

DIP Profile #	MCS-7			MCS-8			MCS-9		
	MMSE	MMSE-IRC	Gain (%)	MMSE	MMSE-IRC	Gain (%)	MMSE	MMSE-IRC	Gain (%)
1	4067	4113	1.12%	3924	3936	0.32%	3891	3899	-2.01%
2	4061	4411	8.62%	3876	4174	7.69%	3871	4016	1.12%
3	4018	4622	15.05%	3903	4291	9.92%	3849	4136	1.46%
4	4148	4729	14.01%	3874	4486	15.81%	3934	4250	6.85%
5	4063	4893	20.43%	3945	4499	14.04%	3887	4332	7.72%
6	4061	4802	18.24%	3852	4531	17.62%	3829	4239	7.06%
7	4087	4895	19.78%	3888	4547	16.95%	3862	4283	7.62%
8	4076	4891	20.00%	3967	4598	15.90%	3888	4390	8.03%
9	4105	5049	22.98%	3901	4660	19.45%	3854	4432	11.21%
10	4012	5095	26.99%	3899	4796	22.99%	3837	4487	10.95%
11	4108	5118	24.60%	3971	4950	24.66%	3761	4548	12.59%
12	4016	5186	29.15%	3840	4958	29.09%	3932	4651	16.31%
13	4071	5323	30.75%	3825	5068	32.52%	3785	4734	20.20%
14	4067	5409	32.98%	3934	5138	30.62%	3878	4939	22.06%
15	3977	5490	38.04%	3965	5386	35.83%	3835	4973	22.65%
16	4018	5569	38.61%	3916	5386	37.55%	3843	5063	26.07%
17	3961	5666	43.06%	3889	5660	45.53%	3784	5345	32.56%
18	3925	5645	43.83%	3922	5626	43.44%	3775	5422	36.56%
19	3845	5670	47.45%	3804	5709	50.10%	3746	5331	35.15%
20	3784	5578	47.42%	3779	5548	46.83%	3800	5333	32.63%
Average	4024	5108	27.15%	3894	4897	25.84%	3842	4640	15.84%

Table 7.5-13: Throughput performance for DIPs based on weighted average throughput gain (0 dB geometry case, DM-RS based covariance matrix estimation, R4-120511, NTT DOCOMO)

DIP set#	Throughput (Mbps)								
	MCS #10			MCS #11			MCS #12		
	Rel.8 baseline receiver	MMSE-IRC receiver	Gain	Rel.8 baseline receiver	MMSE-IRC receiver	Gain	Rel.8 baseline receiver	MMSE-IRC receiver	Gain
1	4.865	4.682	-3.76%	4.564	4.41	-3.37%	4.265	4.151	-2.67%
2	4.877	4.921	0.90%	4.583	4.615	0.70%	4.277	4.312	0.82%
3	4.881	5.054	3.54%	4.59	4.736	3.18%	4.277	4.4	2.88%
4	4.844	5.188	7.10%	4.597	4.862	5.76%	4.281	4.502	5.16%
5	4.883	5.265	7.82%	4.599	4.934	7.28%	4.282	4.558	6.45%
6	4.884	5.357	9.68%	4.602	5.024	9.17%	4.286	4.634	8.12%
7	4.882	5.453	11.70%	4.606	5.122	11.20%	4.288	4.713	9.91%
8	4.886	5.62	15.02%	4.616	5.291	14.62%	4.292	4.853	13.07%
9	4.887	5.726	17.17%	4.617	5.409	17.15%	4.297	4.954	15.29%
10	4.889	5.934	21.37%	4.627	5.636	21.81%	4.303	5.163	19.99%
11	4.884	5.828	19.33%	4.616	5.517	19.52%	4.297	5.048	17.48%
12	4.872	5.668	16.34%	4.596	5.339	16.17%	4.282	4.891	14.22%
13	4.867	5.827	19.72%	4.596	5.505	19.78%	4.283	5.031	17.46%
14	4.86	5.996	23.37%	4.596	5.688	23.76%	4.281	5.182	21.05%
15	4.851	6.197	27.75%	4.594	5.911	28.67%	4.282	5.386	25.78%
16	4.845	6.431	32.73%	4.59	6.186	34.77%	4.282	5.654	32.04%
17	4.836	6.702	38.59%	4.587	6.536	42.49%	4.283	6.016	40.46%
18	4.823	7.096	47.13%	4.581	7.096	54.90%	4.287	6.695	56.17%
19	4.801	7.52	56.63%	4.574	7.813	70.81%	4.29	7.801	81.84%
20	4.784	7.659	60.10%	4.566	8.089	77.16%	4.29	8.342	94.45%
Ave.	4.8601	5.9062	21.61%	4.5949	5.686	23.78%	4.2853	5.3143	24.00%

Note that the throughput filled in pink is closest to the average throughput

Table 7.5-14: Throughput performance for DIPs based on weighted average throughput gain (-3 dB geometry case, DM-RS based covariance matrix estimation, R4-120511, NTT DOCOMO)

DIP set#	Throughput (Mbps)								
	MCS #7			MCS #8			MCS #9		
	Rel.8 baseline receiver	MMSE-IRC receiver	Gain	Rel.8 baseline receiver	MMSE-IRC receiver	Gain	Rel.8 baseline receiver	MMSE-IRC receiver	Gain
1	2.905	2.89	-0.52%	2.803	2.792	-0.39%	2.743	2.736	-0.26%
2	2.896	3.068	5.94%	2.786	2.94	5.53%	2.729	2.838	3.99%
3	2.884	3.312	14.84%	2.771	3.137	13.21%	2.718	2.979	9.60%
4	2.877	3.43	19.22%	2.765	3.234	16.96%	2.711	3.048	12.43%
5	2.874	3.477	20.98%	2.762	3.277	18.65%	2.707	3.08	13.78%
6	2.868	3.604	25.66%	2.755	3.383	22.79%	2.701	3.156	16.85%
7	2.862	3.679	28.55%	2.752	3.45	25.36%	2.697	3.207	18.91%
8	2.861	3.69	28.98%	2.75	3.458	25.75%	2.698	3.212	19.05%
9	2.866	3.646	27.22%	2.752	3.419	24.24%	2.699	3.184	17.97%
10	2.863	3.683	28.64%	2.749	3.451	25.54%	2.697	3.207	18.91%
11	2.865	3.566	24.47%	2.754	3.35	21.64%	2.702	3.13	15.84%
12	2.864	3.428	19.69%	2.755	3.236	17.46%	2.702	3.05	12.88%
13	2.856	3.517	23.14%	2.745	3.307	20.47%	2.695	3.104	15.18%
14	2.847	3.588	26.03%	2.739	3.368	22.96%	2.688	3.148	17.11%
15	2.837	3.692	30.14%	2.729	3.457	26.68%	2.68	3.213	19.89%
16	2.828	3.799	34.34%	2.721	3.547	30.36%	2.672	3.283	22.87%
17	2.815	3.904	38.69%	2.713	3.643	34.28%	2.663	3.355	25.99%
18	2.802	4.072	45.32%	2.699	3.796	40.64%	2.65	3.473	31.06%
19	2.779	4.394	58.11%	2.679	4.118	53.71%	2.629	3.72	41.50%
20	2.757	4.682	69.82%	2.659	4.429	66.57%	2.612	3.984	52.53%
Ave.	2.8503	3.6561	28.46%	2.7419	3.4396	25.62%	2.6897	3.2054	19.30%

Note that the throughput filled in pink is closest to the average throughput

Table 7.5-14a: Throughput performance for DIPs based on weighted average throughput gain (-2.5 dB geometry case, DM-RS based covariance matrix estimation, R4-121557, NTT DOCOMO)

