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| Re: | MBWA Call for Proposals |
| Abstract | This contribution (part of the MBTDD proposal package for 802.20), contains the MBTDD Wideband Mode Performance Report 1. |
| Purpose | For consideration of 802.20 in its efforts to adopt a TDD proposal for MBWA. |
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# MBTDD Wideband Mode Performance Report 1

## 1 Simulation Calibrations

This document specifies the performance of the MBWA system proposed in [5] as required by the 802.20 System Requirements Document (SRD) [2]. The link level and system level simulations are carried out according to the methodology specified in the evaluation criteria document [1]. In this section, the link-to-system interface is described. Then the system simulation calibration results are presented in terms of deterministic location calibration and traffic model calibration. Finally we describe the generation of MIMO channel correlations for link and system level simulations. The rest of the document will be broken into sections to address each of the performance requirements in SRD.

### 1.1 Link – System Interface

An Effective SNR metric has been proposed to 802.20 working group as a link to system interface for MIMO system performance studies [6], [7]. In the proposed MBWA system, MMSE processing is employed for spatial processing of multiple antenna configurations. The effective SNR mapping is defined as follows: Let $SNR_i$ denote the post MMSE processing SNR of the i'th modulation symbol in a packet consisting of N modulation symbols (potentially over multiple HARQ transmissions). The effective SNR of the packet, denoted by $SNR_{eff}$ is defined as

$$SNR_{eff} = C^{-1}\left(\frac{1}{N}\sum_{i=1}^{N} C(SNR_i)\right).$$

Here C(.) denotes the constrained capacity function corresponding to the modulation scheme being used. The link simulation generates FER results as a function of the effective SNR. The system-level simulation measures the effective SNR of the packet and indexes into the link level simulation. The link simulation can incorporate all the relevant imperfections, like channel estimation and interference power estimation. The effective SNR metric has been validated through simulations with different channel, interference models and antenna configurations.

#### 1.1.1 Validation of Link to System Metric

The effective SNR metric has been validated through simulations with different channel, interference models and antenna configurations. Four channel models, i.e., AWGN, Ped B, Veh A and Veh B channels, have been simulated for MIMO single code word transmissions assuming perfect channel estimation. In Figure 1-1, the FER vs. effective C/I link curves are illustrated for 3 packet formats of spectral efficiency 0.5, 2 and 3 bps/Hz per MIMO layer. It is observed that all channel models have similar error performance for the same packet format. The maximum difference between the required effective C/I's corresponding to the same FER and rank over different channel modules are shown to be within 0.1 dB. The maximum difference between the required effective C/I's corresponding to the same

FER and different ranks are shown to be within 0.5 dB. The insensitivity of the effective C/I metric to channel models is a validation of the capacity based approach for link to system interface.

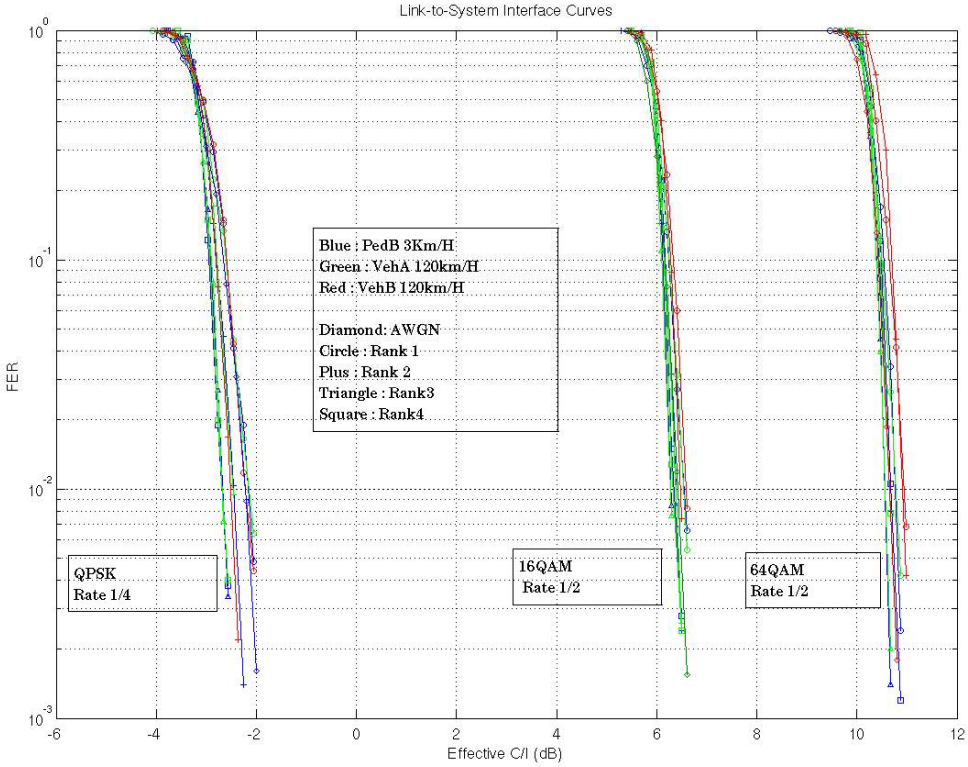


**Figure 1-1 FER vs. effective SNR for different packet format, rank and channel models in a MIMO single codeword setup with 4 Tx and 4 Rx.**

The FER vs. EbN0 curves over AWGN channels are shown in Appendix C and Appendix D for FL and RL packet formats, respectively. Note that effective C/I and C/I are equivalent for AWGN channel. Since the link performances over different channels are insensitive to the channel model when the channel knowledge is available, only AWGN performance is shown. EbN0 instead of C/I is used for performance comparison to further illustrate coding gain due to incremental redundancy HARQ.

When channel estimation algorithms are implemented in link level simulations, the loss due to channel estimation error is observed to be a backoff of the FER vs. effective C/I curves.

## 1.2 FER versus Average SINR

The FER versus average SINR performance for a set of packet formats are shown in Figure 1-2**Error! Reference source not found.** to Figure 1-5**Error! Reference source not found.** for Ped B 3 km/h, Veh A 120 km/h and Veh B 120 km/h, where simulations model actual channel estimation. The interference variation is modeled according to the FL interference observed in system level simulations.**Error! Reference source not found.**

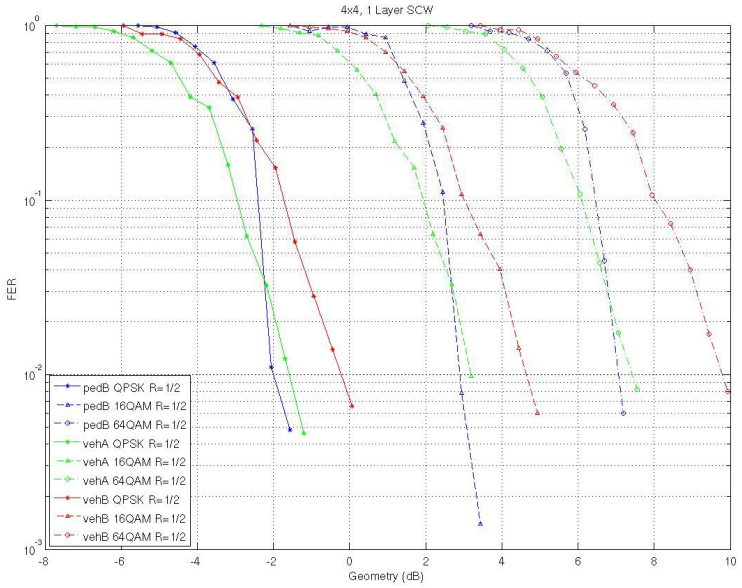


**Figure 1-2 FER versus average SNR performance with channel estimation error for packet formats with spectral efficiency from 1 bps/Hz to 3 bps/Hz. MIMO configuration is 4 Tx 4 Rx with 1 layer transmission.**

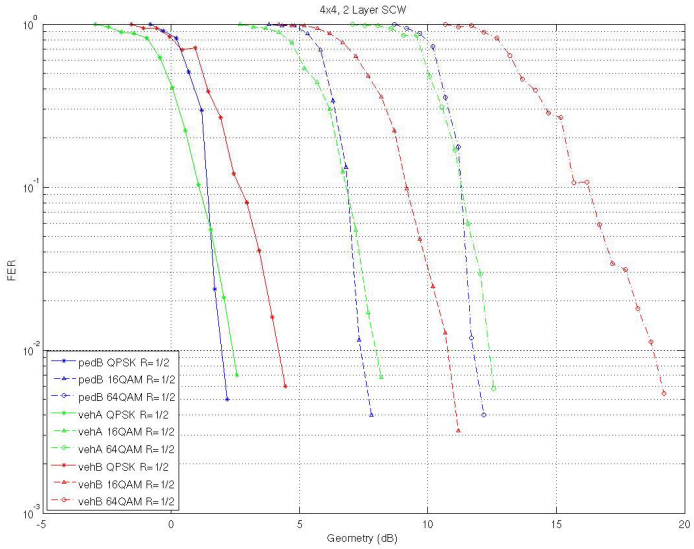


**Figure 1-3 FER versus average SNR performance for packet formats with spectral efficiency from 1 bps/Hz to 3 bps/Hz. MIMO configuration is 4 Tx 4 Rx with 2 layers transmission.**

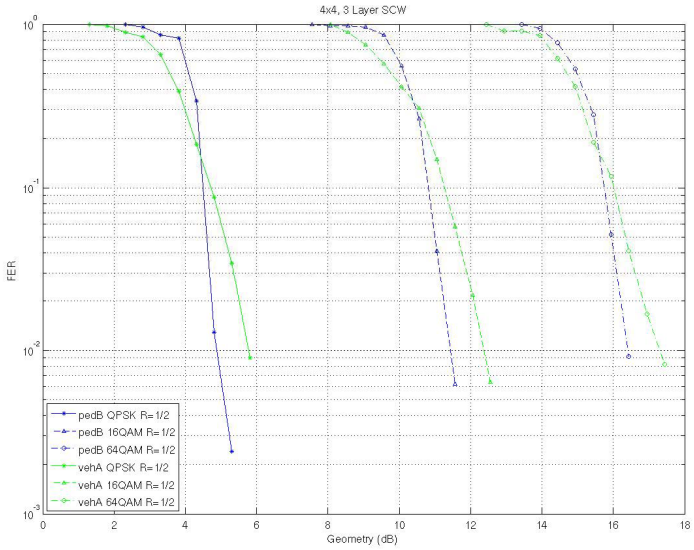


**Figure 1-4 FER versus average SNR performance for packet formats with spectral efficiency from 1 bps/Hz to 3 bps/Hz. MIMO configuration is 4 Tx 4 Rx with 3 layers transmission**

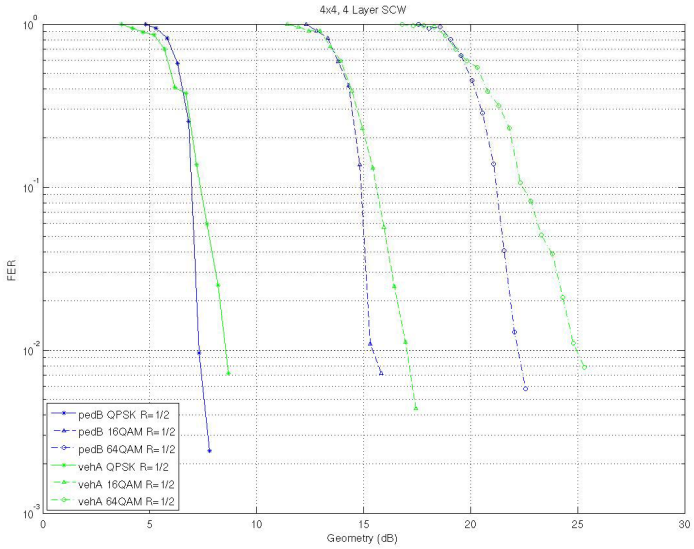


**Figure 1-5 FER versus average SNR performance for packet formats with spectral efficiency from 1 bps/Hz to 3 bps/Hz. MIMO configuration is 4 Tx 4 Rx with 4 layers transmission**

## 1.3 System Level Simulation

### 1.3.1 Location Calibration

Deterministic mobile locations, which are specified in the evaluation criteria document [1], are used in our system simulation calibration. In Appendix E, we append the achieved long term C/I per antenna for all mobiles that are specified in [1]. Each mobile's C/I is determined by the mobile location and a random shadowing realization between the mobile and all sectors in the system. In Figure 1-6, the CDF of the C/I values listed in Appendix E is compared with the C/I distribution obtained from other experiments. It is observed that the locations provided by the Evaluation Criteria is optimistic and results in up to 2.5 dB better C/I compared to C/I generated from 30 random drops of 570 users.

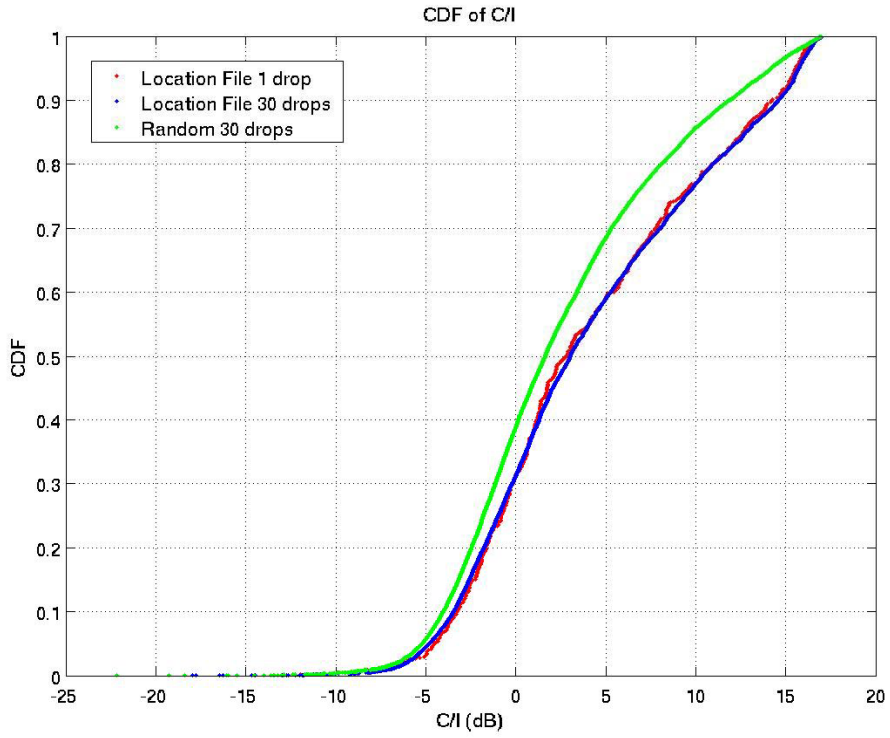


**Figure 1-6 CDF of C/I distributions for fixed mobile locations and randomly generated mobile locations**

### 1.3.2 Traffic Model Calibration

We implemented the HTTP, FTP, NRTV, and VOIP traffic models, and instrumented each model to log the completion of every significant event in the model. Data transfers were logged, as were delays (such as think time) introduced by the models, and object sizes.

A simulation topology was set up with 7 cells (21 sectors, 210 users) and wrap-around, and a PedB channel model. Although these parameters had no effect on the measured simulation results, we list them anyway to emphasize that verification was performed with a "real" simulation. The simulation time for HTTP, NRTV, and FTP was 80 minutes per run (3 runs total.). The simulation time for VOIP was 30 seconds with 700 users. In addition, all 4 models were run together in a 5th simulation, without

significantly different results. The simulation parameters specified by the 802.20 Evaluation Criteria document are depicted in Table 1-1. A post processing script analyzed the output logs from each simulation. The post-processing script extracted the mean, variance, and number of trials for all simulations. The difference between the expected mean (from the 802.20 spec) and the actual mean (from our simulation) is listed in the last column of this table, in the "Error %" column. As can be seen, the error is less than 2.2% for all simulation parameters.

**Table 1-1 Traffic Model Parameter Verification**

| Traffic Model | Table/ Ref. | Variable | Params | Mean | Stddev | Measured Mean | Samples | Error % |
|---|---|---|---|---|---|---|---|---|
| **HTTP** | **Logfile = http_10_16_061935.txt, 80 minutes** | | | | | | | |
| Main object size (bytes) | 2 | Truncated Lognormal | $\sigma = 1.37$, $\mu = 8.35$ | 10710 | 25032 | 10753.5 | 21391 | 0.4% |
| Embedded object size (bytes) | 2 | Truncated Lognormal | $\sigma = 2.36$, $\mu = 6.17$ | 7758 | 126168 | 7728.4 | 120135 | 0.4% |
| No. of embedded objects | 2 | Truncated Pareto - shifted by -2 | $\alpha = 1.1$, $\kappa = 2$ | 5.64 | - | 5.62 | 21391 | 0.4% |
| Reading time | 2 | Exponential | $\lambda = 0.033$ | 30 sec | 30 secs | 29.758 (**) | 21391 | 0.8% |
| Parsing time | 2 | Exponential | $\lambda = 7.69$ | 0.13 sec | 0.13 sec | 0.1302 (**) | 21391 | 0.2% |
| **FTP** | **Logfile = ftp_10_21_102148.txt, 80 minutes** | | | | | | | |
| File Size | 3 | Truncated Lognormal | $\sigma = 0.35$, $\mu = 14.45$ | 2.0 MB | 0.722 MB | 2043245 | 387 | 2.2% |
| Reading Time | 3 | Exponential | $\lambda = 0.00555$ | 180 sec | 180 sec | 181.2 (**) | 387 | 0.7% |
| **NRT Video** | **Logfile = nrtv_10_17_121904.txt, 80 minutes** | | | | | | | |
| Inter Arrival | 4 | Fixed | | 100 ms | 0 | 100.1 ms(**) | 12062 | 0.1% |
| Packets per frame | 4 | Fixed | | 8 | 0 | 8 | 12062 | 0% |
| Packet size (bytes) | 4 | Truncated Pareto | $\alpha = 1.2$, $\kappa = 20$ | 100 | - | 102.0 | 12062 | 2.0% |
| Inter arrival | 4 | Truncated Pareto | $\alpha = 1.2$, $\kappa = 2.5$ | 6 ms | - | 5.933 ms(**) | 12062 | 1.3% |
| **VOIP** | **Logfile = voice_10_17_121904.txt, 30 seconds** | | | | | | | |
| Packet Size (bytes) | G.729 | Fixed | | 10 | 0 | 10 | 2095785 | 0% |
| Packet Header (bytes) | §4.3.5 | Fixed | | 4 | 0 | 4 | 2095785 | 0% |
| G.729A Period | G.729 | Fixed | | 10 ms | 0 | 10.00 ms | 2095785 | 0% |
| Domestic Calls (%) | 11 | Fixed | | 80% | 0 | 78..9% | 700 | 1.4% |
| Backhaul Domestic | 10, 11 | Gamma shifted by +7.5 | $\alpha=1$, $\beta=2.5$ | 10 ms | - | 10.00 ms | 2095785 | 0% |
| Backhaul International | 10, 11 | Gamma shifted by +107.5 | $\alpha=1$, $\beta=2.5$ | 110 ms | - | 110.0 ms | 2095785 | 0% |

(**) statistic has been adjusted to account for discrete time steps in simulation time.