DIP set #	MCS #7			MCS #8			MCS #9		
	Rel.8 baseline (MMSE) receiver	MMSE-IRC Receiver	Gain	Rel.8 baseline (MMSE) receiver	MMSE-IRC Receiver	Gain	Rel.8 baseline (MMSE) receiver	MMSE-IRC Receiver	Gain
	(Mbps)	(Mbps)	(%)	(Mbps)	(Mbps)	(%)	(Mbps)	(Mbps)	(%)
1	3.261	3.183	-2.4	3.105	3.047	-1.9	2.964	2.924	-1.4
2	3.252	3.384	4.1	3.092	3.211	3.9	2.951	3.039	3.0
3	3.246	3.496	7.7	3.084	3.298	6.9	2.946	3.106	5.4
4	3.240	3.589	10.8	3.078	3.375	9.7	2.941	3.164	7.6
5	3.235	3.676	13.6	3.073	3.449	12.2	2.936	3.217	9.6
6	3.231	3.691	14.2	3.068	3.461	12.8	2.932	3.229	10.1
7	3.222	3.716	15.3	3.059	3.481	13.8	2.927	3.244	10.8
8	3.214	3.778	17.6	3.054	3.535	15.8	2.922	3.283	12.4
9	3.207	3.863	20.5	3.046	3.609	18.5	2.918	3.339	14.4
10	3.199	3.930	22.9	3.040	3.664	20.5	2.913	3.382	16.1
11	3.189	4.030	26.4	3.031	3.754	23.9	2.903	3.451	18.9
12	3.182	4.125	29.6	3.023	3.846	27.2	2.899	3.519	21.4
13	3.171	4.238	33.7	3.014	3.951	31.1	2.890	3.598	24.5
14	3.159	4.362	38.1	3.007	4.071	35.4	2.885	3.692	28.0
15	3.148	4.515	43.4	2.995	4.227	41.1	2.876	3.815	32.7
16	3.135	4.672	49.0	2.984	4.396	47.3	2.867	3.952	37.8
17	3.119	4.877	56.4	2.970	4.632	56.0	2.856	4.163	45.8
18	3.098	5.135	65.8	2.952	4.969	68.3	2.841	4.493	58.2
19	3.082	5.297	71.9	2.938	5.213	77.4	2.831	4.765	68.3
20	3.072	5.385	75.3	2.929	5.343	82.4	2.823	4.935	74.8
Avg.	3.1831	4.1471	30.3	3.0271	3.9266	29.7	2.9011	3.6155	24.6

Table 7.5-15: Gain of MMSE-IRC receiver (0 dB geometry case, CRS based covariance matrix estimation, R4-120511, NTT DOCOMO)

		Rel.8 baseline (MMSE) receiver	MMSE-IRC receiver
MCS index#10	DIP set#10	4.89 Mbps	5.93 Mbps (+21.4%)
MCS index#11	DIP set#14	4.60 Mbps	5.69 Mbps (+23.8%)
MCS index#12	DIP set#15	4.28 Mbps	5.39 Mbps (+25.8%)

Table 7.5-16: Gain of MMSE-IRC receiver (-3 dB geometry case, CRS based covariance matrix estimation, R4-120511, NTT DOCOMO)

		Rel.8 baseline (MMSE) receiver	MMSE-IRC receiver
MCS index #7	DIP set #9	2.87 Mbps	3.65 Mbps (+27.2%)
MCS index #8	DIP set #7	2.75 Mbps	3.45 Mbps (+25.4%)
MCS index #9	DIP set #7, #10	2.70 Mbps	3.21 Mbps (+18.9%)

Table 7.5-17: Throughput performance for DIPs based on weighted average throughput gain (0 dB geometry case, DM-RS based covariance matrix estimation, R4-120657, Motorola Mobility)

DIP set#	Throughput (Mbps)		
	MCS #12		
	Rel.8 baseline receiver	MMSE-IRC receiver	Gain
1	5.024	5.185	3.20%
2	4.968	5.066	2.00%
3	4.963	5.21	5.00%
4	5.014	5.27	5.10%
5	4.978	5.468	9.80%
6	4.935	5.554	12.60%
7	5.161	5.652	9.50%
8	5.046	5.627	11.50%
9	5.021	5.65	12.50%
10	5.096	6.033	18.40%
11	5.02	5.652	12.60%
12	4.963	5.584	12.50%
13	4.983	5.729	15.00%
14	5.046	5.776	14.50%
15	5.033	6.065	20.50%
16	5.063	6.118	20.80%
17	5.065	6.433	27.00%
18	5.205	7.008	34.70%
19	5.329	7.597	42.60%
20	5.533	7.346	32.80%

Table 7.5-19a: Throughput performance for DIPs based on weighted average throughput gain (-2.5 dB geometry case, DM-RS based covariance matrix estimation, R4-121410, Motorola Mobility)

#	DIP1 [dB]	DIP2 [dB]	Throughput (Mbps)		Relative throughput (% of max throughput)		Throughput Gain (%)
			MMSE	MMSE-IRC	MMSE	MMSE-IRC	
1	-5.71	-6.77	3.497	3.668	43.8	45.9	4.9
2	-4.34	-5.91	3.628	3.831	45.4	47.9	5.6
3	-3.86	-5.63	3.632	3.847	45.4	48.1	5.9
4	-3.49	-5.54	3.579	3.946	44.8	49.4	10.3
5	-3.22	-5.42	3.636	3.954	45.5	49.5	8.8
6	-2.99	-5.95	3.734	3.989	46.7	49.9	6.8
7	-2.72	-6.80	3.678	4.057	46.0	50.8	10.3
8	-2.50	-7.21	3.665	4.009	45.9	50.2	9.4
9	-2.30	-7.28	3.667	4.025	45.9	50.4	9.8
10	-2.12	-7.78	3.501	4.028	43.8	50.4	15.1
11	-1.90	-8.33	3.540	4.062	44.3	50.8	14.7
12	-1.73	-8.66	3.625	4.106	45.4	51.4	13.3
13	-1.55	-9.31	3.604	4.161	45.1	52.1	15.5
14	-1.39	-9.55	3.546	4.262	44.4	53.3	20.2
15	-1.21	-9.92	3.574	4.283	44.7	53.6	19.8
16	-1.03	-10.99	3.633	4.313	45.5	54.0	18.7
17	-0.83	-11.44	3.610	4.337	45.2	54.3	20.1
18	-0.58	-12.12	3.589	4.420	44.9	55.3	23.2
19	-0.41	-13.21	3.624	4.396	45.4	55.0	21.3
20	-0.31	-13.73	3.567	4.376	44.6	54.8	22.7

Table 7.5-18: Throughput performance for DIPs based on weighted average throughput gain (0 dB geometry, scenario 2, R4-120919, ST-Ericsson/Ericsson)

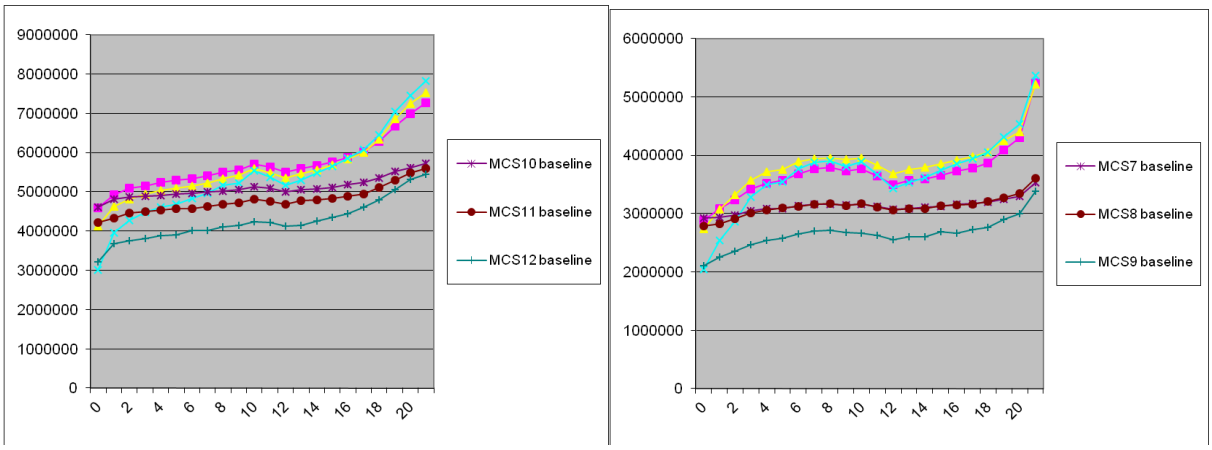
DIP Profile #	MCS-10			MCS-11			MCS-12		
	MMSE	MMSE-IRC	Gain (%)	MMSE	MMSE-IRC	Gain (%)	MMSE	MMSE-IRC	Gain (%)
1	4813534	4932335,3	2,47%	4336875,4	4633275,4	6,83%	3680949,7	3964024,1	7,69%
2	4862893,1	5084489,1	4,56%	4459392,5	4817981,4	8,04%	3760809	4275278,4	13,68%
3	4880502	5155730,7	5,64%	4502302,3	4947371,3	9,89%	3806146,7	4470652,3	17,46%
4	4909749,6	5241014,2	6,75%	4538767,3	5028355,2	10,79%	3874097,5	4613343,7	19,08%
5	4941663,5	5294846,1	7,15%	4579605,3	5082159,9	10,97%	3894596	4677813,1	20,11%
6	4963007,8	5339158,5	7,58%	4568487,1	5153215,4	12,80%	4018529,6	4829504,5	20,18%
7	4993809,4	5400390,8	8,14%	4632520,3	5222817,8	12,74%	4017498,5	4957131,7	23,39%
8	5021515,3	5499526,3	9,52%	4685397,3	5340438,2	13,98%	4098086,4	5170197	26,16%
9	5057187,9	5559843	9,94%	4710895,7	5430879,4	15,28%	4146338,7	5227584,9	26,08%
10	5123413,9	5710225,5	11,45%	4817564,3	5591948,4	16,07%	4244098,5	5530531,7	30,31%
11	5083711,3	5627628,9	10,70%	4752741,1	5474584,3	15,19%	4213993	5376677,4	27,59%
12	5002297,5	5499116,6	9,93%	4683252,7	5357017,8	14,39%	4124077,4	5170100,5	25,36%
13	5048539,4	5587246,6	10,67%	4780015,1	5456526,4	14,15%	4146697,5	5302759,8	27,88%
14	5074056,1	5662875,5	11,60%	4787967,2	5555660	16,03%	4251101,5	5472273,4	28,73%
15	5117917,1	5762305,9	12,59%	4830207,8	5677510,9	17,54%	4339706,5	5639327,6	29,95%
16	5192269,5	5879239,1	13,23%	4881278,3	5826158,8	19,36%	4447411,1	5847926,6	31,49%
17	5241509,2	6024588,4	14,94%	4936609,2	6002103,5	21,58%	4603168,8	6081082,4	32,11%
18	5343668,3	6284705,8	17,61%	5107786,9	6329796,4	23,92%	4793529,6	6448341,7	34,52%
19	5524688,2	6670106,4	20,73%	5301349,7	6850671,9	29,23%	5062364,8	7040531,7	39,08%
20	5603846,7	6979677,5	24,55%	5485894,1	7246814,7	32,10%	5308116,6	7459545,7	40,53%
AWGN	4613314,2	4590136,1	-0,50%	4218554,6	4121415,1	-2,30%	3213741,7	3010778,9	-6,32%
1 strong cell, no AWGN	5722883,5	7273968,5	27,10%	5597381,7	7519258,3	34,34%	5447408	7827762,8	43,70%
Average gain			10,99%			16,04%			26,07%

Table 7.5-19: Throughput performance for DIPs based on weighted average throughput gain (-3 dB geometry, scenario 2, R4-120919, ST-Ericsson/Ericsson)

DIP Profile #	MCS-7			MCS-8			MCS-9		
	MMSE	MMSE-IRC	Gain (%)	MMSE	MMSE-IRC	Gain (%)	MMSE	MMSE-IRC	Gain (%)
1	2932238,5	3081240,9	5,08%	2821894,9	3070602	8,81%	2252743,8	2542513,4	12,86%
2	2967657,6	3227204,7	8,75%	2908098,3	3318535,9	14,11%	2355629,8	2865791,6	21,66%
3	3043358	3416984,3	12,28%	3013088	3571774,5	18,54%	2463931,3	3281358	33,18%
4	3090013,9	3516392,3	13,80%	3056241,8	3718744,3	21,68%	2545336,9	3487529,4	37,02%
5	3089055,1	3568094,3	15,51%	3095877,4	3753857,9	21,25%	2582620,7	3546953,6	37,34%
6	3136896,9	3677083	17,22%	3122193,6	3891904,3	24,65%	2649349,2	3760201,6	41,93%
7	3155258	3763521	19,28%	3158476,8	3943585,3	24,86%	2702074,4	3872607,6	43,32%
8	3160961,3	3784726,8	19,73%	3167659,3	3954170,5	24,83%	2709576,8	3903341,6	44,06%
9	3150014,1	3731490,3	18,46%	3137719,2	3921440	24,98%	2676853	3805408,3	42,16%
10	3163445,2	3768162,2	19,12%	3168155,8	3951983,5	24,74%	2666545,1	3885205	45,70%
11	3125776,9	3637167,5	16,36%	3113027,5	3831247,8	23,07%	2623032,1	3672262,4	40,00%
12	3074105,6	3496446	13,74%	3054659,5	3674670,6	20,30%	2552199,7	3436974,3	34,67%
13	3086155	3561456,5	15,40%	3086915,6	3747247,6	21,39%	2596322,6	3534565,3	36,14%
14	3110284,2	3591037,7	15,46%	3088140,1	3789698,3	22,72%	2602015,7	3611286,6	38,79%
15	3125625,7	3656737,1	16,99%	3136867,7	3849281	22,71%	2693361	3743505,3	38,99%
16	3161462,7	3726431,1	17,87%	3143482,2	3908215,3	24,33%	2658821	3847169,9	44,69%
17	3170069,1	3781425,6	19,29%	3157731,1	3978099,5	25,98%	2727707,6	3934816,5	44,25%
18	3193422,9	3870385,3	21,20%	3208978,7	4046123	26,09%	2767561,5	4049238,6	46,31%
19	3251569,5	4085050,8	25,63%	3273271,6	4242944,7	29,62%	2896492,1	4311980,1	48,87%
20	3289675,9	4303652,9	30,82%	3348261,9	4399860,3	31,41%	2999666,1	4530794,6	51,04%
AWGN	2917304	2882222,3	-1,20%	2787819,7	2735721,8	-1,87%	2106222,5	2042908,2	-3,01%
1 strong cell, no AWGN	3529893,6	5242131	48,51%	3600169,4	5213017,5	44,80%	3381888,8	5363805,1	58,60%
Average gain			17,10%			22,80%			39,15%