In the following figures, we plot the CDF of statistics from the traffic model as mandated by the Evaluation Criteria.

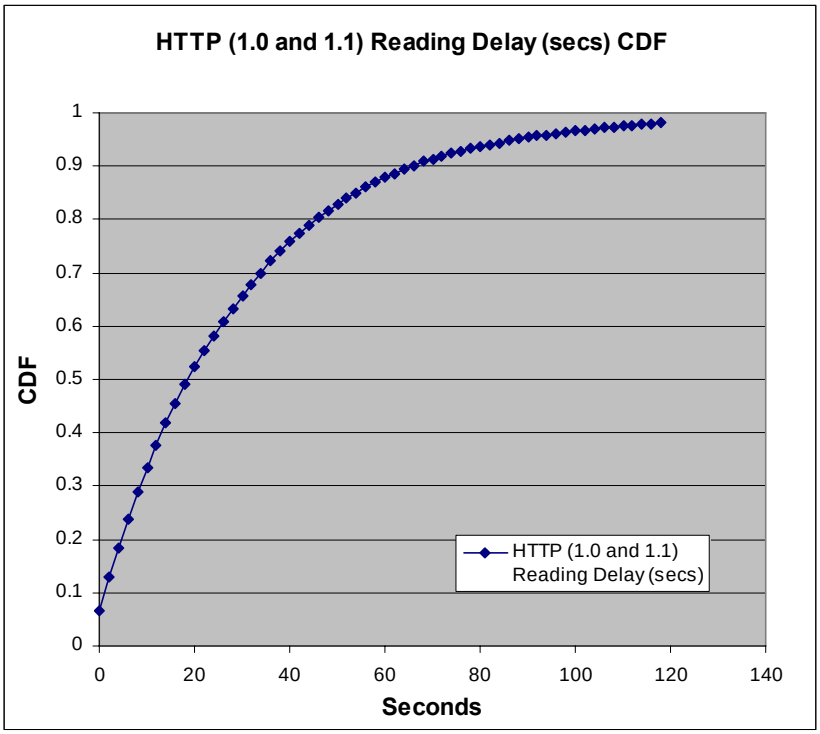


**Figure 1-7 HTTP (1.0 and 1.1) reading delay CDF**

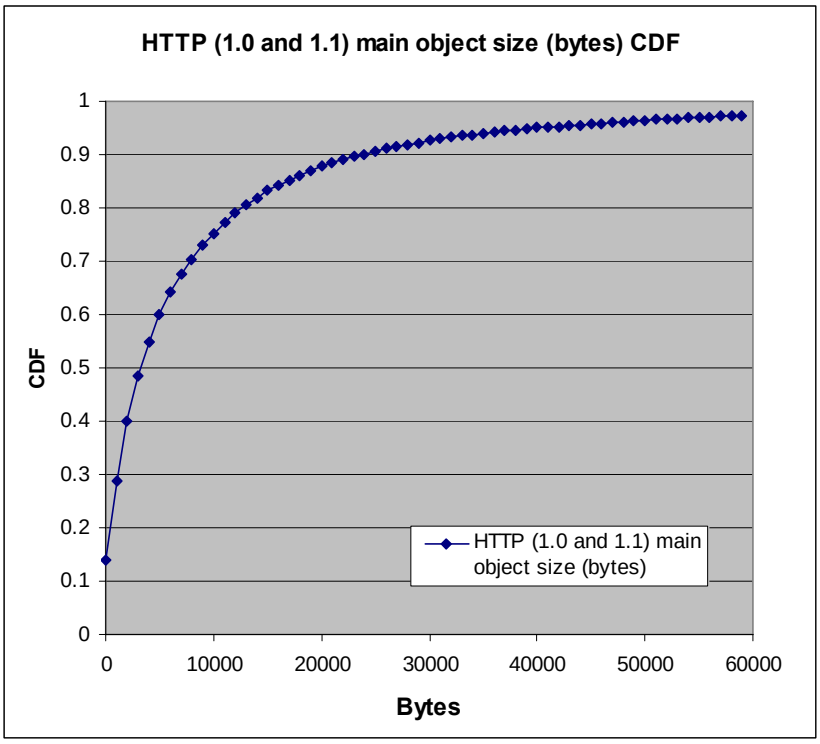


**Figure 1-8 HTTP (1.0 and 1.1) main object size CDF**

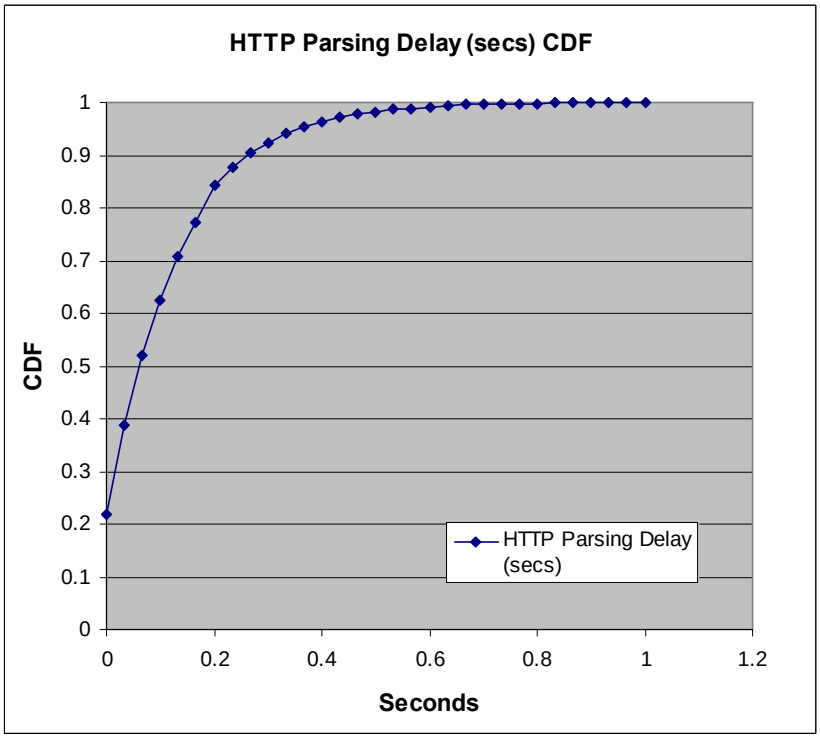


**Figure 1-9 HTTP parsing delay CDF**

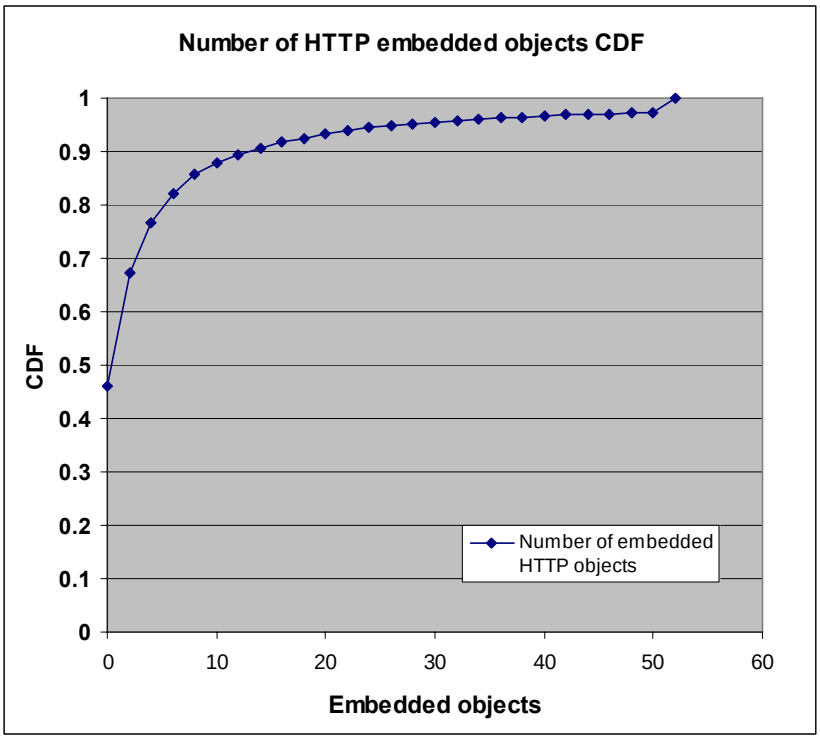


**Figure 1-10 Number of HTTP embedded objects CDF**

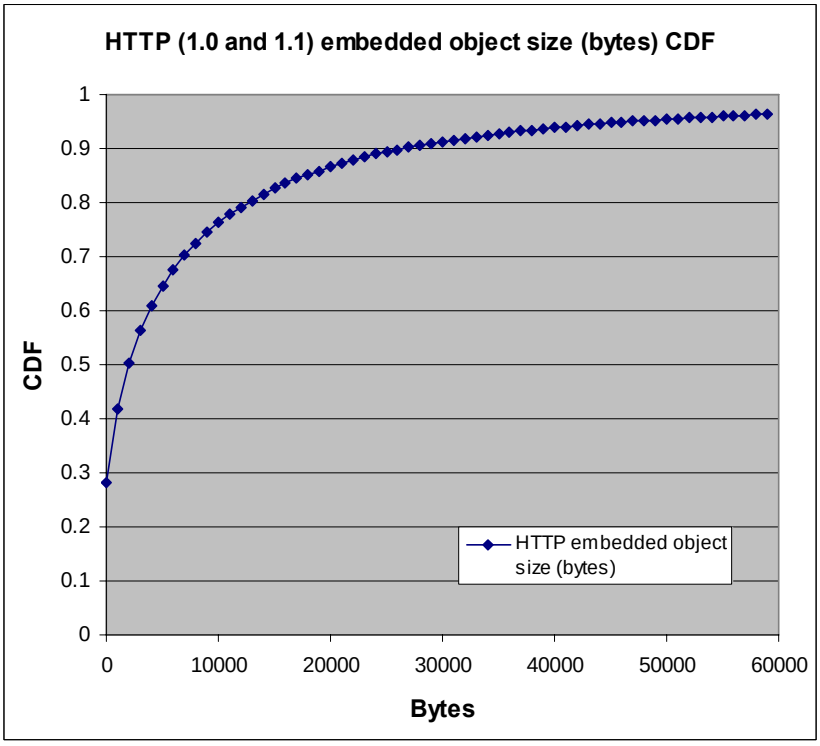


**Figure 1-11 HTTP (1.0 and 1.1) embedded object size CDF**

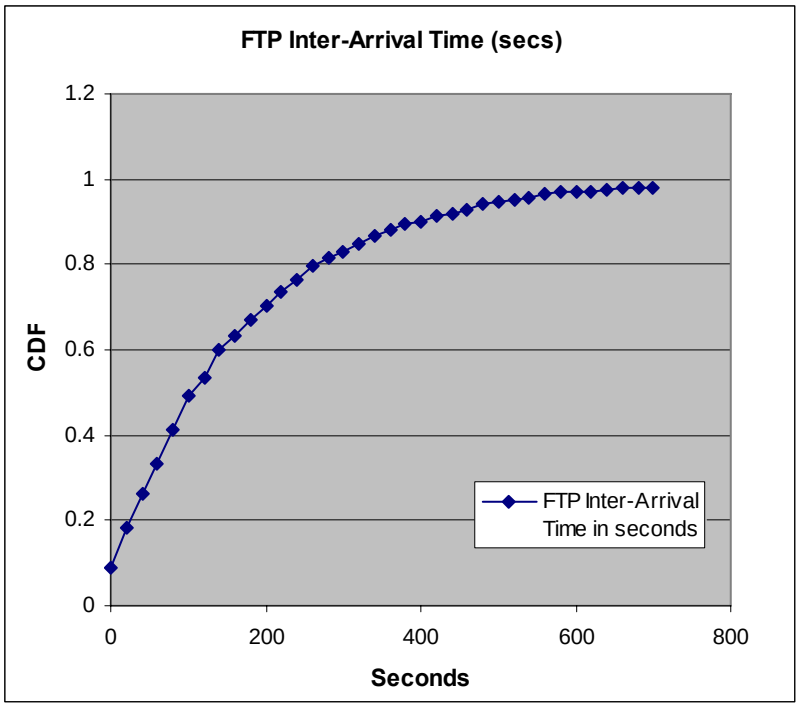


**Figure 1-12 FTP inter-arrival time CDF**

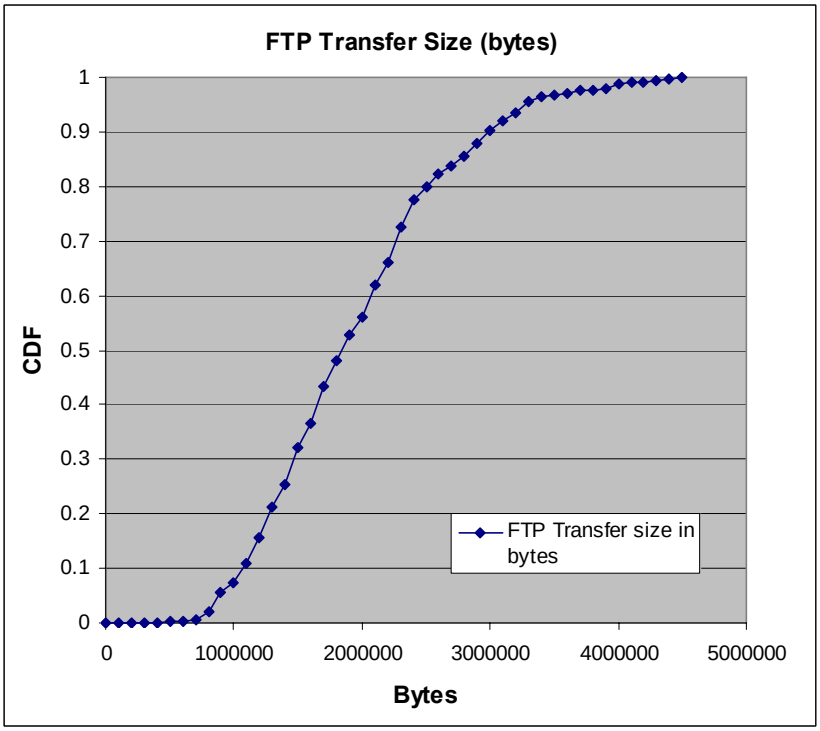


**Figure 1-13 FTP transfer size CDF**

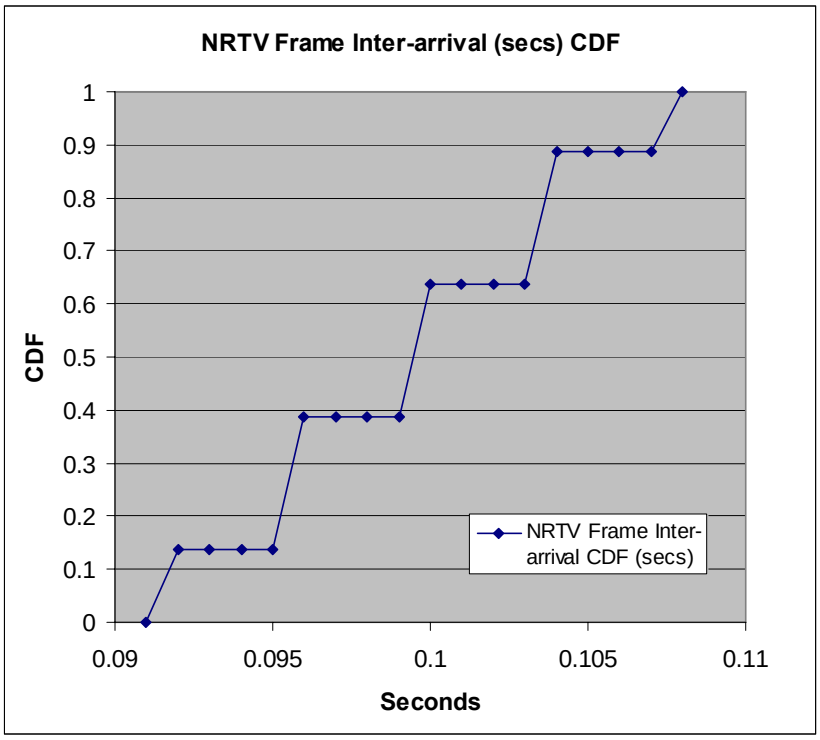


**Figure 1-14 NRTV frame inter-arrival time CDF**

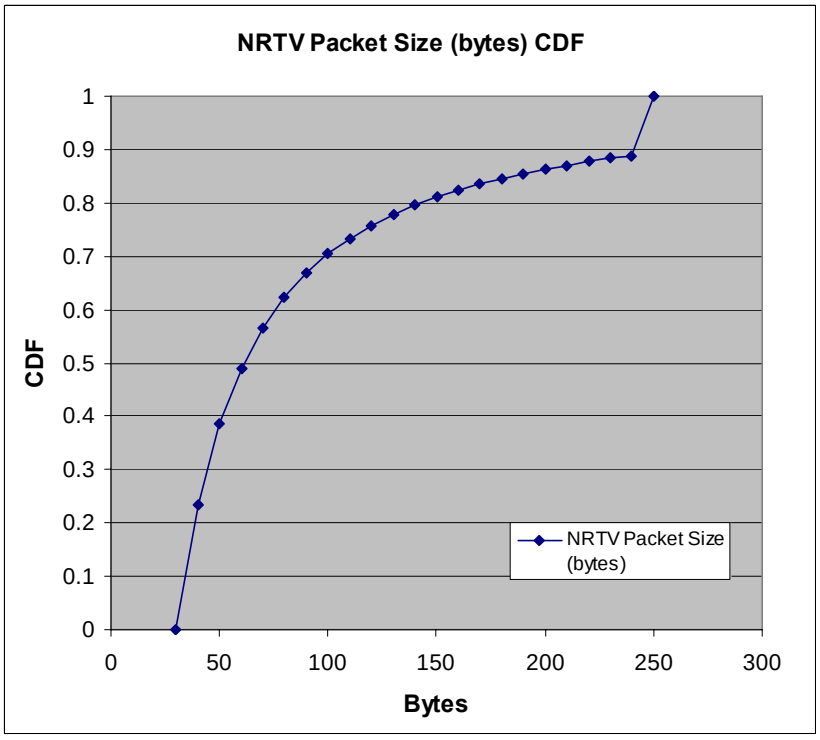


**Figure 1-15 NRTV packet size CDF**

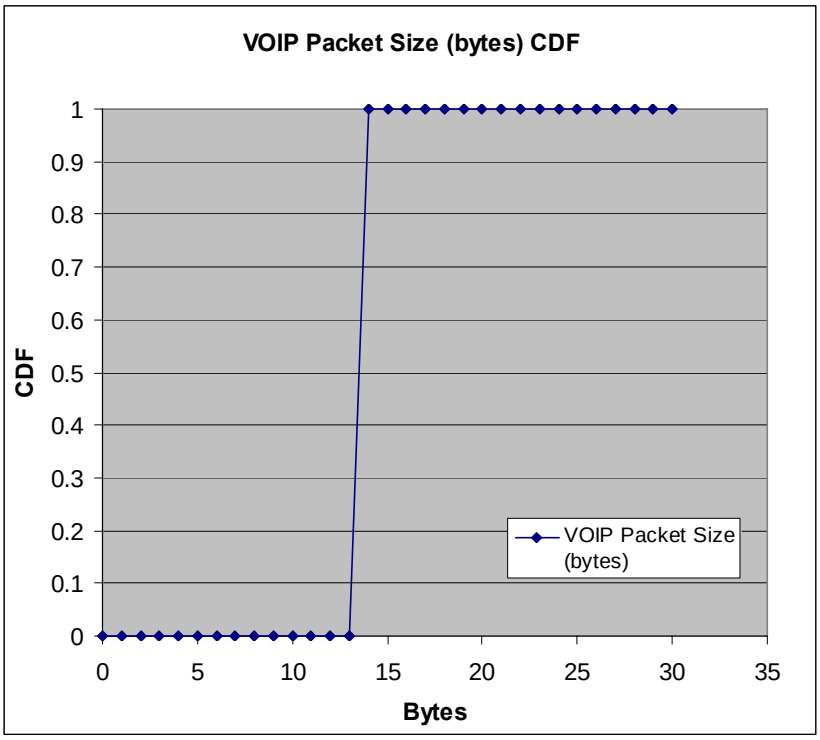


**Figure 1-16 VoIP packet size CDF**

### 1.3.3 Overhead Channel Modeling

Overhead channels are taken into account in the system simulation by taking a conservative estimate of fixed overhead. In a 10 MHz system, the forward link throughput is scaled down by 10% to model the F-SSCH overhead, which in reality takes 10% bandwidth overhead and less than 10% power overhead for all simulation scenarios in this report. This assumption is justified by the maximum assignment and acknowledgement activities for the simulated scenarios. The reverse link control channel transmitted on the CDMA control segment is assumed to take 4% overhead. As shown in Section3.2.1, the CDMA control segment loading is very low for all the simulation scenarios in this report. The reverse link ACK/NAK channels are assumed to take 7% overhead.

#### 1.3.3.1 Forward Link Overhead Channel Interference and Errors

For all the simulation scenarios in this report, the average PSD of F-SSCH is designed to be lower than or equal to data channel PSD. However, the interference from the F-SSCH to other sector data transmission on forward link is modeled conservatively by simulating 100% data transmissions in each sector.

F-SSCH assignment errors and acknowledgement errors have minimal impact on full buffer simulations since the error rate is designed to be 1% for the scenarios simulated in this report. Our simulations target a confidence interval of 90-95%, where 1% error events do not need to be modeled. Errors on bits transmitted on the FL for controlling RL transmission power are modeled at 10%. Errors on the OSICH are modeled with geometry based link curves.

#### 1.3.3.2 Reverse Link Overhead Channel Interference and Error

For all the simulation scenarios in this report, the average PSD of reverse link ACK/NAK channel is designed to be lower than or equal to data channel PSD. However, the interference level from the ACK/NAK to other sector data transmission on reverse link is modeled conservatively by simulating 100% data transmissions in each sector. The reverse link CDMA control segments are orthogonal to data transmission, hence no interference need to be modeled.

Reverse link ACK to NAK and NAK to ACK error probabilities are designed to have minimal impact on packet errors, hence are not modeled for forward link full buffer simulations. R-CQICH erasure is modeled as 50% in forward link simulations. This assumption is validated by reverse link control channel power control simulations in Section 3.2.1, which demonstrate a tight R-CQICH erasure performance. REQ erasure is not modeled for full buffer simulations, since it only affects latency which is not evaluated for full buffer traffic.

## 1.4 MIMO Channel Modeling for Simulations

The channel spatial correlation matrices (transmit or receive) depend on three parameters: angle of arrival (AoA) and/or angle of departure (AoD), angle spread (AS), and the antenna spacing. The channel modeling document specifies several spatial channel models that use different combinations of these parameters. In addition the channel modeling document specifies that these channels are to be generated using the correlation matrix approach (see the channel modeling document for details). In our simulations, correlation matrices for link level simulation are generated using both SCM model and the analytical approach specified in [3]. Correlation matrices for system level simulations are generated using the SCM model.

### 1.4.1 MIMO Channels for Link Level Simulations

The channel models considered for link level simulations are suburban macro cell with 20 and 50 degree AoA at the BS and 67.5 degree AoA at the MS. The analytical correlation model specified in [1] assumes the same AoD/AoA for all paths and the angular spread follows Laplacian distribution. The correlation matrices used for link level simulation are listed in Appendix A. Also listed in Appendix A are the correlation matrices generated from SCM scattering model.

The robustness of the proposed system is tested for multi-path profiles and mobile speeds as checked in Table 1-2.

**Table 1-2 Multipath profile and speed for link level simulations**

| | 3 km/h | 120 km/h | 250 km/h |
|---|---|---|---|
| Case-II: Vehicular A | | X | X |
| Case-III: Pedestrian B | X | | |
| Case-IV: Vehicular B | | X | X |

### 1.4.2 MIMO Channels for System Level Simulations

In system simulations, transmitter correlation matrices are generated using the SCM suburban macro channel model in the following way:

1. All possible AoDs over the whole azimuth are quantized into 36 bins of $10^o$. All AoDs fall in one bin are mapped into one angle (mean angle of the corresponding bin)

2. For any give bin and antenna spacing, use the SCM model with the same parameters to generate a large number of channel realizations.

3. Use these channel realizations to estimate the corresponding correlation matrix.

4. Estimated correlation matrices are then stored in a look-up table that is indexed by the tuple: AoD and antenna spacing.

In a given drop, each user in that drop will have a specific AoD. This AoD will be mapped to one of the 36 quantized angles. For any user in that drop, his transmitter correlation matrix is selected based on his AoD and antenna spacing and then used to generate his corresponding channel using the correlation matrix approach.