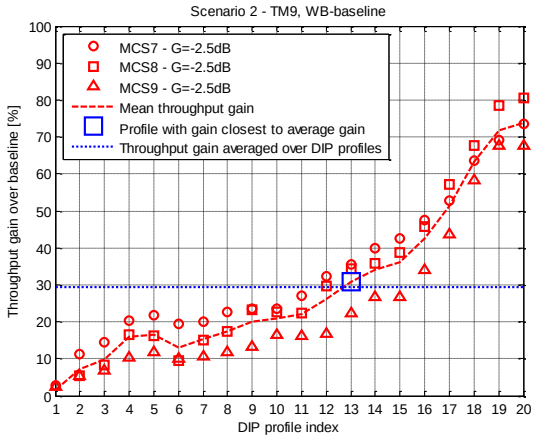
Table 7.5-21a: Throughput performance for DIPs based on weighted average throughput gain (-2.5 dB geometry, scenario 2, R4-121778, ST-Ericsson/Ericsson)

DIP Profile #	MCS-5			MCS-6			MCS-7			MCS-8			MCS-9		
	MMSE-MRC	MMSE-IRC	Gain (%)	MMSE-MRC	MMSE-IRC	Gain (%)	MMSE-MRC	MMSE-IRC	Gain (%)	MMSE-MRC	MMSE-IRC	Gain (%)	MMSE-MRC	MMSE-IRC	Gain (%)
AWGN	3544625	3504517	-1,13%	3182577	3155350	-0,86%	3186639	3154597	-1,01%	3223925	3174207	-1,54%	2771467	2726531	-1,62%
1	3495880	3619778	3,54%	3253873	3359578	3,25%	3199214	3313958	3,59%	3254110	3439120	5,69%	2844091	3097186	8,90%
2	3503400	3731430	6,51%	3290593	3504854	6,51%	3243454	3447065	6,28%	3342018	3641667	8,97%	2928625	3377183	15,32%
3	3510314	3788126	7,91%	3320816	3597074	8,32%	3280506	3528796	7,57%	3364684	3724879	10,71%	2961195	3519366	18,85%
4	3506692	3834325	9,34%	3345358	3646908	9,01%	3294343	3585120	8,83%	3389934	3799617	12,09%	2995757	3639732	21,50%
5	3521107	3877768	10,13%	3349160	3709094	10,75%	3309142	3647286	10,22%	3413827	3866128	13,25%	3033455	3733666	23,08%
6	3517341	3871653	10,07%	3351024	3693406	10,22%	3316673	3649578	10,04%	3394251	3863978	13,84%	3037089	3740414	23,16%
7	3512553	3887202	10,67%	3341906	3724091	11,44%	3320319	3657745	10,16%	3416962	3874167	13,38%	3054544	3747417	22,68%
8	3518740	3913810	11,23%	3351193	3745577	11,77%	3325323	3698528	11,22%	3429152	3904295	13,86%	3109845	3795280	22,04%
9	3522464	3943478	11,95%	3356199	3796214	13,11%	3345178	3754122	12,22%	3442202	3969034	15,31%	3114049	3884383	24,74%
10	3529025	3971594	12,54%	3371743	3821213	13,33%	3354073	3773348	12,50%	3461374	3987504	15,20%	3149668	3968239	25,99%
11	3536731	4004852	13,24%	3385899	3878030	14,53%	3387376	3841377	13,40%	3486939	4042281	15,93%	3200491	4058327	26,80%
12	3535720	4027990	13,92%	3392893	3934691	15,97%	3393771	3918927	15,47%	3517019	4104663	16,71%	3235448	4141110	27,99%
13	3546185	4062855	14,57%	3408675	3973461	16,57%	3411893	3984506	16,78%	3533096	4157953	17,69%	3257399	4232334	29,93%
14	3547711	4099684	15,56%	3437514	4049905	17,81%	3444768	4079559	18,43%	3562822	4238442	18,96%	3302393	4332742	31,20%
15	3560131	4155575	16,73%	3444763	4123835	19,71%	3478711	4170858	19,90%	3584741	4330521	20,80%	3349587	4419358	31,94%
16	3566794	4200792	17,77%	3454812	4208338	21,81%	3513507	4304809	22,52%	3616379	4416554	22,13%	3427318	4572376	33,41%
17	3569136	4254142	19,19%	3468678	4322165	24,61%	3569209	4471185	25,27%	3668850	4533519	23,57%	3485803	4731512	35,74%
18	3578333	4324091	20,84%	3503437	4509260	28,71%	3635211	4744197	30,51%	3729978	4748046	27,29%	3584708	4978961	38,89%
19	3587607	4367152	21,73%	3528538	4670600	32,37%	3694500	4931565	33,48%	3802265	4911809	29,18%	3652769	5133226	40,53%
20	3594264	4397230	22,34%	3542197	4746292	33,99%	3715549	5111721	37,58%	3819002	5056108	32,39%	3693991	5268833	42,63%
1 strong cell, no AWGN	3604891	4477142	24,20%	3585092	4980743	38,93%	3841822	5671907	47,64%	3946443	5562683	40,95%	3867798	5660384	46,35%
Average gain			13,49%			16,19%			16,30%			17,35%			27,27%

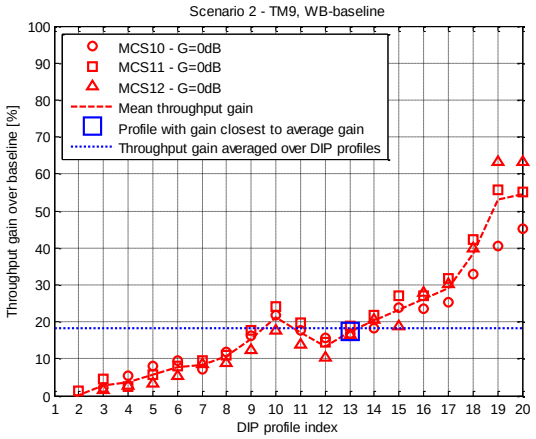


(a) Geometry = 0 dB for Scenario 2 **(b) Geometry = -3 dB for Scenario 2**

Figure 7.5-5: throughput behaviour (R4-120919, ST-Ericsson/Ericsson)

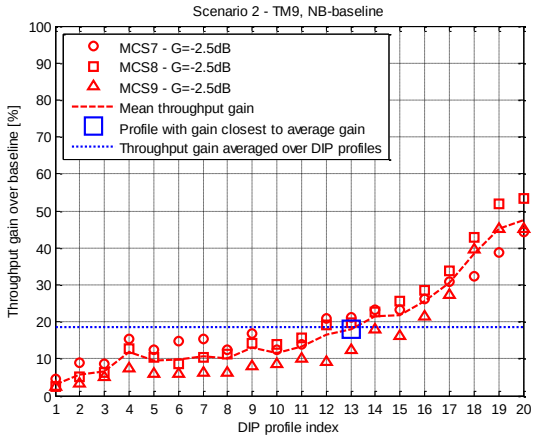


(a) Geometry = -2.5 dB

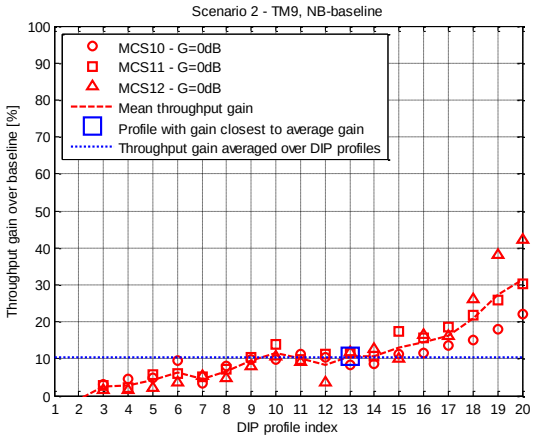


(b) Geometry = 0 dB

Figure 7.5-6: Fixed MCS throughput gain of IRC (1 PRB) vs. WB-baseline for each DIP profile (R4-120944, Renesas Mobile Europe Ltd.)