Unlike the transmitter correlation matrices, the receiver correlation matrices are not clustered into AoA bins. Instead, one correlation matrix is computed for each SCM model and antenna configuration by averaging the receiver correlation of a large number of channel realizations from mobiles with arbitrary AoA. This assumption is justified by the fact that the mobile antenna array orientation and AoA could change significantly within the simulation time.

See Appendices A and B for a list of correlation matrices used.

# 2 PAR Requirement

In Table 2-1, we included the PAR values specified in the approved IEEE 802.20 PAR and the corresponding values of Proposed TDD MBWA system for 10 MHz deployment.

**Table 2-1 Spectral Efficiency Requirements**

| Characteristic | Target Value | Proposal MBWA System |
|---|---|---|
| Mobility | Vehicular mobility classes up to 250 km/hr (as defined in ITU-R M.1034-1) | Satisfies requirement.<br>Maximum Spectral Efficiency for VehA 250 km/h on FL and RL are around 7 bps/Hz and 2.5 bps/Hz, respectively. |
| Sustained spectral efficiency | > 1 b/s/Hz/cell | Satisfies requirement.<br>> 2b/s/Hz/Sector on FL (pedestrian)<br>> 1b/s/Hz/Sector on RL (pedestrian)<br>Refer to Section 4.3 |
| Peak user data rate (Forward link (FL)) | > 1 Mbps* | Satisfies requirement.<br>63 Mbps<br>Refer to Section 4.2 |
| Peak user data rate (Reverse link (RL)) | > 300 kbps* | Satisfies requirement.<br>15 Mbps<br>Refer to Section 4.2 |
| Peak aggregate data rate per cell (FL) | > 4 Mbps* | Satisfies requirement.<br>63 Mbps / Sector |
| Peak aggregate data rate per cell (RL) | > 800 kbps* | Satisfies requirement.<br>45 Mbps / Sector<br>Achieved by multiplexing 3 users using quasi-orthogonal reverse link (QORL), where each of the user achieves 15 Mbps peak rate. Refer to Whitepaper |
| Airlink MAC frame RTT | < 10 ms | Satisfies requirement.<br>Approximately 5.5 ms |
| Bandwidth | e.g., 1.25 MHz, 5 MHz | Support different bandwidths from 5MHz to 20MHz. |
| Cell Sizes | Appropriate for ubiquitous metropolitan area networks and capable of reusing existing infrastructure. | Satisfies requirement. Refer to link budget tables in Section 3.5. |
| Spectrum (Maximum operating frequency) | < 3.5 GHz | Satisfies requirement. |

| Characteristic | Target Value | Proposal MBWA System |
|---|---|---|
| Spectrum (Frequency Arrangements) | Supports FDD (Frequency Division Duplexing) and TDD (Time Division Duplexing) frequency arrangements | Satisfies requirement. |
| Spectrum Allocations | Licensed spectrum allocated to the mobile service | Satisfies requirement. |
| Security Support | AES (Advanced Encryption Standard) | Satisfies requirement. Refer to Section 5.6 of [5]. |

* Targets for 1.25 MHz channel bandwidth. This represents 2 x 1.25 MHz (paired) channels for FDD and a 2.5 MHz (unpaired) channel for TDD. For other bandwidths, the data rates may change.

# 3 PHY/RF Level Performance

## 3.1 Link Adaptation

The proposed system employs link adaptation on both forward link and reverse link. There are 15 packet formats for forward and reverse link transmissions as shown in Table 3-1 and Table 3-2. The FER vs. EbN0 curves over AWGN channels are shown in Appendix C and Appendix D for FL and RL packet formats, respectively.

**Table 3-1 Forward link packet formats.**

| Packet Format Index | Spectral efficiency on 1st trans-mission | Max number of trans-missions | Modulation order for each transmission | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 |
| 0 | 0.2 | 6 | 2 | 2 | 2 | 2 | 2 | 2 |
| 1 | 0.5 | 6 | 2 | 2 | 2 | 2 | 2 | 2 |
| 2 | 1.0 | 6 | 2 | 2 | 2 | 2 | 2 | 2 |
| 3 | 1.5 | 6 | 3 | 2 | 2 | 2 | 2 | 2 |
| 4 | 2.0 | 6 | 4 | 3 | 3 | 3 | 3 | 3 |
| 5 | 2.5 | 6 | 6 | 4 | 4 | 4 | 4 | 4 |
| 6 | 3.0 | 6 | 6 | 4 | 4 | 4 | 4 | 4 |
| 7 | 4.0 | 6 | 6 | 6 | 4 | 4 | 4 | 4 |
| 8 | 5.0 | 6 | 6 | 6 | 4 | 4 | 4 | 4 |
| 9 | 6.0 | 6 | 6 | 6 | 4 | 4 | 4 | 4 |
| 10 | 7.0 | 6 | 6 | 6 | 4 | 4 | 4 | 4 |
| 11 | 8.0 | 6 | 6 | 6 | 6 | 4 | 4 | 4 |
| 12 | 9.0 | 6 | 6 | 6 | 6 | 4 | 4 | 4 |
| 13 | 10.0 | 6 | 6 | 6 | 6 | 6 | 4 | 4 |
| 14 | 11.0 | 6 | 6 | 6 | 6 | 6 | 4 | 4 |
| 15 | NULL | | | | | | | |

**Table 3-2 Reverse link packet formats**

| Packet format index | Spectral efficiency on 1st transmission | Max number of transmissions | Modulation order for each transmission | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 |
| 0 | 0.25 | 6 | 2 | 2 | 2 | 2 | 2 | 2 |
| 1 | 0.50 | 6 | 2 | 2 | 2 | 2 | 2 | 2 |
| 2 | 1.0 | 6 | 2 | 2 | 2 | 2 | 2 | 2 |
| 3 | 1.5 | 6 | 3 | 2 | 2 | 2 | 2 | 2 |
| 4 | 2.0 | 6 | 3 | 3 | 2 | 2 | 2 | 2 |
| 5 | 2.67 | 6 | 4 | 4 | 3 | 3 | 3 | 3 |
| 6 | 4.0 | 6 | 4 | 4 | 3 | 3 | 3 | 3 |
| 7 | 6.0 | 6 | 4 | 4 | 4 | 3 | 3 | 3 |
| 8 | 8.0 | 6 | 4 | 4 | 4 | 4 | 4 | 3 |
| 9 | 4.0 | 6 | 6 | 6 | 4 | 4 | 4 | 4 |
| 10 | 5.0 | 6 | 6 | 6 | 4 | 4 | 4 | 4 |
| 11 | 6.0 | 6 | 6 | 6 | 4 | 4 | 4 | 4 |
| 12 | 7.0 | 6 | 6 | 6 | 4 | 4 | 4 | 4 |
| 13 | 8.0 | 6 | 6 | 6 | 6 | 4 | 4 | 4 |
| 14 | 9.0 | 6 | 6 | 6 | 6 | 4 | 4 | 4 |

## 3.2 Power Control

### 3.2.1 Reverse Link Control Channel Power Control

The reverse link control channel power control is based on the R-CQICH channel erasures. The R-CQICH channel is part of the CDMA control segment which is TDM/FDM multiplexed with the traffic channels. Target error rate on the R-CQICH is 0.1%. By sending up commands when the R-CQICH channel is erased, and down commands otherwise, a R-CQICH erasure rate of 0.5 is targeted. The AT only responds to the up/down power control commands received from the RL serving sector, by increasing the R-CQICH channel PSD by .25 dB in response to an up command, and decreasing the R-CQICH channel PSD by .25 dB in response to a down command. In this section we present numerical results demonstrating the effectiveness of the proposed power control algorithm.

Figure 3-1 shows the trace of the R-CQICH erasure rate for one mobile. As we see, after the initial transient period, the erasure rate has converged to the target value of 50%.

Figure 3-2 shows the distribution of the resulting ratio of the total received PSD to the thermal noise PSD, also called RoT, for different numbers of receive antennas and mobiles per sector, obtained from system simulations for Pedestrian B channel at 3 Km/h. As we see in this figure, since the control channel power control algorithm is effectively controlling the control C/I value of each user, the resulting RoT value depends on the number of mobiles per sector. Furthermore, since the target C/I values are different for different numbers of receive antennas, the resulting RoT value also depends on the number of receive antennas.

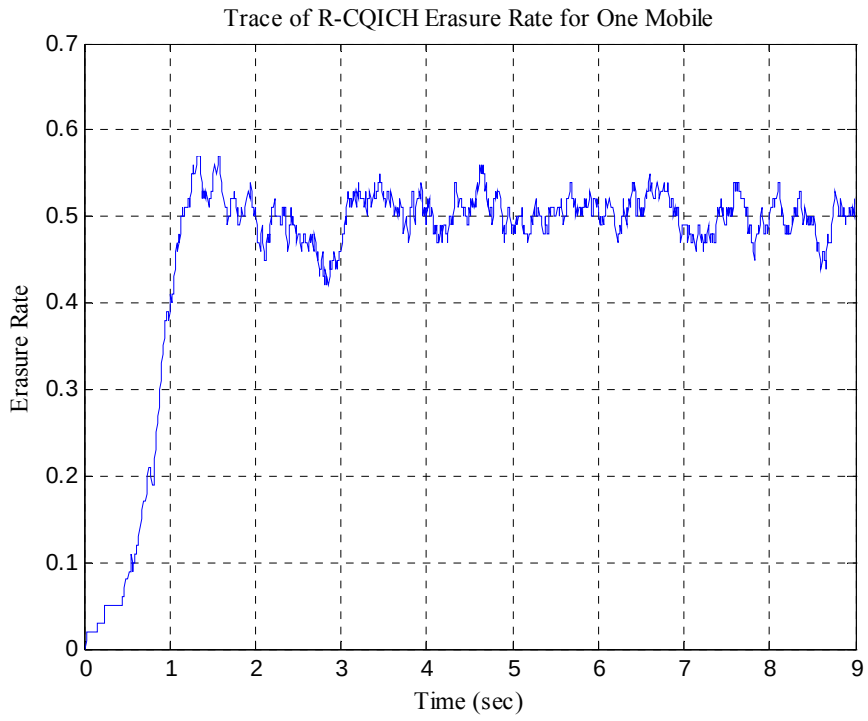


**Figure 3-1 Trace of R-CQICH erasure rate for one mobile**

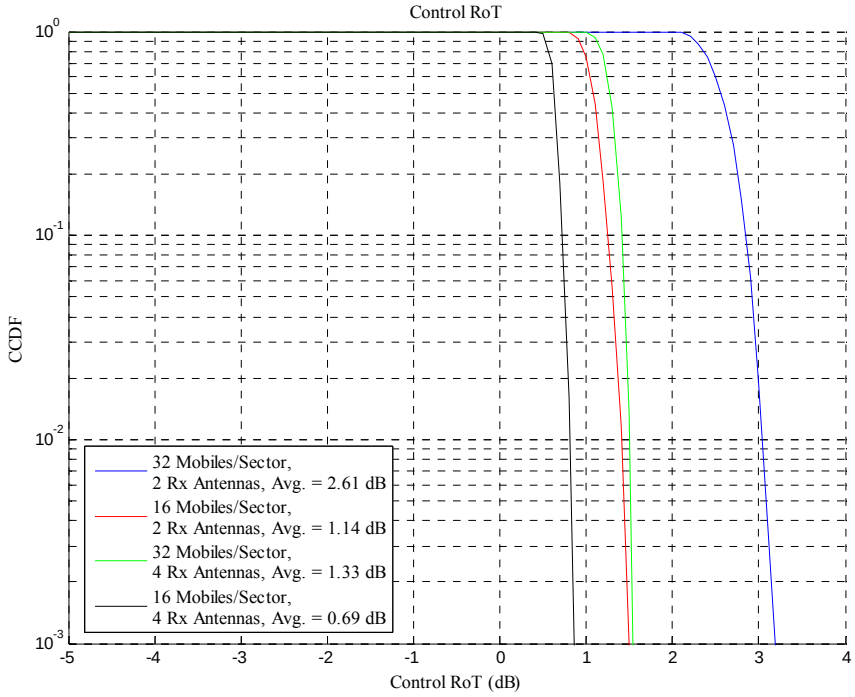


**Figure 3-2 Control Channel RoT Distribution**

### 3.2.2 Reverse Link Traffic Channel Power Control

The reverse link traffic channel power control is based on inter-sector interference control. Each sector broadcasts a three-level indication of the amount of interference it is receiving from the mobiles in the other sectors. The inter-sector interference indication is set based on a target value for the total interference and noise to thermal ratio (IoT). Each mobile monitors this indication from the neighboring sectors, and only responds to the indication broadcast from a non-serving sector that has the largest forward link channel gain to that mobile. Based on the value of this indication, the mobile increases or decreases the value of a parameter called delta, which is in turn used as an offset to set the traffic channel PSD with respect to the control channel (R-CQICH). A minimum and a maximum value (called delta_min and delta_max) are used to limit the range of the values for delta, and control the amount of ICI in high Doppler scenarios.

Figure 3-3 shows the distributions of IoT for 32 mobiles per sector and different cell radii and different IoT target values. The error rate on the inter-sector interference indications are modeled using the link-level performance curves. As we see, the target IoT is achieved on the average, with the 1% tail of the IoT distributions being only 1dB away from the target. The tight IoT tail distribution demonstrates the stability of the proposed power control design.

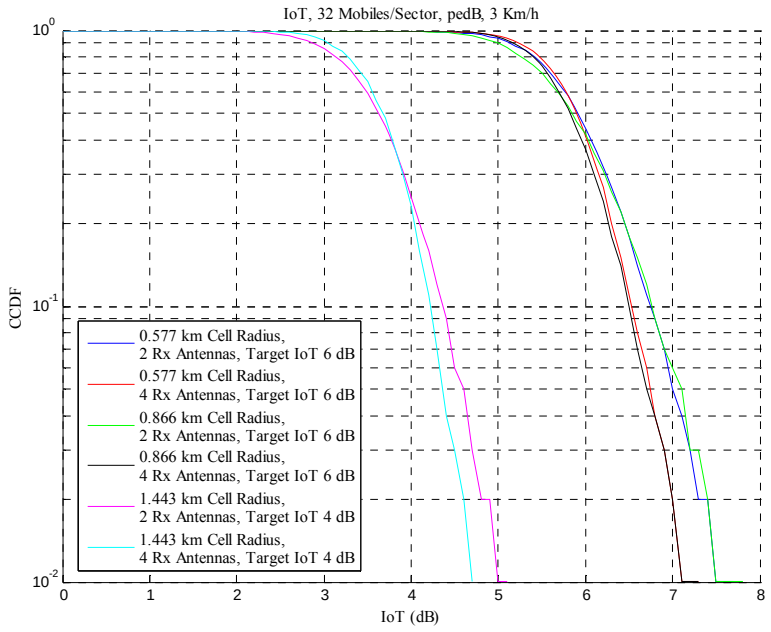


**Figure 3-3 IoT Distribution**

## 3.3 Mobility

To satisfy the requirement of "The AI shall support different rates of mobility from pedestrian (3 km/hr) to high vehicular speeds (250 km/hr)." in Section 4.1.4 of SRD, we demonstrate in the following sections robust performance under different channel speed and multipath profiles.

### 3.3.1 Forward Link Mobility Simulations

Link level simulations were carried out over different multipath profiles, Doppler spreads, and correlation models. The following simulations assume a 4x4 MIMO single codeword (SCW) design with MMSE receiver. Note that the spectral efficiency is obtained by running link simulations with adaptive rate and rank prediction, channel estimation, and HARQ with 6 maximum retransmissions. A large number of packets are simulated for each fixed geometry, i.e., long term average C/I per antenna. A certain packet format and the corresponding rank are selected based on the latest channel observations. If AT fails decoding, incremental redundancy subpackets will be transmitted until the packet decodes successfully or the maximum transmission is reached. The spectral efficiency computation takes into account the pilot overhead and residual packet errors. The interference variation is modeled according to the FL interference observed in system level simulations.**Error! Reference source not found.**

The analytical channel correlation models mandated in Section 3.7 of the channel model document [3] are used to generate the transmitter and receiver correlation matrices at the given AoD and AoA. It was observed that both the transmitter correlation and receiver correlation are very high (Appendix A). A suburban macro cell SCM model (AS 2 degree per path) is then used to calibrate the correlation matrix as stated in Section 1.4. The antenna correlation resulting from the SCM is observed to be significantly lower than the analytical model that assumes the same AoD for all paths with a Laplacian angular spread distribution (Appendix A).

The spectral efficiency curves based on the analytical correlation model are illustrated in Figure 3-4 and Figure 3-5, and the spectral efficiency curves based on the SCM model is illustrated in Figure 3-6. For all correlation models, it was observed that the spectral efficiency degrades gracefully as the mobility increases from 3 km/h to 250 km/h, where the highest spectral efficiency achieved at 250 km/h is greater than 7 bps/Hz. The MIMO throughput is observed to be notably higher with the SCM correlation model than the analytical correlation model. This is due to the high correlation of the analytical model which results in low rank channels, hence, lower spectral efficiency.

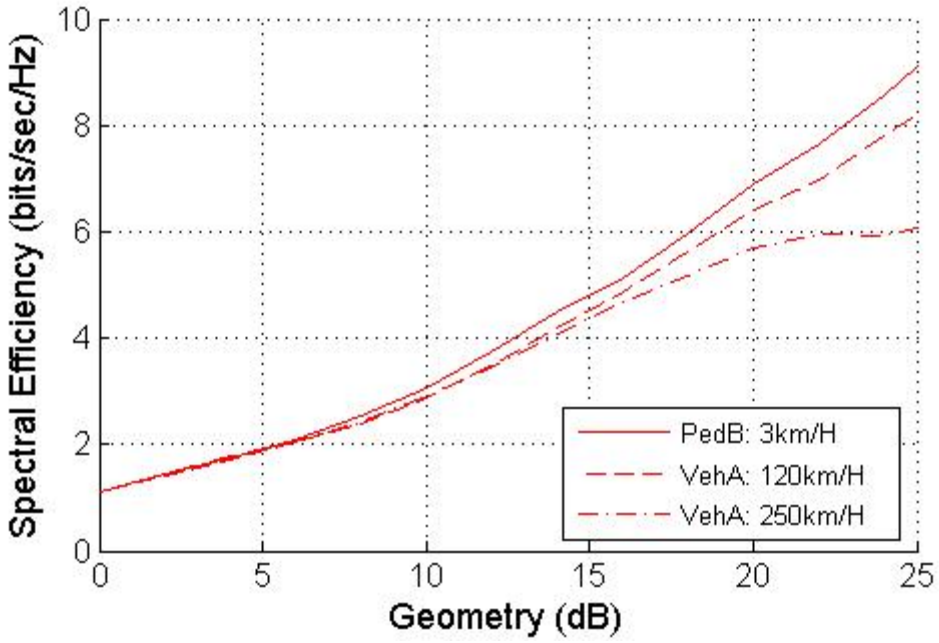


**Figure 3-4 Spectral efficiency vs. SINR SCW-MIMO 4x4 with single path Laplacian correlation model. Base station AoD 50 degree, AS 2 degree; Mobile station AoD 67.5 degree, AS 35 degree.**

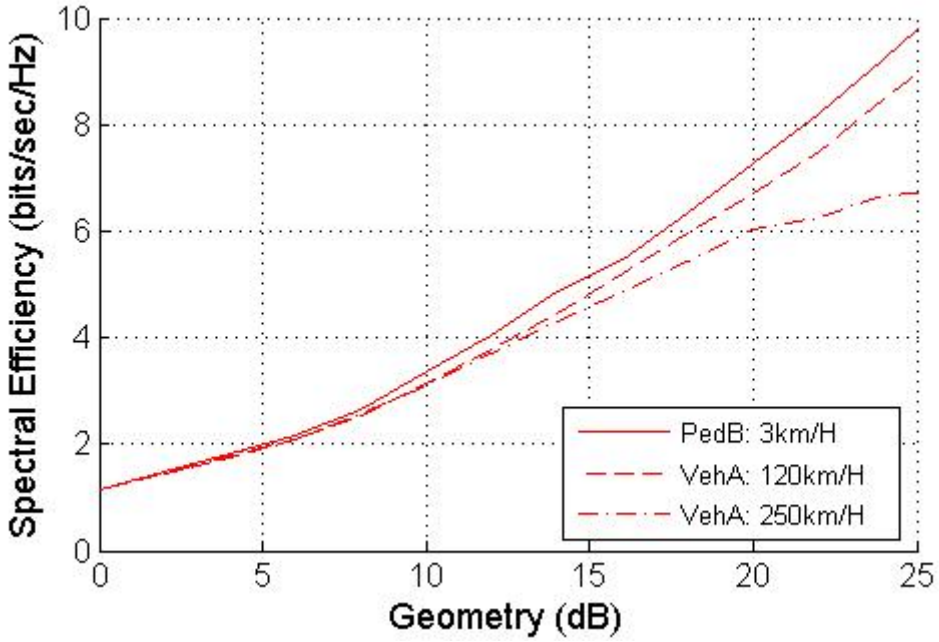


**Figure 3-5 Spectral efficiency vs. SINR SCW-MIMO 4x4 with single path Laplacian correlation model. Base station AoD 20 degree, AS 5 degree; Mobile station AoD 67.5 degree, AS 35 degree.**

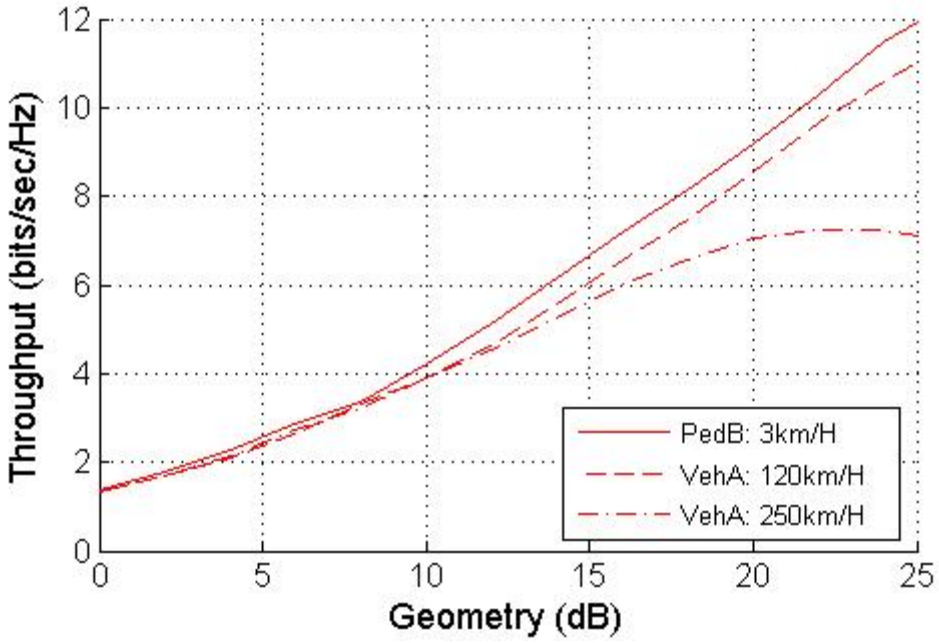


**Figure 3-6 Spectral efficiency vs. SINR SCW-MIMO 4x4 with SCM suburban macro cell correlation model. Base station AoD 50 degree, AS 2 degree; Mobile station, AS 35 degree.**

### 3.3.2 Reverse Link Mobility Simulations

Reverse link mobility sensitivity study results are presented in Figure 3-7 and Figure 3-8. RL packet formats of the desired spectral efficiencies are simulated over a range of SNR, so that an average SNR required to achieve 1% FER is obtained for each packet format. Each point in the plot is the spectral efficiency vs. the SNR for the simulated packet format, where pilot overhead is deducted from the final spectral efficiency. The interference is modeled as AWGN noise. Different curves corresponding to five different channel models. The two plots are for 2 and 4 receive antenna, respectively. Note that all link level spectral efficiency results take into account the pilot overheads.

As shown in the following figures, the link level performance degrades gracefully with mobility.

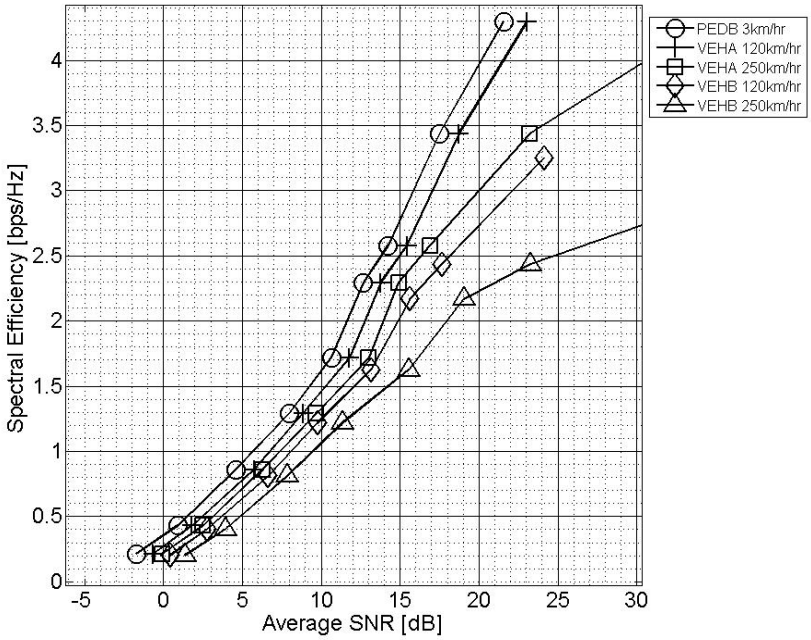


**Figure 3-7 Spectral efficiency vs. SINR with dual Rx diversity at BS**

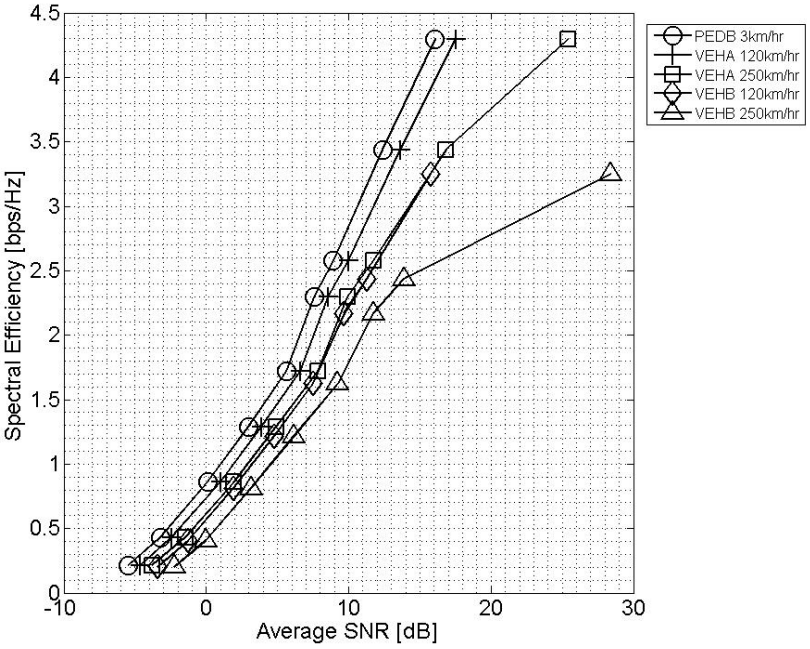


**Figure 3-8 Spectral efficiency vs. SINR with 4 Rx diversity at BS**

## 3.4 RF Specification Requirements

Figure 3-9 shows the transmit spectrum for the MBTDD downlink with 10MHz deployment. The spectrum was generated using 16 guard subcarriers at each edge of the band, and all the remaining 992 non-guard subcarriers were populated. The AM-AM and AM-PM characteristics of the power amplifier used to generate these spectra are shown in Figure 3-11 and Figure 3-12 respectively. These characteristics were measured from an implemented power amplifier. A zeroth order hold digital-to-analog convertor (DAC) was used, and the amplitude response of the low-pass filter used after the DAC is shown in Figure 3-13. An oversampling factor of 8 was used at the DAC input. The power-amplifier backoff used was 10.4 dB. A seventh order lowpass elliptic filter with a passband ripple of 0.15 dB and minimum stopband attenuation of 20 dB was implemented at the output of the power amplifier. The transition band of this filter is the band occupied by the guard subcarriers. The amplitude response of this filter is shown in Figure 3-10. The transmit spectrum meets the FCC emissions requirement.