(a) Geometry = -2.5 dB



(b) Geometry = 0 dB

Figure 7.5-7: Fixed MCS throughput gain of IRC (1 PRB) vs. NB-baseline for each DIP profile (R4-120944, Renesas Mobile Europe Ltd.)

Table 7.5-20: Fixed MCS throughput gain of IRC (1 PRB) vs. baseline for each DIP profile (R4- 120944, Renesas Mobile Europe Ltd.)

Table : Fixed MCS throughput gain of IRC (1 PRB) vs. baseline for each DIP profile (R4- 120944, Renesas Mobile Europe Ltd.)DIP profile index	G = -2.5 dB								
	MCS#7			MCS#8			MCS#9		
	WB-Baseline	NB-Baseline	IRC-1 PRB	WB-Baseline	NB-Baseline	IRC-1 PRB	WB-Baseline	NB-Baseline	IRC-1 PRB
1	3.8191	3.7515	3.9215	3.7353	3.6323	3.7173	3.7805	3.7786	3.8779
2	3.8510	3.9271	4.2794	3.7442	3.7495	3.9448	3.7532	3.8301	3.9542
3	3.8111	4.0098	4.3588	3.7152	3.7944	4.0298	3.7647	3.8295	4.0251
4	3.7947	3.9605	4.5683	3.7268	3.8556	4.3429	3.7562	3.8640	4.1492
5	3.7618	4.0704	4.5786	3.6461	3.8430	4.2399	3.7556	3.9530	4.1952
6	3.7956	3.9539	4.5321	3.8240	3.8562	4.1914	3.7635	3.9058	4.1425
7	3.8308	3.9901	4.5997	3.7036	3.8530	4.2579	3.7417	3.8931	4.1425
8	3.7928	4.1310	4.6477	3.7089	3.9190	4.3561	3.7453	3.9348	4.1867
9	3.8708	4.0981	4.7857	3.6608	3.9607	4.5171	3.7593	3.9391	4.2582
10	3.8370	4.2099	4.7374	3.6688	3.9522	4.4981	3.6902	3.9548	4.3005
11	3.7364	4.1676	4.7519	3.7210	3.9433	4.5566	3.7357	3.9476	4.3441
12	3.8102	4.1775	5.0450	3.6487	3.9654	4.7287	3.7459	4.0057	4.3738
13	3.7482	4.1883	5.0788	3.6471	4.0895	4.8992	3.6981	4.0220	4.5240
14	3.7487	4.2555	5.2470	3.6292	4.0172	4.9320	3.7133	3.9827	4.7038
15	3.7111	4.2921	5.2935	3.6930	4.0805	5.1236	3.7157	4.0469	4.7050
16	3.7360	4.3649	5.5133	3.6181	4.1032	5.2725	3.6618	4.0414	4.9133
17	3.6848	4.3034	5.6293	3.5985	4.2273	5.6583	3.6115	4.0771	5.1930
18	3.5561	4.3964	5.8205	3.5025	4.1127	5.8737	3.5637	4.0378	5.6410
19	3.4650	4.2198	5.8562	3.3742	3.9691	6.0257	3.4045	3.9282	5.7058
20	3.3447	4.0225	5.8073	3.2919	3.8746	5.9439	3.3342	3.8519	5.5902
	G = 0 dB								
	MCS#10			MCS#11			MCS#12		
	WB-	NB-	IRC-1	WB-	NB-	IRC-1	WB-	NB-	IRC-1
1	5.7137	5.6180	5.5139	5.4763	5.3967	5.1797	5.3149	5.2218	5.1858
2	5.8039	5.8281	5.7760	5.3967	5.5042	5.4730	5.3119	5.3412	5.2781
3	5.7833	5.7312	5.9141	5.3861	5.4883	5.6343	5.4065	5.4103	5.5012
4	5.7427	5.7833	6.0503	5.5367	5.5553	5.6754	5.3420	5.4103	5.4921
5	5.7058	5.8893	6.1678	5.6356	5.6376	5.9568	5.3622	5.4321	5.5492
6	5.8445	5.8372	6.3966	5.5825	5.6887	6.0285	5.4238	5.5124	5.7182
7	5.8874	6.1115	6.3088	5.5825	5.8121	6.1094	5.3540	5.5267	5.8233
8	5.8547	6.0673	6.5534	5.6721	5.8785	6.2972	5.4493	5.6641	5.9352
9	5.6973	6.0200	6.6176	5.5374	5.9044	6.5202	5.4937	5.7114	6.1732
10	5.6380	6.2525	6.8592	5.4425	5.9336	6.7591	5.4373	5.7820	6.4023
11	5.7990	6.1423	6.8319	5.5108	6.0125	6.5939	5.4283	5.6619	6.1800
12	5.6622	5.9268	6.5450	5.5739	5.7351	6.3736	5.3600	5.7114	5.9172
13	5.7663	6.2138	6.7308	5.5792	5.9475	6.6350	5.3682	5.5883	6.2528
14	5.6604	6.1544	6.6872	5.5321	6.0849	6.7386	5.3713	5.7505	6.4849
15	5.6804	6.3209	7.0281	5.5473	6.0079	7.0452	5.4906	5.9157	6.5201
16	5.7337	6.3555	7.0862	5.5991	6.1493	7.1095	5.3765	5.8991	6.8791
17	5.8329	6.4263	7.3012	5.6084	6.2282	7.3889	5.4171	6.0779	7.0623
18	5.6870	6.5801	7.5615	5.5095	6.4432	7.8375	5.5635	6.1695	7.7884
19	5.5478	6.6031	7.7928	5.3708	6.6377	8.3598	5.3682	6.3422	8.7714
20	5.3783	6.3997	7.8037	5.4073	6.4413	8.3884	5.3765	6.1702	8.7811

Table 7.5-21: IRC throughput gain of DMRS based TM9 for MCS=10, 11 and 12 at G=-0 dB (R4-121932, Huawei, HiSillicon)