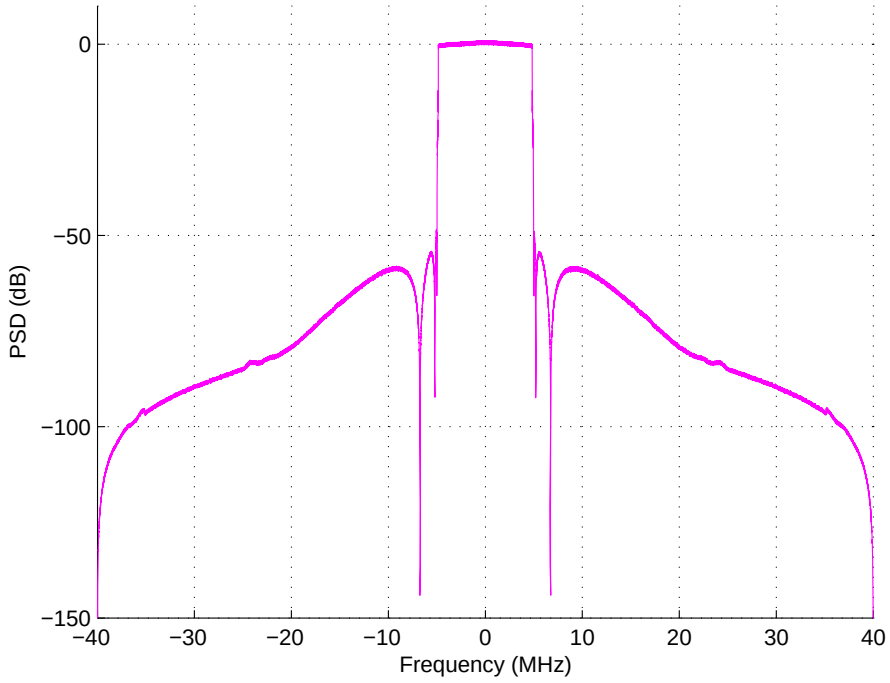


**Figure 3-9 Forward link transmit spectrum**

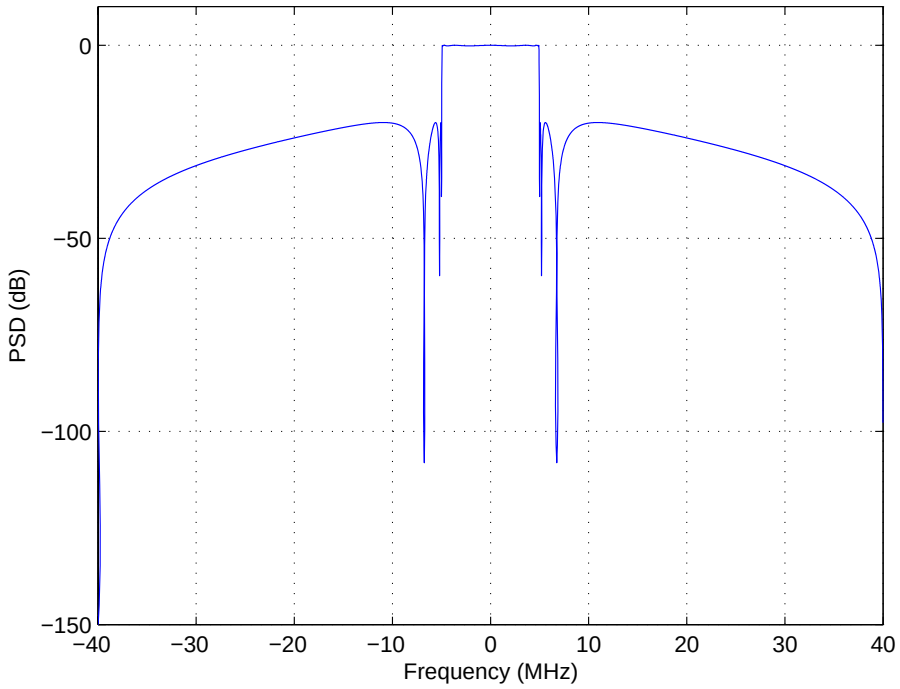


**Figure 3-10 Amplitude response of downlink post-power amplifier elliptic filter**

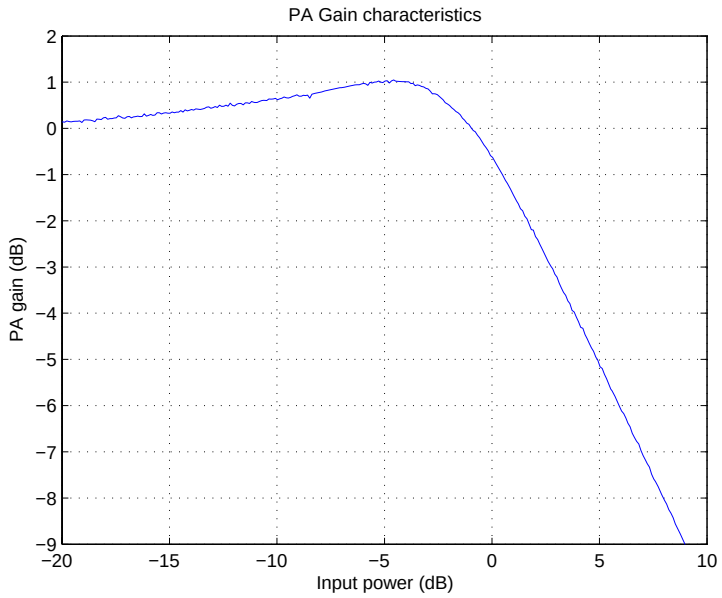


**Figure 3-11 Power Amplifier AM-AM characteristic**

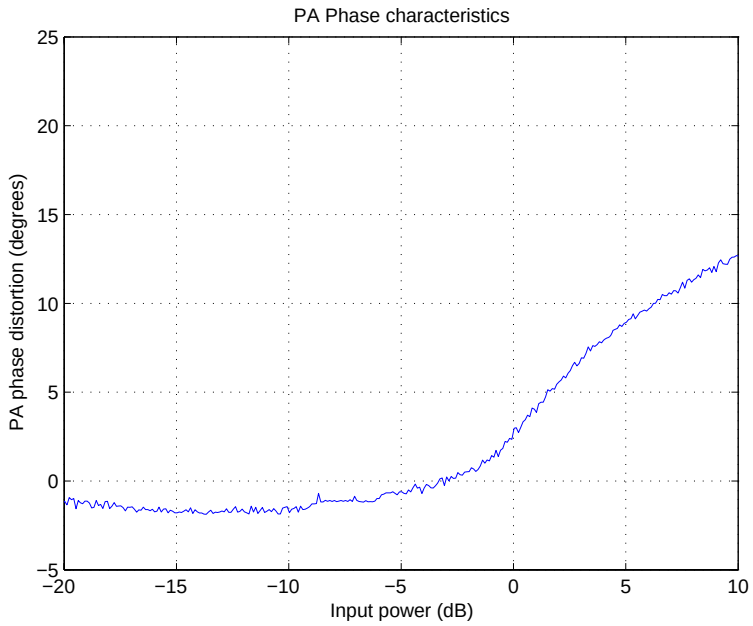


**Figure 3-12 Power Amplifier AM-PM characteristic**

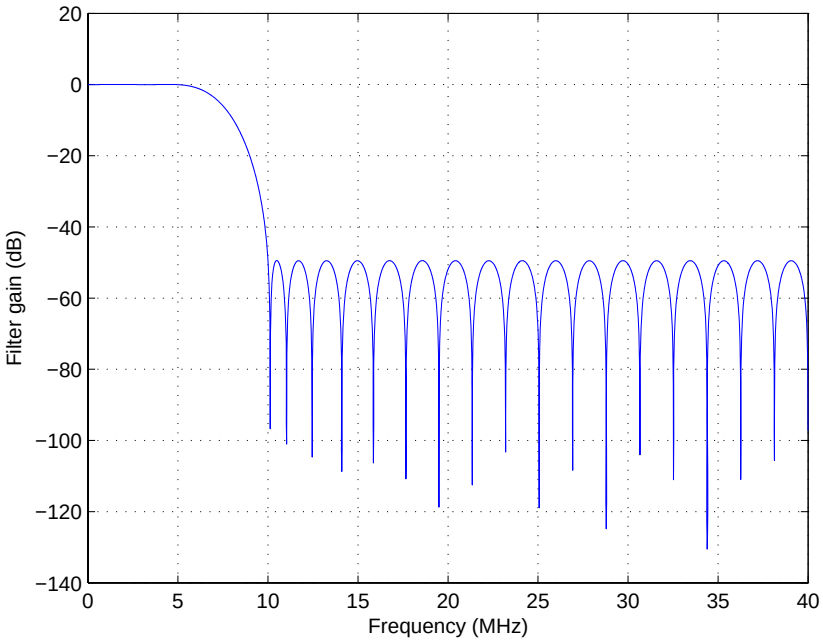


**Figure 3-13 DAC low-pass filter amplitude response (8x oversampling)**

Figure 3-14 shows the transmit spectrum for the MBTDD uplink with 10MHz deployment. The spectrum was generated using 16 guard subcarriers at each edge of the band, and of the remaining 992 subcarriers, the uplink user was allocated two independently hopping groups of 16 subcarriers each. The AM-AM and AM-PM characteristics of the power amplifier used to generate these spectra are shown in Figure 3-11 and Figure 3-12 respectively. These characteristics were measured from an implemented power amplifier. A zeroth order hold digital-to-analog convertor (DAC) was used, and the amplitude response of the low-pass filter used after the DAC is shown in Figure 3-13. An oversampling factor of 8 was used at the DAC input. The power-amplifier backoff used was 8.4 dB, and the FCC emissions criterion is met. No peak to average reduction techniques were used while generating these plots, hence the required backoff is conservative.

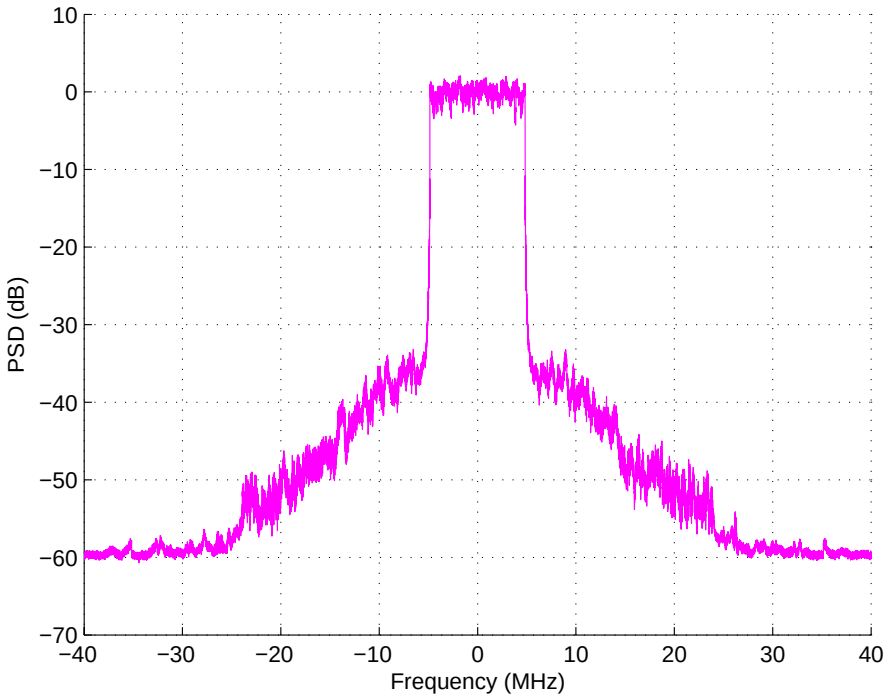


**Figure 3-14 Reverse link transmit spectrum**

**Table 3-3 RF Specifications**

| # | RF Parameter | Base Value 1 MHz Channel | 10 MHz Ch BW |
|---|---|---|---|
| 1 | Transmitter Power – **BS** | 43 dBm/MHz | +53 dBm |
| 2 | Transmitter Power – **MS** | 27 dBm | +27 dBm |
| 3 | Out of Band emission limits – BS and MS (emission measured in 1 MHz resolution bandwidth) | Attenuation of the transmit power P by: 43 +10 log(P) dB | -13 dBm |
| 4* | ACLR - Attenuation of emissions into an adjacent channel (same Ch BW) – **BS** | --- | 60.2 dB |

| # | RF Parameter | Base Value 1 MHz Channel | 10 MHz Ch BW |
|---|---|---|---|
| 5* | ACLR - Attenuation of emissions into an adjacent channel (same Ch BW) – **MS** | --- | 37.7 dB |
| 6 | Receiver noise figure – **BS** | 5 dB | 5 dB |
| 7 | Receiver noise figure – **MS** | 10 dB | 10 dB |
| 8 | Receiver reference sensitivity (to be proposed by each technology) | Specify at FER of 1% | *value 3 (proposal specific)* |
| 9* | Receiver Selectivity – **BS** | --- | 63 dB |
| 10* | Receiver Selectivity – **MS** | --- | 33 dB |
| 11[*] | Receiver Blocking – **BS** (level of same technology blocking signal at frequency offset of 2 times Channel BW) | --- | -40 dBm |
| 12[*] | Receiver Blocking – **MS** (level of same technology blocking signal at frequency offset of 2 times Channel BW) | --- | -56 dBm |

## 3.5 Link Budget

For reverse link, link budget was computed for 64Kbps edge rate, which was achieved using transmission on 32 tones each of bandwidth 9.6KHz, with scheduling on all interlaces. A maximum of 6 HARQ attempts was allowed, with EbNo and spectral efficiency chosen such that the packet error rate was less than 1% after the $6^{th}$ attempt and the desired data rate was achieved. The raw BER corresponding to this packet error rate is less than 0.1%. For forward link, the same method was applied to compute the link budget. The resulting link budget applies to edge rate of 64Kbps assuming 32 tones and to 1.984Mbps assuming all the available 992 tones are used. Note that we are only considering the TDD mode with equal duty-cycle for forward and reverse links.

**Table 3-4 Link budget assumptions**

| id/ ii | Item | Forward link | Reverse link |
|---|---|---|---|
| | Test environment | Suburban/urban macro-cell, micro-cell, | Suburban/urban macro-cell, micro-cell, |
| | Operating frequency | 1.9GHz | 1.9GHz |
| | Test service | | |
| | Multipath channel class | Cases I-IV | Cases I-IV |
| Ii/id | (a0) Average transmitter power per traffic channel (when transmitting) | 52.79 dBm (no power control, so average and maximum power is same) | 27dBm (no power control, so average and maximum power is same) |

| id/ ii | Item | Forward link | Reverse link |
|---|---|---|---|
| id | (a1) Maximum transmitter power per traffic channel (when transmitting) | 52.79 dBm<br>(Find power per tone based on 43dBm/MHz, multiply by total 992 tones in 10MHz design) | 27dBm |
| id | (a2) Maximum total transmitter power (when transmitting) | 43 dBm/MHz | 27dBm |
| ii | (b) Cable, connector, and combiner losses (enumerate sources) | 3 dB | 0 dB |
| | Body Losses | 0 dB | 3 dB |
| ii | (c) Transmitter antenna gain | 17 dBi | 0 dBi |
| id | (d1) **Transmitter e.i.r.p. per traffic channel = (a1 – b + c)** | 66.79 dBm | 27 dBm |
| id | (d2) **Total transmitter e.i.r.p. = (a2 – b + c)** | 57 dBm<br>(per MHz) | 27 dBm |
| | Penetration Loss (Ref: 3GPP2) | 10 dB or 20 dB depending on indoor/outdoor | 10 dB or 20 dB depending on indoor/outdoor |
| Ii | (e) Receiver antenna gain | 0 dBi | 17 dBi |
| Ii | (f) Cable and connector losses | 0 dB | 3 dB |
| | Body Losses | 3 dB | 0 dB |
| Ii | (g) Receiver noise figure | 10 dB | 5 dB |
| Ii | (h) Thermal noise density<br>(H) (linear units) | –174 dBm/Hz<br>$3.98 \times 10^{-18}$ mW/Hz | –174 dBm/Hz<br>$3.98 \times 10^{-18}$ mW/Hz |
| Id | (i) Receiver interference density (NOTE 1)<br>(I) (linear units) | -infinity dBm/Hz<br>0 mW/Hz<br>Isolated cell, thermal-limited | -infinity dBm/Hz<br>0 mW/Hz<br>Isolated cell, thermal-limited |
| id | (j) **Total effective noise plus interference density**<br>**= 10 log ($10^{((g + h)/10)} + I$)** | -174+10= -164 dBm/Hz | -174+5= -169 dBm/Hz |
| ii | (k) Information rate (10 log ($R_b$)) | 62.98 dB (Hz)<br>(1.984 Mbps) | 48 dB (Hz)<br>(64 Kbps) |
| id | (l) Required $E_b/(N_0 + I_0)$ | EsNo+<br>10 log(992*9600)-(**k**)<br>(user bandwidth=992 tones, each 9.6KHz,). See tables below for EsNo | EsNo+10 log(32*9600)-(**k**)<br>(user bandwidth=32 tones, each 9.6KHz). See tables below for EsNo |
| id | (m) **Receiver sensitivity = (j + k + l)** | (based on EsNo tables below. Eg, for EsNo of -2.2dB, value is -96.4 dBm) | (based on EsNo tables below. Eg. for EsNo of -2.2dB, value is -116.3 dBm) |

| id/ ii | Item | Forward link | Reverse link |
|---|---|---|---|
| id | (n) Hand-off gain | 0dB | 0dB<br>(fast cell-switching handoff) |
| id | (o) Explicit diversity gain | 0dB<br>(included in Eb/(No+Io)) | 0dB<br>(included in Eb/(No+Io)) |
| id | (o′) Other gain | 0dB<br>Early-termination gain not accounted for | 0dB<br>Early-termination gain not accounted for |
| id | (p) Log-normal fade margin | 6.9 dB | 6.9 dB |
| Id | (q) **Maximum path loss**<br>**= {d1 – m + (e – f) + o + n + o′ – p}** | See table below | See table below |
| id | (r) Maximum range | See table below<br>(used suburban Macro, pathloss in dB= 31.5+35log(range)) | See table below<br>(used suburban Macro, pathloss in dB= 31.5+35log(range)) |

**Table 3-5 Reverse link link budget for 2 Rx 64 Kbps (10dB penetration loss)**

| CHANNEL | EsNo per antenna (dB) (for item l in link-budget template) | Maximum pathloss in dB (item q in link-budget template) | Maximum range in metres (item r in link-budget template) |
|---|---|---|---|
| I (ped-A) | -0.9 | 136.1 | 974 |
| II (veh-A) | -2.4 | 137.6 | 1075 |
| III (ped-B) | -2.2 | 137.4 | 1061 |
| IV (veh-B) | -1.7 | 136.9 | 1027 |

**Table 3-6 Reverse link link budget for 4 Rx 64 Kbps (10dB penetration loss)**

| CHANNEL | EsNo per antenna (dB) (for item l in link-budget template) | Maximum pathloss in dB (item q in link-budget template) | Maximum range in metres (item r in link-budget template) |
|---|---|---|---|
| I (ped-A) | -4.5 | 139.7 | 1238 |
| II (veh-A) | -5.6 | 140.8 | 1327 |
| III (ped-B) | -5.8 | 141.0 | 1345 |
| IV (veh-B) | -4.6 | 139.8 | 1243 |

**Table 3-7 Forward link link budget for 2 Rx, 1.984 Mbps (10dB penetration loss)**

| CHANNEL | EsNo per antenna (dB) (for item l in link-budget template) | Maximum pathloss in dB (item q in link-budget template) | Maximum range in metres (item r in link-budget template) |
|---|---|---|---|
| I (ped-A) | -0.9 | 145 | 1749 |
| II (veh-A) | -2.4 | 146.5 | 1931 |
| III (ped-B) | -2.2 | 146.3 | 1906 |
| IV (veh-B) | -1.7 | 145.8 | 1844 |

**Table 3-8 Reverse link link budget for 2 Rx 64 Kbps (20dB penetration loss)**

| CHANNEL | EsNo per antenna (dB) (for item l in link-budget template) | Maximum pathloss in dB (item q in link-budget template) | Maximum range in metres (item r in link-budget template) |
|---|---|---|---|
| I (ped-A) | -0.9 | 126.1 | 504 |
| II (veh-A) | -2.4 | 127.6 | 557 |
| III (ped-B) | -2.2 | 127.4 | 550 |
| IV (veh-B) | -1.7 | 126.9 | 532 |

**Table 3-9 Reverse link link budget for 4 Rx 64 Kbps (20dB penetration loss)**

| CHANNEL | EsNo per antenna (dB) (for item l in link-budget template) | Maximum pathloss in dB (item q in link-budget template) | Maximum range in metres (item r in link-budget template) |
|---|---|---|---|
| I (ped-A) | -4.5 | 129.7 | 639 |
| II (veh-A) | -5.6 | 130.8 | 687 |
| III (ped-B) | -5.8 | 131.0 | 696 |
| IV (veh-B) | -4.6 | 129.8 | 644 |

**Table 3-10 Forward link link budget for 2 Rx, 1.984 Mbps (20dB penetration loss)**

| CHANNEL | EsNo per antenna (dB) (for item l in link-budget template) | Maximum pathloss in dB (item q in link-budget template) | Maximum range in metres (item r in link-budget template) |
|---|---|---|---|
| I (ped-A) | -0.9 | 135 | 906 |
| II (veh-A) | -2.4 | 136.5 | 1000 |
| III (ped-B) | -2.2 | 136.3 | 987 |
| IV (veh-B) | -1.7 | 135.8 | 955 |

# 4 System Level Performance

## 4.1 Simulation Assumptions

We simulated system full buffer throughput for a 10 MHz TDD system. The suburban macro cell channel model with PedB, VehB and VehA multipath profiles are simulated. The simulation assumptions are listed in Table 4-1 and Table 4-2.

**Table 4-1 System Simulation Parameters (I)**

| | FL Evaluation | RL Evaluation |
|---|---|---|
| Network Topology | Hexagonal Grid, 19 cells with wrap around. | Hexagonal Grid, 19 cells with wrap around. |
| TDD Mode | 1:1 (FL:RL) | 1:1 (FL:RL) |
| Site-to-Site distance | 1km, 2.5km | 1km, 2.5km |
| Sectorization | 3 sectors/cell | 3 sectors/cell |
| Horizontal Antenna Pattern | 70 deg@3dB bandwidth, 20dB maximum attenuation. | 70 deg@3dB bandwidth, 20dB maximum attenuation. |
| Vertical Antenna Pattern | None | None |
| Propagation model. | Suburban macro<br>$31.5+ 35\log_{10}$(d in m)dB | Suburban macro<br>$31.5+ 35\log_{10}$(d in m) dB |
| BTS Minimum Separation | 35m | 35m |
| BTS Ant Height | 32m (macro) | 32m(macro) |
| AT Ant Height | 1.5m | 1.5m |
| Carrier Frequency | 1.9GHz | 1.9GHz |
| Bandwidth | 10MHz | 10MHz |
| Admission Control | None | None |
| Log-normal Shadowing | 10dB | 10dB |
| Site-to-site shadow correlation coefficient | 0.5 | 0.5 |
| Thermal Noise Density | -174dBm/Hz | -174dBm/Hz |
| Noise Figure | 10dB | 5dB |
| Max Transmit Power | 43dBm/MHz | 27dBm |
| Peak base-station antenna gain with cable loss | 17dBi-3dB = 14dBi | 17dBi-3dB=14dBi |
| Penetration Loss | 10dB(Veh) | 10dB(Veh) |
| MS Antenna Gain | 0dBi | 0dBi |
| Body Losses | 3dB | 3dB |
| Maximum C/I achievable per antenna | 30dB | 30dB |

| | | FL Evaluation | RL Evaluation |
|---|---|---|---|
| BTS Antennas | | 1, 4 transmitter antennas | 2, 4 receiver antennas |
| AT Antennas | | 2, 4 receiver antennas | 1 transmitter antenna |
| ITU Channels | | Suburban macro, pedB@3km/h, VehA,VehB@120km/h | Suburban macro, pedB@3km/h, VehA,VehB@120km/h |
| AT | Ant. Spacing | 0.5λ | 0.5λ |
| | Correlation | SCM suburban macro | SCM suburban macro |
| BTS | Ant. Spacing | 10 λ | 10 λ |
| | Correlation | SCM suburban macro | SCM suburban macro |
| Fairness | | DV fairness (0.1, 0.1), (0.5, 0.5) normalized throughput line. | DV fairness (0.1, 0.1), (0.5, 0.5) normalized throughput line. |
| Traffic | | Full Buffer | Full Buffer |
| Receiver Combining | | MMSE | MMSE |

**Table 4-2 System Simulation Parameters (II)**

| | |
|---|---|
| Transmission Bandwidth | 10MHz |
| Subcarrier Spacing | 9.6kHz |
| Sampling Frequency | 9.8304MHz |
| FFT Size | 1024 |
| Guard Carriers | 32 |
| Cyclic Prefix Length | 6.51 μs |
| Windowing Duration | 3.26 μs |
| OFDM Symbol Duration | 113 μs |
| Number of OFDM Symbols Per Frame | 8 |

## 4.2 Peak Data Rates

The user peak data rate is computed according to the following formula:

$$R = r(B - B_{Guard})T_{Link}(1 - O_{ctrl})(1 - O_{pilot})(1 - O_{CPandWGI}),$$

where

- R denotes the peak data rate,
- r denotes the maximum spectral efficiency before counting the pilot overhead,
- B denotes the total bandwidth,
- $B_{Guard}$ denotes the guard bandwidth,

- $T_{Link}$ denotes the fraction of time for the desired link.
- $O_{ctrl}$ denotes the control overhead as a fraction of the usable bandwidth,
- $O_{pilot}$ denotes the pilot overhead,
- $O_{CP/WGI}$ denotes the cyclic prefix and windowing guard time.

For the 10 MHz simulations, the guard band is set to 32 subcarriers per 1024 subcarriers on both FL and RL. For a TDD system with 1:1 partitioning, the fraction of time for FL and RL are the same, 48%, where the preamble overhead is 4%. The control overhead is assumed to be 10% on FL and 11% on RL. The pilot overhead for block hopping is 14% for non-MIMO transmissions and 19% for rank 4 MIMO transmissions. The cyclic prefix and windowing overhead is 8.5%.

The forward link peak rate for 10 MHz bandwidth with 9.8 Mcps sampling rate is 63 Mbps for a user that uses the highest FL packet format of 5.5 bps/Hz and transmits on 4 layers. The reverse link peak rate for 10 MHz bandwidth with 9.8 Mcps sampling rate is 15 Mbps for a user that uses the highest RL packet format of 5 bps/Hz.

**Table 4-3 Forward link and reverse link peak rate**

| Parameter | Bandwidth 10 MHz | |
|---|---|---|
| | Forward link | Reverse link |
| Required Peak User Data Rate | 18 Mbps | 9 Mbps |
| MBWA TDD Proposal | 63 Mbps | 15 Mbps |

## 4.3 System Spectral Efficiency (bps/Hz/sector)

The spectral efficiency values of the proposed MBWA system are listed in Table 4-4 together with the requirement in SRD. The simulations assume 10 MHz block assignment. Note that the spectral efficiencies are computed based on the aggregated data rates listed in Table 4-5 and Table 4-7 for 1 km BS to BS distance. SCM based correlation model is used for all system simulations.

**Table 4-4 Spectral Efficiency**

| Parameter | Spectral Efficiency Requirements | | | |
|---|---|---|---|---|
| | Downlink | | Uplink | |
| | PedB 3 km/hr | VehA 120 km/hr | PedB 3 km/hr | VehA 120 km/hr |
| Required Spectral Efficiency (b/s/Hz/sector) | 2.0 | 1.5 | 1.0 | 0.75 |
| MBWA TDD Spectral efficiency (b/s/Hz/sector) | 2.11 | 1.85 | 1.27 | 1.15 |

## 4.4 Aggregate Data Rates –Forward link and Reverse link

The aggregated data rates and corresponding system spectral efficiency for a 10 MHz block assignment for FL and RL simulations are shown in Table 4-5, Table 4-6, Table 4-7, and Table 4-8. The fairness of all simulations are shown in Figure 4-1 to Figure 4-5. It is observed that all simulations meet the fairness requirements in the Evaluation Criteria [1].

**Table 4-5 FL sector throughput**

| Sector Throughput (Kbps) | | 1x2 | 1x4 | 4x4 |
|---|---|---|---|---|
| 1km BS to BS | pedB 3km/h | 5775 | 7409 | 10544 |
| | vehA 120km/h | 5366 | 6801 | 9262 |
| | vehB 120km/h | 3096 | 4613 | 6599 |
| 2.5km BS to BS | pedB 3km/h | 5659 | 7152 | 9119 |
| | vehA 120km/h | 5048 | 6765 | 7784 |
| | vehB 120km/h | 2944 | 4300 | 5354 |

**Table 4-6 FL system spectral efficiency**

| Spectral Efficiency (b/s/Hz/sector) | | 1x2 | 1x4 | 4x4 |
|---|---|---|---|---|
| 1km BS to BS | pedB 3km/h | 1.16 | 1.48 | 2.11 |
| | vehA 120km/h | 1.07 | 1.36 | 1.85 |
| | vehB 120km/h | 0.62 | 0.92 | 1.32 |
| 2.5km BS to BS | pedB 3km/h | 1.13 | 1.43 | 1.82 |
| | vehA 120km/h | 1.01 | 1.35 | 1.56 |
| | vehB 120km/h | 0.59 | 0.86 | 1.07 |

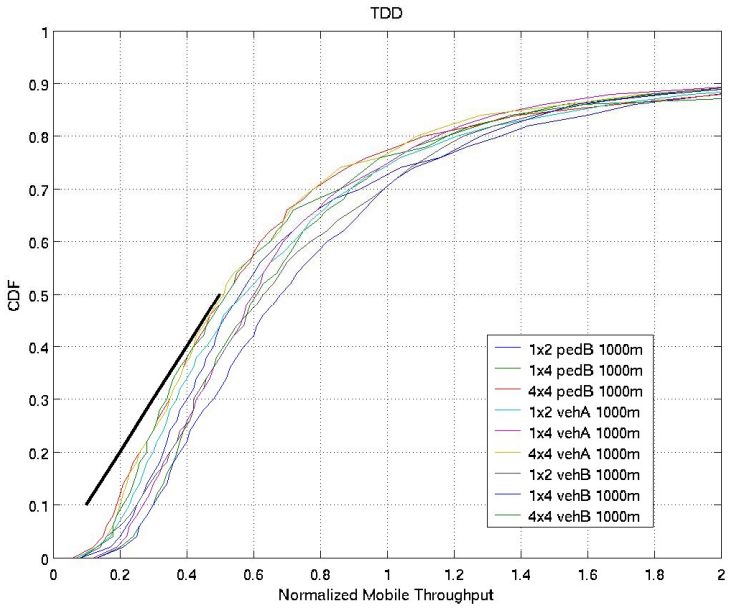


**Figure 4-1 Fairness, FL, 4x4, pedB,vehA,vehB, 1000m site to site**

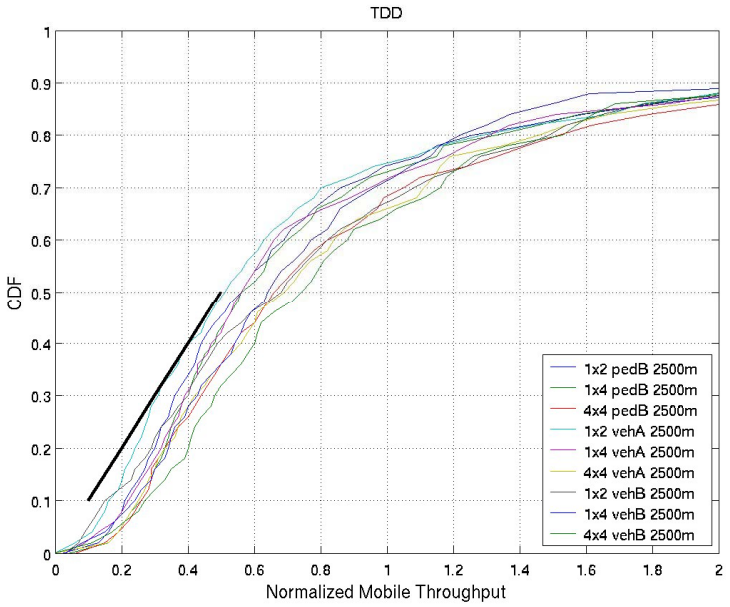


**Figure 4-2 Fairness, FL, pedB,vehA,vehB, 2500m site to site**

Note that RL simulations only use packet formats 0 to 8, hence the throughput results are conservative

**Table 4-7 RL Sector Throughput**

| Sector Throughput (Kbps) | | 1x2 | 1x4 |
|---|---|---|---|
| 1km BS to BS | pedB 3km/h | 3938 | 6341 |
| | vehA 120km/h | 3387 | 5746 |
| | vehB 120km/h | 2788 | 4926 |
| 2.5km BS to BS 16 users/sector | pedB 3km/h | 3140 | 4900 |
| | vehA 120km/h | 2516 | 4341 |
| | vehB 120km/h | 2656 | 3881 |
| 2.5km BS to BS 32 users/sector | pedB 3km/h | 2324 | 3591 |
| | vehA 120km/h | 2196 | 3460 |
| | vehB 120km/h | 1773 | 2574 |

**Table 4-8 RL system spectral efficiency**

| Spectral Efficiency (b/s/Hz/sector) | | 1x2 | 1x4 |
|---|---|---|---|
| 1km BS to BS | pedB 3km/h | 0.79 | 1.27 |
| | vehA 120km/h | 0.68 | 1.15 |
| | vehB 120km/h | 0.56 | 0.99 |
| 2.5km BS to BS 16 users/sector | pedB 3km/h | 0.63 | 0.98 |
| | vehA 120km/h | 0.5 | 0.87 |
| | vehB 120km/h | 0.53 | 0.78 |
| 2.5km BS to BS 32 users/sector | pedB 3km/h | 0.46 | 0.72 |
| | vehA 120km/h | 0.44 | 0.69 |
| | vehB 120km/h | 0.35 | 0.51 |