#	DIP1 [dB]	DIP2 [dB]	TM6(Mbps)								
			MCS10			MCS11			MCS12		
			MMSE	MMSE-IRC	Gain(%)	MMSE	MMSE-IRC	Gain (%)	MMSE	MMSE-IRC	Gain (%)
1	-5.876	-7.071	5.3403	5.6024	4.907964	5.3524	5.6239	5.072491	5.1513	5.3446	3.752451
2	-4.871	-6.297	5.4489	5.8997	8.273229	5.4724	5.9507	8.740224	5.2484	5.6508	7.667099
3	-4.423	-6.067	5.4753	6.0436	10.37934	5.5197	6.1136	10.75964	5.291	5.8114	9.83557
4	-4.094	-5.781	5.5049	6.1914	12.47071	5.5687	6.273	12.64748	5.3505	5.9819	11.80077
5	-3.832	-5.852	5.5049	6.2657	13.82041	5.5898	6.3764	14.07206	5.3773	6.078	13.0307
6	-3.616	-5.761	5.5193	6.3544	15.13054	5.6169	6.4833	15.42488	5.3901	6.19	14.84017
7	-3.426	-5.641	5.5297	6.4432	16.51988	5.6476	6.5875	16.64247	5.4229	6.3229	16.59629
8	-3.254	-5.186	5.5616	6.603	18.72483	5.6861	6.7732	19.11855	5.4685	6.5617	19.99086
9	-3.119	-4.977	5.5608	6.7117	20.69666	5.7063	6.9029	20.96981	5.4893	6.7174	22.37262
10	-3.004	-4.391	5.5856	6.8947	23.43705	5.7325	7.1219	24.23724	5.5329	7.0088	26.67498
11	-2.881	-5.092	5.556	6.7716	21.87905	5.7177	7.0001	22.4286	5.4962	6.8323	24.30952
12	-2.617	-7.21	5.5001	6.5726	19.49965	5.6213	6.7452	19.9936	5.3951	6.5092	20.65022
13	-2.331	-7.571	5.5081	6.6925	21.50288	5.6344	6.8731	21.98459	5.4179	6.6847	23.38175
14	-2.056	-8.246	5.5089	6.8028	23.48745	5.6379	6.9966	24.0994	5.4298	6.8442	26.04884
15	-1.783	-8.96	5.5121	6.9299	25.72159	5.6292	7.1429	26.89014	5.4437	7.0425	29.36973
16	-1.515	-9.745	5.5137	7.0545	27.94494	5.6371	7.3418	30.24073	5.4447	7.2536	33.22313
17	-1.243	-10.71	5.5177	7.2032	30.54715	5.6555	7.5397	33.31624	5.4645	7.5232	37.67408
18	-0.874	-11.521	5.5161	7.4246	34.59872	5.6441	7.8761	39.54572	5.4833	8.0069	46.02338
19	-0.415	-13.384	5.4465	7.6515	40.48471	5.595	8.2169	46.86148	5.4407	8.6799	59.53646
20	-0.171	-15.604	5.2939	7.7027	45.50143	5.4303	8.3378	53.54216	5.3039	8.9267	68.30446

Table 7.5-22: IRC throughput gain of DMRS based TM9 for MCS=10, 11 and 12 at G=-2.5 dB (R4-121932, Huawei, HiSillicon)

#	DIP1 [dB]	DIP2 [dB]	TM9(Mbps)								
			MCS10			MCS11			MCS12		
			MMSE	MMSE-IRC	Gain (%)	MMSE	MMSE-IRC	Gain (%)	MMSE	MMSE-IRC	Gain (%)
1	-5.709	-6.77	3.8279	4.0393	5.52261	3.6735	3.7962	3.340139	3.825	3.9041	2.067974
2	-4.345	-5.907	3.7826	4.2377	12.03141	3.6533	3.9704	8.679824	3.7938	3.9896	5.161052
3	-3.855	-5.632	3.7659	4.3301	14.98181	3.6464	4.061	11.37012	3.7794	4.0136	6.196751
4	-3.489	-5.538	3.7591	4.3915	16.82318	3.6443	4.1425	13.67066	3.7698	4.0463	7.334607
5	-3.221	-5.421	3.7417	4.4479	18.87377	3.6408	4.2087	15.59822	3.7642	4.0847	8.514425
6	-2.985	-5.951	3.7485	4.4646	19.10364	3.6352	4.2142	15.9276	3.7666	4.0895	8.572718
7	-2.724	-6.803	3.7336	4.4776	19.92715	3.631	4.2205	16.2352	3.769	4.0927	8.588485
8	-2.497	-7.215	3.7225	4.5334	21.78375	3.6255	4.2658	17.66101	3.757	4.1175	9.595422
9	-2.299	-7.281	3.7113	4.5886	23.63862	3.6241	4.3264	19.3786	3.7522	4.1491	10.57779
10	-2.116	-7.783	3.7033	4.6271	24.94532	3.6192	4.3717	20.79189	3.7419	4.1758	11.59571
11	-1.905	-8.326	3.6921	4.6835	26.85193	3.6073	4.4261	22.69842	3.7363	4.2142	12.79073
12	-1.726	-8.659	3.684	4.7511	28.9658	3.6066	4.4811	24.24721	3.7267	4.2485	14.00166
13	-1.55	-9.307	3.6729	4.81	30.95919	3.6045	4.5578	26.4475	3.7147	4.2925	15.55442
14	-1.39	-9.547	3.6642	4.8707	32.9267	3.6011	4.633	28.65513	3.6555	4.3453	18.8702
15	-1.213	-9.922	3.645	4.9439	35.63512	3.5927	4.7139	31.20773	3.6467	4.4084	20.88738
16	-1.034	-10.993	3.6072	5.0189	39.13562	3.5829	4.7898	33.685	3.634	4.4867	23.4645
17	-0.829	-11.443	3.5836	5.1057	42.47405	3.5321	4.8999	38.72484	3.6116	4.5906	27.1071
18	-0.583	-12.119	3.5817	5.1937	45.00656	3.5056	5.0086	42.87426	3.5788	4.7185	31.84587
19	-0.406	-13.213	3.5241	5.2471	48.89192	3.5237	5.0518	43.36635	3.5373	4.7792	35.1087
20	-0.313	-13.73	3.4987	5.2533	50.15006	3.4847	5.0748	45.6309	3.5796	4.7856	33.69092

Table 7.5-23: Throughput gain of 0 dB geometry DIP profiles for Scenario 2 (R4- 122018, LG Electronics)

#	DIP1 [dB]	DIP2 [dB]	TM6(Mbps)								
			MCS10			MCS11			MCS12		
			MMSE	MMSE-IRC	Gain(%)	MMSE	MMSE-IRC	Gain (%)	MMSE	MMSE-IRC	Gain (%)
1	-5.876	-7.071	5.632	5.9197	5.10831	5.3331	5.5714	4.46832	5.1552	5.2851	2.519786
2	-4.871	-6.297	5.6455	6.1171	8.353556	5.3883	5.8517	8.600115	5.2008	5.4942	5.64144
3	-4.423	-6.067	5.6376	6.2186	10.3058	5.4093	5.9901	10.73706	5.2276	5.6052	7.2232
4	-4.094	-5.781	5.6328	6.3353	12.47159	5.4224	6.1329	13.10305	5.2365	5.7212	9.256183
5	-3.832	-5.852	5.6344	6.408	13.72994	5.4312	6.1995	14.14605	5.2454	5.7955	10.48728
6	-3.616	-5.761	5.6288	6.4663	14.87884	5.4408	6.2809	15.44074	5.2474	5.8798	12.05168
7	-3.426	-5.641	5.6336	6.5183	15.70399	5.4452	6.3545	16.69911	5.2603	5.9601	13.30342
8	-3.254	-5.186	5.6471	6.6166	17.1681	5.461	6.4947	18.92877	5.2861	6.1286	15.93803
9	-3.119	-4.977	5.6519	6.6797	18.18504	5.4636	6.5963	20.73175	5.3049	6.2307	17.45179
10	-3.004	-4.391	5.6471	6.8012	20.43704	5.4741	6.7671	23.62032	5.3188	6.419	20.68512
11	-2.881	-5.092	5.6408	6.7365	19.42455	5.4645	6.6646	21.96175	5.298	6.3219	19.32616
12	-2.617	-7.21	5.6072	6.6422	18.45841	5.4286	6.5131	19.97753	5.2722	6.1127	15.94211
13	-2.331	-7.571	5.5968	6.7277	20.20619	5.4373	6.6226	21.79942	5.2841	6.2465	18.21313
14	-2.056	-8.246	5.5848	6.8108	21.95244	5.4312	6.7172	23.67801	5.2762	6.3625	20.58868
15	-1.783	-8.96	5.5784	6.8923	23.55335	5.4365	6.8407	25.82912	5.2742	6.5221	23.66046
16	-1.515	-9.745	5.5648	6.9882	25.57864	5.4198	6.9966	29.09332	5.2781	6.7065	27.06277
17	-1.243	-10.71	5.5488	7.1017	27.98623	5.4049	7.1692	32.6426	5.297	6.9215	30.6683
18	-0.874	-11.521	5.5217	7.2759	31.7692	5.4032	7.4075	37.09468	5.293	7.3468	38.80219
19	-0.415	-13.384	5.4338	7.4517	37.13607	5.3366	7.7079	44.43466	5.2504	7.7948	48.46107
20	-0.171	-15.604	5.2547	7.4238	41.27924	5.1921	7.7298	48.87618	5.1523	7.8374	52.11459