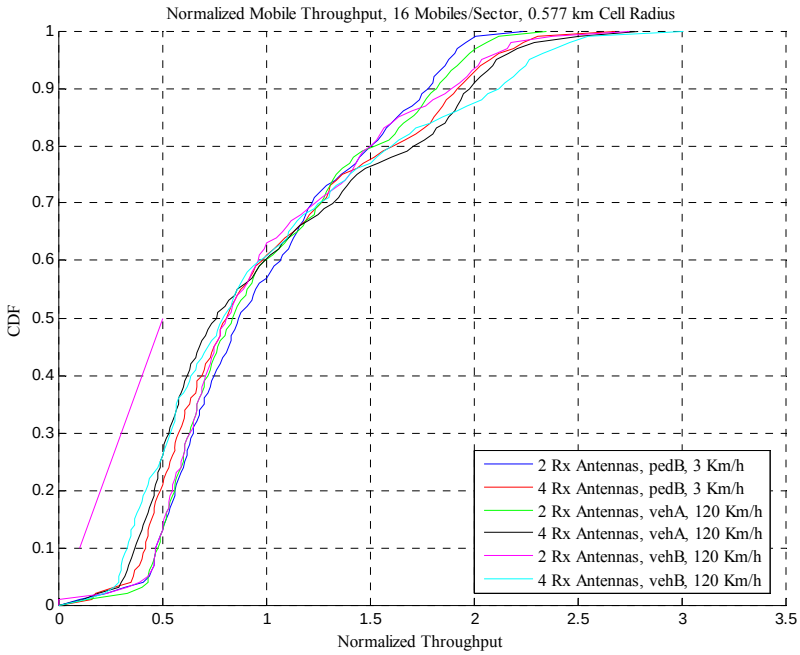


**Figure 4-3 Fairness, RL, 1000m Site-to-Site Distance**

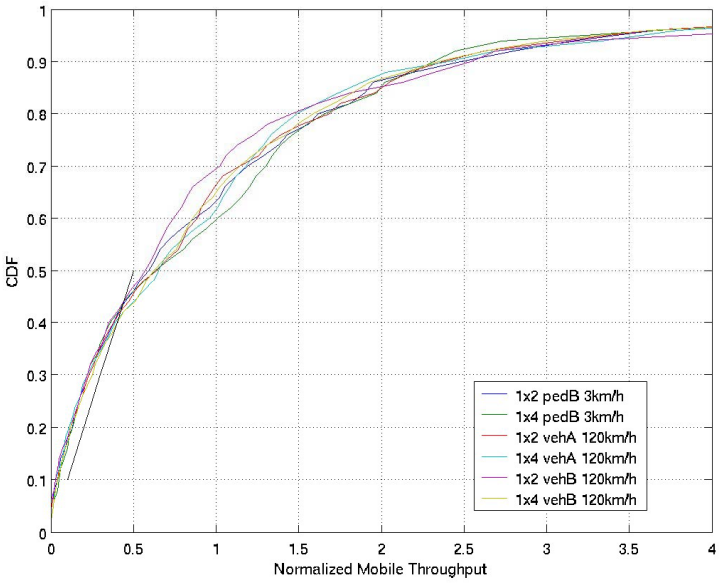


**Figure 4-4 Fairness, RL, 2500m Site-to-Site Distance, 16 users per sector**

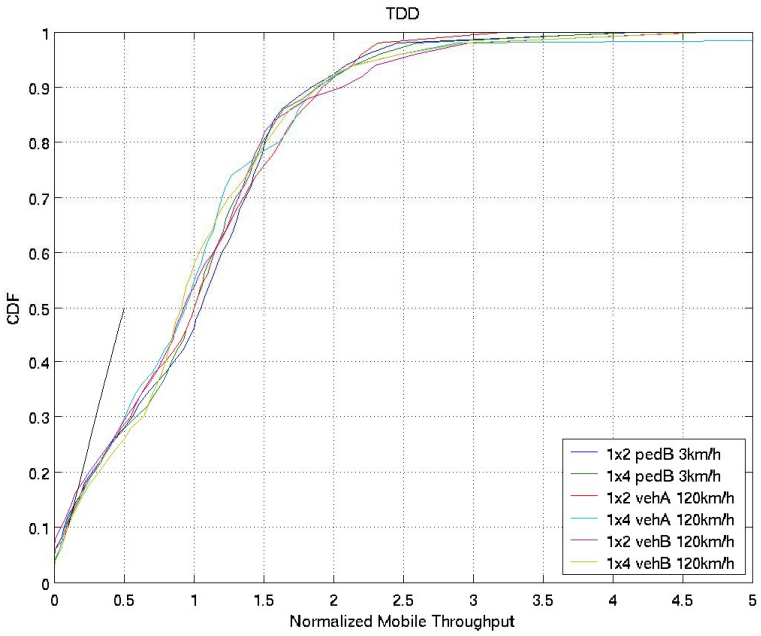


**Figure 4-5 Fairness, RL, 2500m Site-toSite Distance, 32 users per sector**

## 4.5 Throughput Coverage Tradeoff

### 4.5.1 Forward Link

#### 4.5.1.1 802.20 Fairness Scheduling

In this section we present throughput and coverage trade off for forward link with an 802.20 fairness scheduler which meets the fairness criteria specified in the Evaluation Criteria. Figure 4-6 shows the CDF of mobile throughput for a 4x4 system in a suburban macro cell deployment with a site-to-site distance of 1000m with 8 users per sector. Table 4-9 and Table 4-10 show the sector throughput and spectral efficiency, and edge user throughput values as a function of the site-to-site distance and number of users per sector. Figure 4-7 shows the edge user throughput against system load (users per sector) vs. site-to-site distance as tabulated in Table 4-10. Figure 4-8 shows the edge user throughput vs. sector throughput and site-to-site distance as tabulated in Table 4-9 and Table 4-10. Figure 4-9 shows the system spectral efficiency vs. site-to-site distance for edge user throughputs as tabulated in Table 4-9 and Table 4-10.

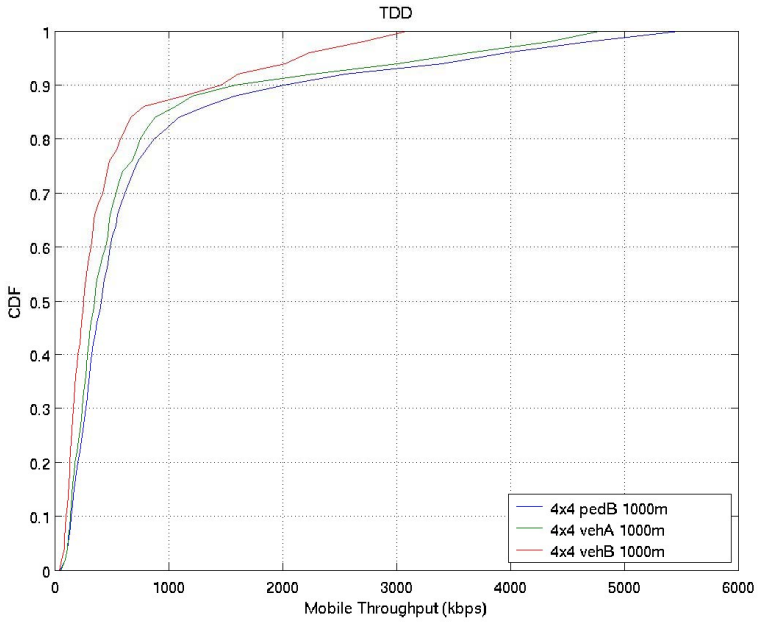


**Figure 4-6 CDF of user throughput (1000m, 16 users/sector) for a 4x4 MIMO system with 802.20 fairness**

**Table 4-9 Sector throughput and spectral efficiency vs. site-to-site distance and the number of users for a 4x4 MIMO system with 802.20 fairness, pedB 3km/h**

| Sector Throughput (Kbps) and Spectral Efficiency (b/s/Hz/sector) | 16 users/sector | 32 users/sector |
|---|---|---|
| 1km BS to BS | 10544 kbps (2.11 b/s/Hz) | 11199 kbps (2.24 b/s/Hz) |
| 2.5km BS to BS | 9119 kbps (1.83 b/s/Hz) | 9126 kbps (1.83 b/s/Hz) |

**Table 4-10 Edge user throughput vs. site-to-site distance and the number of users for 4x4 MIMO system with 802.20 fairness, pedB 3km/h**

| Edge Throughput (Kbps) | 16 users/sector | 32 users/sector |
|---|---|---|
| 1km BS to BS | 177 | 94 |
| 2.5km BS to BS | 159 | 81 |

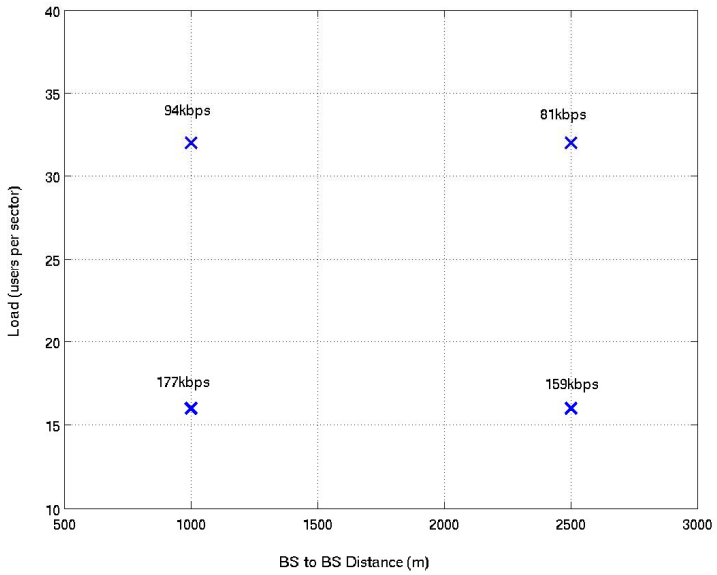


**Figure 4-7 Edge user throughput against system load (users per sector) and site-to-site distance for a 4x4 MIMO system with 802.20 fairness, pedB 3km/h**

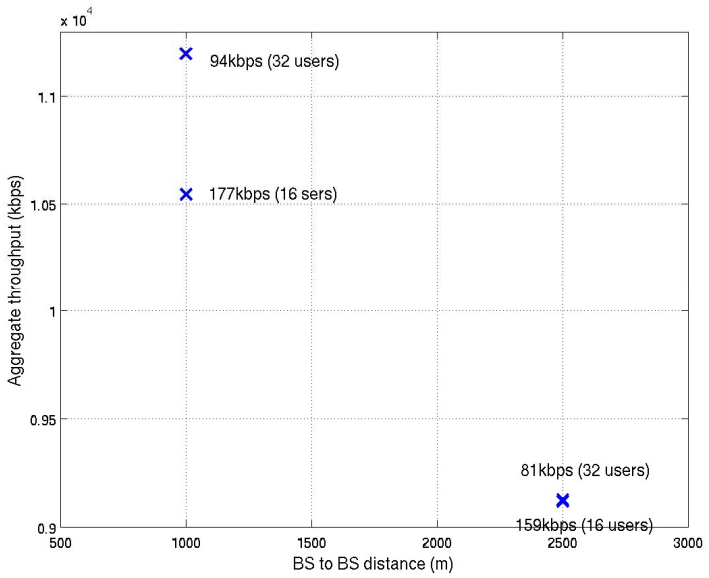


**Figure 4-8 Edge user throughput vs. sector throughput and site-to-site distance for a 4x4 MIMO system with 802.20 fairness, pedB 3km/h**

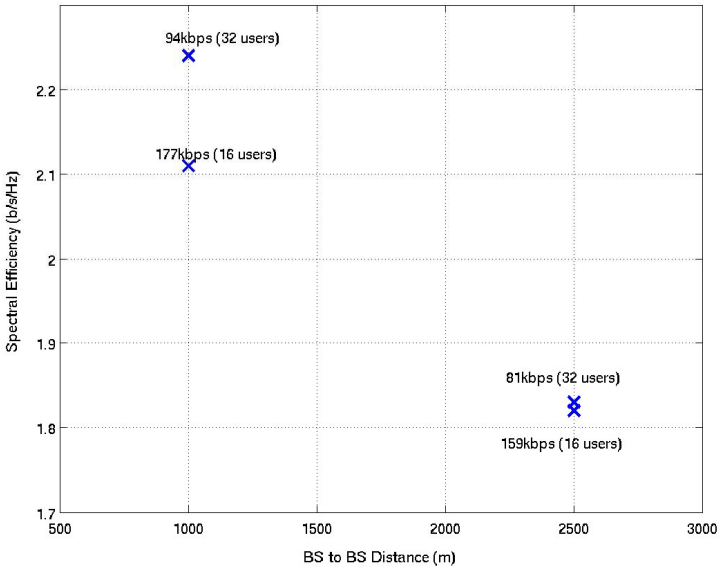


**Figure 4-9 Edge user throughput against spectral efficiency vs. site-to-site distance for a 4x4 MIMO system with 802.20 fairness scheduling, pedB 3km/h**

### 4.5.1.2 Equal Grade of Service Scheduling

In this section we present throughput and coverage trade off for forward link with an EGoS scheduler. Figure 4-10 shows the CDF of mobile throughput for a 4x4 system in a suburban macro cell deployment with a site-to-site distance of 1000m with 8 users per sector. Table 4-11 and Table 4-12 show the sector throughput and spectral efficiency, and edge user throughput values as a function of the site-to-site distance and number of users per sector. Figure 4-11 shows the edge user throughput against system load (users per sector) vs. site-to-site distance as tabulated in Table 4-12. Figure 4-12 shows the edge user throughput vs. sector throughput and site-to-site distance as tabulated in Table 4-11 and Table 4-12. Figure 4-13 shows the system spectral efficiency vs. site-to-site distance for edge user throughputs as tabulated in Table 4-11 and Table 4-12.

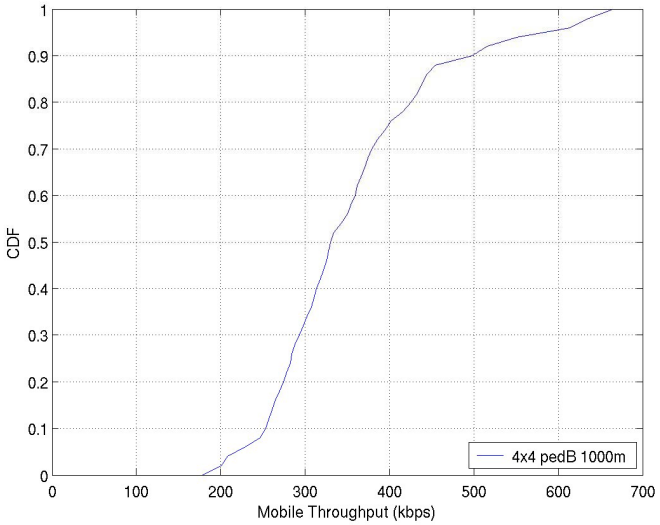


**Figure 4-10 CDF of mobile throughput (1000m, 16 users/sector) for a 4x4 MIMO system with EGoS fairness**

**Table 4-11 Sector throughput and spectral efficiency vs. site-to-site distance and the number of users for a 4x4 MIMO system with EGoS fairness, pedB 3km/h**

| Sector Throughput (Kbps) and Spectral Efficiency (b/s/Hz/sector) | 16 users/sector | 32 users/sector |
|---|---|---|
| 1km BS to BS | 5650 kbps (1.13 b/s/Hz) | 5603 kbps (1.12 b/s/Hz) |
| 2.5km BS to BS | 4583 kbps (0.92 b/s/Hz) | 4514 kbps (0.9 b/s/Hz) |

**Table 4-12 Edge user throughput vs. site-to-site distance and the number of users for a 4x4 MIMO system with EGoS fairness, pedB 3km/h**

| Edge Throughput (Kbps) | 16 users/sector | 32 users/sector |
|---|---|---|
| 1km BS to BS | 274 | 155 |
| 2.5km BS to BS | 197 | 111 |

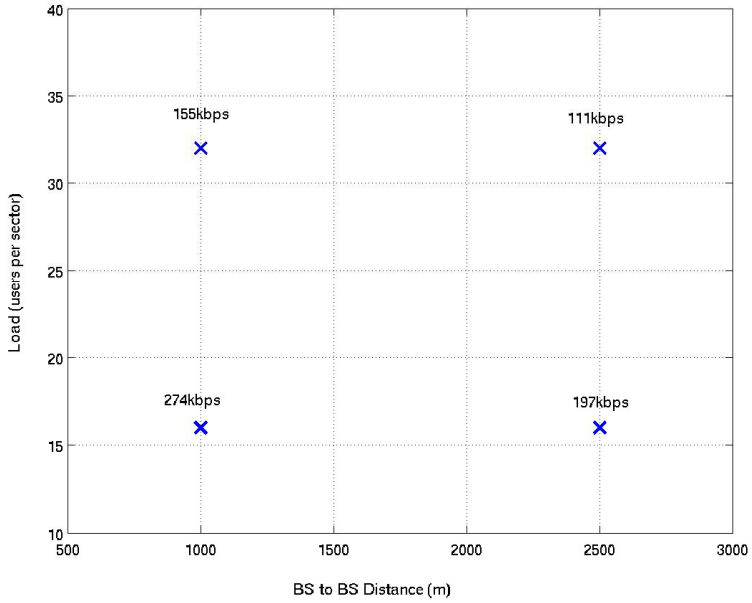


**Figure 4-11 Edge user throughput against users per sectors vs. base station separation for a 4x4 MIMO system with 802.20 fairness scheduling, pedB 3km/h**