Table 7.5-24: Throughput gain of -2.5 dB geometry DIP profiles for Scenario 2 (R4- 122018, LG Electronics)

DIP Profile (-2.5 dB)	MCS7			MCS8			MCS9		
	MMSE	MMSE-IRC	Gain (%)	MMSE	MMSE-IRC	Gain (%)	MMSE	MMSE-IRC	Gain (%)
1	3692.82	3689.06	-0.10%	3736.35	3683.56	-1.41%	3772.77	3868.03	2.53%
2	3722.25	3970.28	6.66%	3663.85	3862.35	5.42%	3770.34	3937.47	4.43%
3	3761.09	4118.09	9.49%	3625.13	4012.99	10.70%	3763.89	3998.02	6.22%
4	3692.19	4153.79	12.50%	3718.05	3998.91	7.55%	3826.86	3987.52	4.20%
5	3846.89	4369.25	13.58%	3689.89	4031.29	9.25%	3838.97	4111.86	7.11%
6	3704.72	4493.26	21.28%	3625.84	4089.01	12.77%	3776.80	4043.23	7.05%
7	3786.77	4260.27	12.50%	3694.82	4069.30	10.14%	3819.59	4089.25	7.06%
8	3834.99	4483.87	16.92%	3784.92	4039.74	6.73%	3765.50	4153.03	10.29%
9	3740.42	4335.43	15.91%	3677.22	4254.43	15.70%	3748.55	4105.40	9.52%
10	3637.07	4569.67	25.64%	3728.61	4156.59	11.48%	3893.87	4051.30	4.04%
11	3790.52	4696.82	23.91%	3777.18	4422.66	17.09%	3742.09	4184.52	11.82%
12	3834.37	4650.47	21.28%	3658.92	4476.16	22.34%	3733.21	4300.78	15.20%
13	3768.60	4623.54	22.69%	3785.63	4515.58	19.28%	3772.77	4208.74	11.56%
14	3732.90	4823.96	29.23%	3656.11	4576.12	25.16%	3801.83	4283.01	12.66%
15	3685.93	4976.79	35.02%	3675.11	4613.42	25.53%	3820.40	4306.43	12.72%
16	3732.28	5088.27	36.33%	3758.17	4702.82	25.14%	3813.13	4400.08	15.39%
17	3789.27	5177.21	36.63%	3749.02	4997.76	33.31%	3852.69	4439.64	15.23%
18	3756.70	5327.53	41.81%	3751.13	4842.19	29.09%	3767.92	4551.86	20.81%
19	3833.74	5258.63	37.17%	3676.52	4879.50	32.72%	3855.92	4603.53	19.39%
20	3975.29	5219.80	31.31%	3817.30	4794.33	25.59%	3758.23	4641.48	23.50%
Average	3765.94	4614.30	22.49%	3712.49	4350.93	17.18%	3794.77	4213.26	11.04%

7.6 Summary

From the simulation results based on conditional median DIP, approximately 11 -24 % gain for CRS based transmission (serving cell: TM6) and 11-20 % gain for DM-RS based transmission (Serving cell: TM9 single layer) can be obtained by RS-based co-variance matrix estimation scheme in synchronous NW. In asynchronous NW. 3 experiments showed lower gains for CRS and DM-RS based transmission (5-10% for CRSs and lower for DM-RS). However, no conclusion on asynchronous NW could be drawn due to the limited inputs. From the simulation results based on weighted DIP, approximately 20-33 % gain for CRS based transmission (serving cell: TM6) and 16-28 % gain for DM-RS based transmission (serving cell: TM9 single layer) could be observed.

8 System performance characterization

8.1 General

The purpose of this clause is to analyze the performance gain from system-level simulation results. Emphasis is on results that were based on agreed set of simulation assumption. This clause introduces an evaluation framework for system-level simulations, and summarizes the performance gain.

8.2 Simulation assumption and methodologies

Simulation assumption is used as shown in Table 5.1.

To evaluate the performance gain for MMSE-IRC receiver, the related appropriate modelling could be used as guideline in order to account for the covariance matrix estimation in system level simulation.

A spatial covariance matrix can be written as follows

$$\hat{R} = \frac{1}{M}\sum_{m=1}^{M}\left[y_m y_m^H\right], \qquad (1)$$

where M is the number of data samples used in order to estimate the covariance matrix

As shown in [31, 32], the sample correlation matrix can be approximated using the complex Wishart distribution [32, 33] with *M* degrees of freedom

$$\sum_{m=1}^{M} y_m y_m^H \sim W_p(R, M), \qquad (2)$$

Where 'R' is the ideal covariance matrix. Correspondingly, it can be modelled in the system simulator as

$$\hat{R} \approx QAA^H Q^H, \qquad (3)$$

where $Q = Chol\{R\}$ is created by the Cholesky decomposition of the ideal spatial correlation matrix.

The lower-triangular matrix *A* is generated according to the complex Wishart distribution as

$$A = \begin{bmatrix} \sqrt{c_1/2} & 0 & 0 & \cdots & 0 \\ n_{21} & \sqrt{c_2/2} & 0 & \cdots & 0 \\ n_{31} & n_{32} & \sqrt{c_3/2} & \cdots & 0 \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ n_{N,1} & n_{N,2} & n_{N,3} & \cdots & \sqrt{c_N/2} \end{bmatrix}, \qquad (4)$$

where the coefficients c_i follow a Chi-square distribution, i.e. $c_i \sim \chi^2 (2*(M - i + 1))$, and $n_{ij} \sim CN(0,1)$.

8.3 Simulation results

This section presents the evaluation results for system level simulation generated by various interested companies to show the contribution.

Table 8.3-1: System level simulation results (R4- 120374, Huawei, HiSilicon)

	3GPP case 1				3GPP case 3			
	Cell average throughput (Mbps)	Gain	Edge user throughtpu (Mbps)	Gain	Cell average throughput (Mbps)	Gain	Edge user throughtpu (Mbps)	Gain
MMSE	21.97	-	0.605	-	16.61	-	0.402	-
Wishart-IRC	22.69	3.30%	0.734	21.70%	17.23	3.70%	0.447	11.20%
ideal-IRC	24.26	10.40%	0.754	25%	18.21	9.60%	0.454	12.90%

Table 8-3.2: System simulation results for TM6, 2x2 XP model (R4-120528, Renesas)

	Average cell SE [bps/Hz/Sector]	5% cell edge SE [bps/Hz/UE]	Average cell SE gain [%]	5% cell edge SE gain [%]
MRC/MMSE Baseline	1.8121	0.0411	0.00%	0.00%
MMSE-IRC Wishart	1.8327	0.0448	1.14%	8.89%
MMSE-IRC Ideal	1.8782	0.0474	3.65%	15.11%

Table 8.3-3: System simulation results for TM4, 2x2 XP model (R4-120528, Renesas)

	Average cell SE [bps/Hz/Sector]	5% cell edge SE [bps/Hz/UE]	Average cell SE gain [%]	5% cell edge SE gain [%]
MRC/MMSE Baseline	2.2103	0.041	0.00%	0.00%
MMSE-IRC Wishart	2.2212	0.0448	0.49%	9.38%
MMSE-IRC Ideal	2.2468	0.0474	1.65%	15.63%

Table 8.3-4: System simulation results for TM6, 2x2 ULA (lambda/2) model (R4-120528, Renesas)

	Average cell SE [bps/Hz/Sector]	5% cell edge SE [bps/Hz/UE]	Average cell SE gain [%]	5% cell edge SE gain [%]
MRC/MMSE Baseline	1.8935	0.0518	0.00%	0.00%
MMSE-IRC Wishart	1.9693	0.0614	3.90%	18.52%
MMSE-IRC Ideal	2.0194	0.0647	6.65%	24.83%

Table 8.3-5: System simulation results for TM4, 2x2 ULA (lambda/2) model (R4-120528, Renesas)

	Average cell SE [bps/Hz/Sector]	5% cell edge SE [bps/Hz/UE]	Average cell SE gain [%]	5% cell edge SE gain [%]
MRC/MMSE Baseline	1.9599	0.0512	0.00%	0.00%
MMSE-IRC Wishart	2.0194	0.0608	3.04%	18.75%
MMSE-IRC Ideal	2.0565	0.0656	4.93%	28.13%

Table 8.3-6: System simulation results for TM9, SU-MIMO rank-1 in serving cell, 4x2 ULA-lambda/2 model (R4-120528, Renesas)

	Average cell SE [bps/Hz/Sector]	5% cell edge SE [bps/Hz/UE]	Average cell SE gain [%]	5% cell edge SE gain [%]
MRC/MMSE Baseline	1.8893	0.0589	0.00%	0.00%
MMSE-IRC Wishart	1.9712	0.0717	4.37%	21.74%
MMSE-IRC Ideal	2.0066	0.0768	6.21%	30.43%

Table 8.3-7: System simulation results for TM9, SU-MIMO rank-1 and rank-2 in serving cell, 4x2 ULA-lambda/2 model (R4-120528, Renesas)

	Average cell SE [bps/Hz/Sector]	5% cell edge SE [bps/Hz/UE]	Average cell SE gain [%]	5% cell edge SE gain [%]
MRC/MMSE Baseline	2.1591	0.0608	0.00%	0.00%
MMSE-IRC Wishart	2.218	0.0747	2.73%	22.81%
MMSE-IRC Ideal	2.2432	0.0755	3.89%	24.21%

Table 8.3-8: System simulation results for TM9, MU-MIMO rank-1 in serving cell, 4x2 ULA-lambda/2 model (R4-120528, Renesas)

	Average cell SE [bps/Hz/Sector]	5% cell edge SE [bps/Hz/UE]	Average cell SE gain [%]	5% cell edge SE gain [%]
MRC/MMSE Baseline (Option 2)	2.5058	0.0704	0.00%	0.00%
MMSE-IRC Wishart	2.5628	0.0794	2.27%	12.73%
MMSE-IRC Ideal	2.6001	0.0848	3.76%	20.45%

Table 8.3-9: System simulation results for TM9, MU-MIMO rank-1 in serving cell, 4x2 ULA- 4 lambda model (R4-120528, Renesas)

	Average cell SE [bps/Hz/Sector]	5% cell edge SE [bps/Hz/UE]	Average cell SE gain [%]	5% cell edge SE gain [%]
MRC/MMSE baseline	1.7269	0.0422	0.00%	0.00%
MMSE-IRC Wishart	1.7581	0.0461	1.80%	9.09%
MMSE-IRC Ideal	1.8001	0.048	4.24%	13.64%

Table 8.3-10: System simulation results for TM9, MU-MIMO rank-1 and rank-2 in serving cell, 4x2 ULA- 4 lambda model (R4-120528, Renesas)

	Average cell SE [bps/Hz/Sector]	5% cell edge SE [bps/Hz/UE]	Average cell SE gain [%]	5% cell edge SE gain [%]
MRC/MMSE Baseline	2.2268	0.0427	0.00%	0.00%
MMSE-IRC Wishart	2.2428	0.0448	0.72%	4.92%
MMSE-IRC Ideal	2.2596	0.0496	1.48%	16.25%

Table 8.3-11: System simulation results for 3GPP case 1 (R4-120850, Intel)

	MMSE receiver		Ideal IRC receiver		Gain	
	Cell average bps/Hz	5%-ile bps/Hz	Cell average bps/Hz	5%-ile bps/Hz	Cell average	5%-ile throughput
4x2 SU-MIMO, ULA-l2	1.86	0.051	2	0.074	7.5%	45.1%
4x2 MU-MIMO, ULA-l2	2.16	0.06	2.75	0.072	27.3%	20.0%
4x2 SU-MIMO, XP labmda/2	1.87	0.046	1.95	0.059	4.3%	28.3%
4x2 SU-MIMO, XP 4lambda	1.74	0.045	1.88	0.051	8.0%	13.3%

8.4 Summary

The study concluded that there is indeed an increase in throughput to be seen for the 5%-ile users, which is in the order of 5-25%, Additionally approximately 3 – 7 % gain for cell-throughput would be obtained.

9 Summary

In this technical report we have documented the work that was accomplished by RAN4 as part of the feasibility study on interference rejection receiver for LTE UE. Receiver methodologies and structures based on UE interference Rejection (IRC) were defined for interference-aware receivers. This type of receiver attempts to cancel the interference that arises from users operating outside the serving cell, which is also referred to as other-cell interference.Interference models/profiles were developed for this other-cell interference in terms of the number of interfering cell to consider, and their powers relative to the total other cell interference power, the latter ratios referred to as Dominant Interferer Proportion (DIP) ratios.For the purposes of this study it was determined that two interfering cells should be taken into account in the interference models. DIP ratios were defined based on two criteria; median values of the corresponding cumulative density functions, weighted average throughput gain.Of these criteria, the one based on the ‘weighted average’ was felt to offer a compromise between the conservative, median value criteria. Throughput estimates were then developed using link level simulations, which included the other-cell interference models plus OCNS models for the serving and interfering cells based on the results of interference modelling. Link level results were developed for a wide range of operating conditions including such factors as transport format, network scenario, modulation, and channel model. From the simulation results based on conditional median DIP, approximately 11 -24 % gain for CRS

based transmission (serving cell: TM6) and 11-20 % gain for DM-RS based transmission (Serving cell: TM9 single layer) can be obtained by RS-based co-variance matrix estimation scheme in synchronous NW. Lower gain was observed for asynchronous NW from 3 simulations, but no conclusion could be made due to limited inputs. From the simulation results based on weighted DIP, approximately 20-33 % gain for CRS based transmission (serving cell: TM6) and 16-28 % gain for DM-RS based transmission (serving cell: TM9 single layer) could be observed. In addition, a system level study was conducted that indicated that MMSE-IRC receiver provided gains for cell edge user throughput from 5-25%. With regards to implementation issues, it was felt that MMSE-IRC receiver is based upon known and mature signal processing techniques, and thus, the complexity is minimized. Given all of the above, RAN4 has concluded that throughput gain can be obtained by MMSE-IRC receiver in interference limited system/ condition for LTE/ LTE-Advanced.

Annex A (informative): Change history

Change history							
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
11-2011		R4-115907			TR skeleton(v0.0.1) for Enhanced performance requirement for LTE UE SI		0.0.1
02-2012					Agreed text proposals from RAN4 #62:	0.0.1	1.0.0
03-2012	RP-55	RP-120316			Presentation to RAN for approval		1.0.0
03-2012	RP-55	RP-120316			Approved by RAN55	1.0.0	11.0.0
12-2012	RP-58	RP-121874	002		CR for DIP and link-level evaluation results on G=-2.5dB for advanced receiver	11.0.0	11.1.0