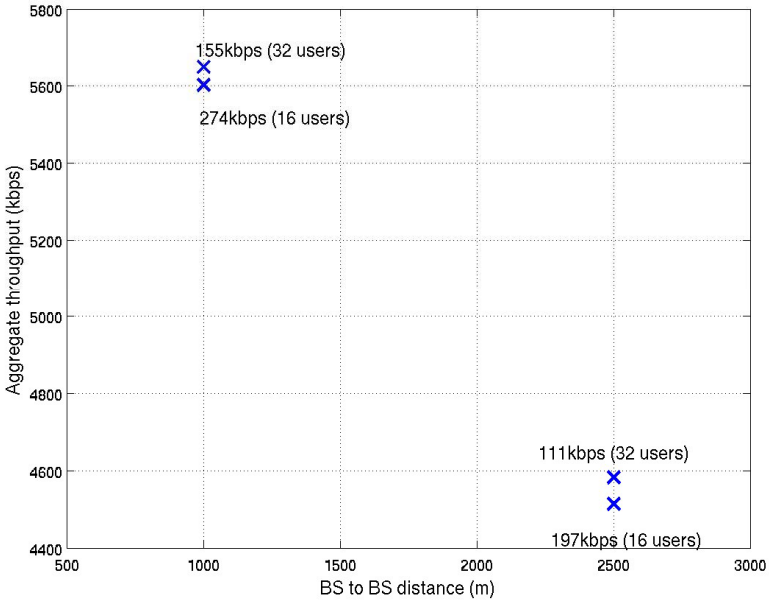


**Figure 4-12 Edge user throughput vs. sector throughput and site-to-site distance for a 4x4 MIMO system with EGoS fairness**

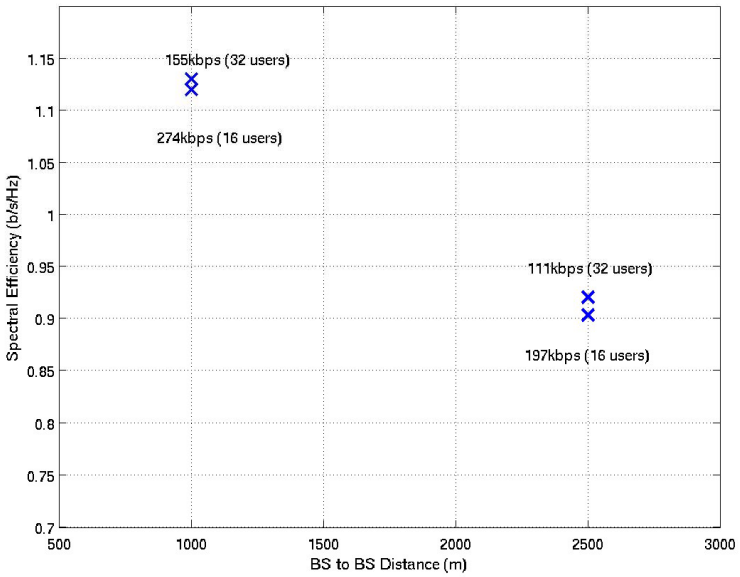


**Figure 4-13 Edge user throughput against spectral efficiency vs. site-to-site distance for a 4x4 MIMO system with 802.20 fairness scheduling, pedB 3km/h**

### 4.5.2 Reverse Link

In this section we present throughput and coverage trade off for reverse link with an EGoS scheduler. Figure 4-14 shows the CDF of mobile throughput for 1x2 and 1x4 systems in a suburban macro cell deployment with a site-to-site distance of 1000m with 8 users per sector. Table 4-13 and Table 4-14 show the sector throughput and spectral efficiency, and edge user throughput values as a function of the site-to-site distance and number of users per sector. Figure 4-15 shows the edge user throughput against system load (users per sector) vs. site-to-site distance as tabulated in Table 4-14. Figure 4-16 shows the edge user throughput vs. sector throughput and site-to-site distance as tabulated in Table 4-13 and Table 4-14. Figure 4-17 shows the system spectral efficiency vs. site-to-site distance for edge user throughputs as tabulated in Table 4-13 and Table 4-14.

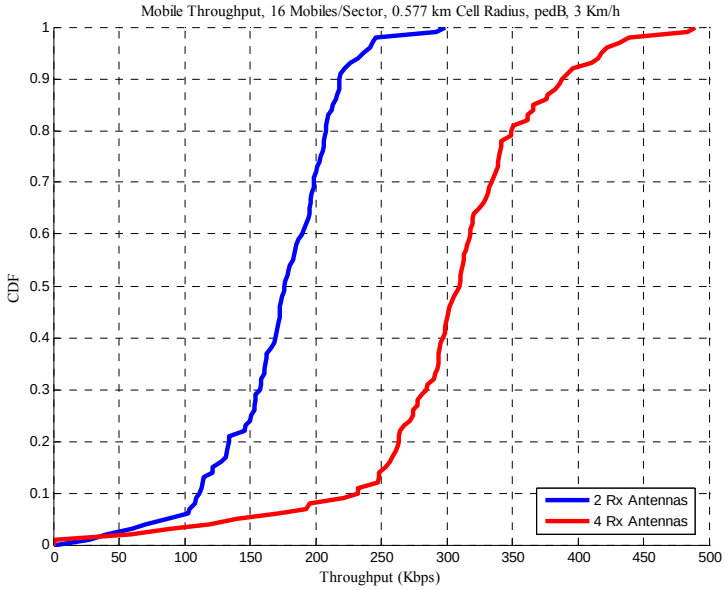


**Figure 4-14 User throughput CDF for 1000m site-to-site distance and 16 users/sector, with EGoS fairness**

**Table 4-13 Sector throughput and spectral efficiency vs. site-to-site distance and number of users with four receive antennas and EGoS fairness, pedB 3km/h**

| Sector Throughput (Kbps) and Spectral Efficiency (b/s/Hz/sector) | 16 users/sector | 32 users/sector |
|---|---|---|
| 1km BS to BS | 4836 kbps (0.97 b/s/Hz) | 4699 kbps (0.94 b/s/Hz) |
| 2.5km BS to BS | 4499 kbps (0.9 b/s/Hz) | 4290 kbps (0.86 b/s/Hz) |

**Table 4-14 Edge user throughput vs. site-to-site distance and number of users with four receive antennas and EGoS fairness**

| Edge Throughput (Kbps) | 16 users/sector | 32 users/sector |
|---|---|---|
| 1km BS to BS | 266 | 135 |
| 2.5km BS to BS | 53 | 50 |

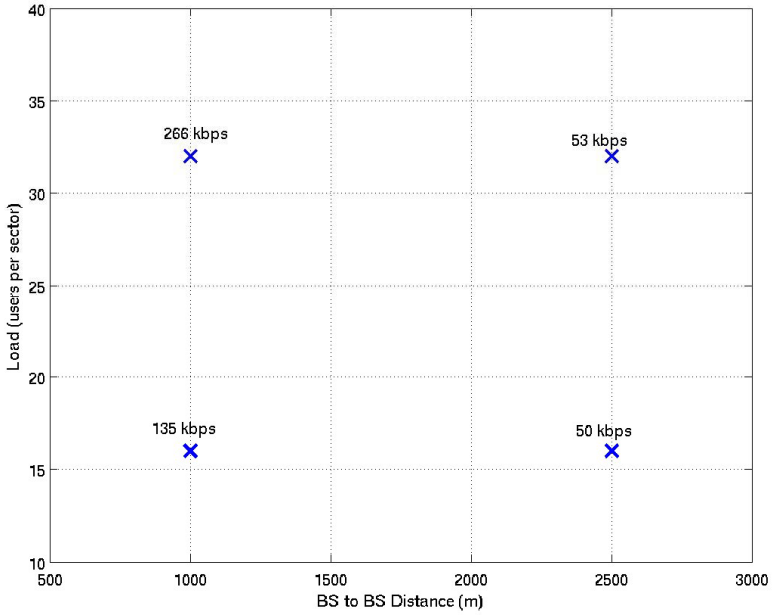


**Figure 4-15 Edge user throughput against system load (users per sector) and site-to-site distance with four receive antennas and EGoS fairness, pedB 3km/h**

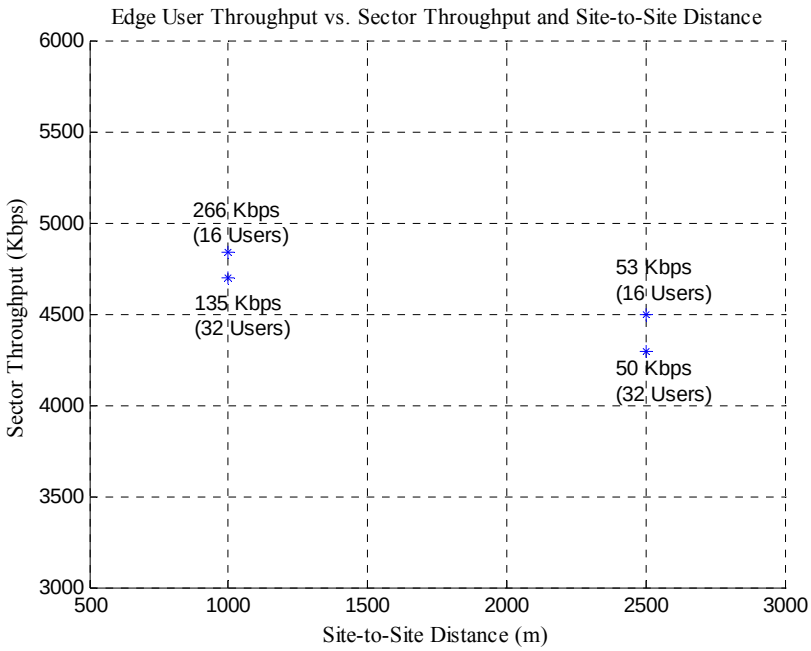


**Figure 4-16 Edge user throughput vs. sector throughput and site-to-site distance with four receive antennas and EGoS fairness, pedB 3km/h**

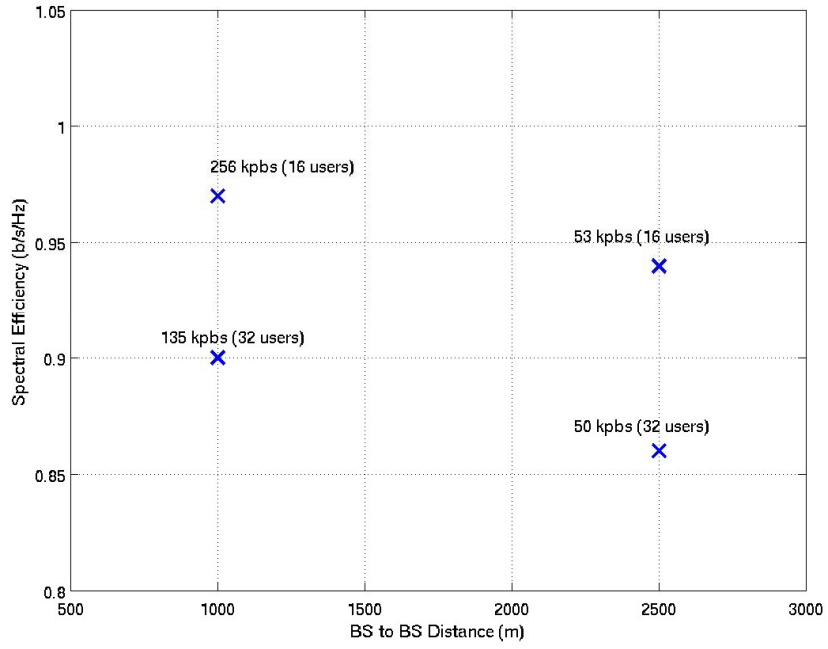


**Figure 4-17 Edge user throughput against spectral efficiency vs. site-to-site distance with four receive antennas and EGoS fairness, pedB 3km/h**

# 5 References

[1] IEEE 802.20 – The approved version of the Evaluation Criteria Document (ECD), 802.20-PD-09.

[2] IEEE 802.20 – The approved System Requirements Document (SRD),802.20-PD-06r1.

[3] IEEE 802.20 – The adopted Channel Models Document, 802.20-PD-08.

[4] IEEE P802.11 – Task Group N - Selection Procedure, 802.11-03/665r8.

[5] IEEE C802.20-06/04 “MBFDD and MBTDD: Proposed Draft Air Interface Specification”.

[6] IEEE C802.20-04-67 “Link-System Interface Simulation Methodologies”

[7] IEEE C802.20-05-03r1 “Mapping SISO and MIMO Channel Performance”

# Appendix A Correlation Matrices for Link Level Simulations

The correlation matrices at the BS are listed in Table 5-1 for a linear array of 4 antennas with 10 λ spacing. The first 2 x 2 sub-matrix of each matrix is also the correlation matrix for a linear array of 2 antennas. The matrices corresponding to two different spatial correlation models namely, the Laplacian model and the SCM model are shown in the table below.

**Table 5-1 Correlation matrices for BS at 50 and 20 degree AoD for 4 antennas**

| Laplacian Model | | | | |
|---|---|---|---|---|
| | | | | |
| Antenna Spacing 10xWavelength, AoA=20, AS=5 | 1 | -0.061884+0.032678i | 0.010079-0.015489i | -0.00059694+0.0082371i |
| | -0.061884-0.032678i | 1 | -0.061884+0.032678i | 0.010079-0.015489i |
| | 0.010079+0.015489i | -0.061884-0.032678i | 1 | -0.061884+0.032678i |
| | -0.00059694-0.0082371i | 0.010079+0.015489i | -0.061884-0.032678i | 1 |
| Antenna Spacing 10xWavelength, AoA=50, AS=2 | 1 | -0.26151-0.42845i | -0.091214+0.17899i | 0.099976-0.009446i |
| | -0.26151+0.42845i | 1 | -0.26151-0.42845i | -0.091214+0.17899i |
| | -0.091214-0.17899i | -0.26151+0.42845i | 1 | -0.26151-0.42845i |
| | 0.099976+0.009446i | -0.091214-0.17899i | -0.26151+0.42845i | 1 |
| | | | | |
| SCM Model | | | | |
| | | | | |
| Antenna Spacing 10xWavelength, AoA=50, AS=2 | 1 | 0.011345+0.0047899i | 0.0043835+0.0052649i | -0.0047587+0.0017224i |
| | 0.011345-0.0047899i | 0.99999 | 0.0076282+0.0065688i | 0.0013711+0.0059998i |
| | 0.0043835-0.0052649i | 0.0076282-0.0065688i | 0.99999 | 0.011046+0.0040806i |
| | -0.0047587-0.0017224i | 0.0013711-0.0059998i | 0.011046-0.0040806i | 0.99999 |

The correlation matrices at the MS are listed in Table 5-1 for a linear array of 4 antennas with 0.5 λ spacing. The first 2 x 2 sub-matrix of each matrix is also the correlation matrix for a linear array of 2 antennas.

**Table 5-2 Correlation matrices for MS at 67.5 degree AoA for 4 antennas**

| Laplacian Model | | | | |
|---|---|---|---|---|
| | | | | |
| Antenna Spacing 0.5xWavelength, AoA=67.5, AS=35 | 1 | -0.71515+0.32409i | 0.52663-0.35021i | -0.41482+0.33932i |
| | -0.71515-0.32409i | 1 | -0.71515+0.32409i | 0.52663-0.35021i |
| | 0.52663+0.35021i | -0.71515-0.32409i | 1 | -0.71515+0.32409i |
| | -0.41482-0.33932i | 0.52663+0.35021i | -0.71515-0.32409i | 1 |
| | | | | |
| SCM Model | | | | |
| | | | | |
| Antenna Spacing 0.5xWavelength, AoA=67.5, AS=35 | 1 | -0.32045+0.018231i | 0.22542-0.0082376i | -0.18756+0.0060785i |
| | -0.32045-0.018231i | 1 | -0.32038+0.018776i | 0.22616-0.0084026i |
| | 0.22542+0.0082376i | -0.32038-0.018776i | 0.99999 | -0.31983+0.019627i |
| | -0.18756-0.0060785i | 0.22616+0.0084026i | -0.31983-0.019627i | 1 |

# Appendix B Correlation Matrices for System Level Simulations

This appendix lists the correlation matrices for the four transmit and receive antenna array configuration for the various values of angles of arrival/departure, angular spreads, and antenna spacings. In any given table shown here, the correlation matrices are listed for the angles of arrival/departure ranging from 0 to 350 degrees, in steps of 10 degrees, for a fixed value of angular spread and antenna spacing. The entries of the 4x4 correlation matrix appear immediately to the right of the angle of arrival/departure listed in the table. The left half of each table corresponds to angles of arrival/departure from 0 to 170 degrees and the right half corresponds to the same for 180 to 350 degrees. All tables with angular spreads either 2 or 5 degrees correspond to the correlation matrices at the BS and the last table with angular spread 35 degrees corresponds to the MS. All tables corresponding to the Laplacian model are listed first followed by some tables corresponding to the suburban macro SCM model.

### Table 5-3 Antenna Spacing 0.5 λ, Angular Spread 2 degrees, Laplacian Model

Angular Spread 2, Antenna Spacing 0.5xWavelength

| Angle of Arrival/Departure | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 0.99404 | 0.97657 | 0.94876 | 180 | 1 | 0.99404+3.8223e-16i | 0.97657+7.7047e-16i | 0.94876+1.5624e-15i |
| | 0.99404 | 1 | 0.99404 | 0.97657 | | 0.99404-3.8223e-16i | 1 | 0.99404+3.8223e-16i | 0.97657+7.7047e-16i |
| | 0.97657 | 0.99404 | 1 | 0.99404 | | 0.97657-7.7047e-16i | 0.99404-3.8223e-16i | 1 | 0.99404+3.8223e-16i |
| | 0.94876 | 0.97657 | 0.99404 | 1 | | 0.94876-1.5624e-15i | 0.97657-7.7047e-16i | 0.99404-3.8223e-16i | 1 |
| 10 | 1 | 0.85007+0.5156i | 0.45156+0.86667i | -0.061759+0.94822i | 190 | 1 | 0.85007-0.5156i | 0.45156-0.86667i | -0.061759-0.94822i |
| | 0.85007-0.5156i | 1 | 0.85007+0.5156i | 0.45156+0.86667i | | 0.85007+0.5156i | 1 | 0.85007-0.5156i | 0.45156-0.86667i |
| | 0.45156-0.86667i | 0.85007-0.5156i | 1 | 0.85007+0.5156i | | 0.45156+0.86667i | 0.85007+0.5156i | 1 | 0.85007-0.5156i |
| | -0.061759-0.94822i | 0.45156-0.86667i | 0.85007-0.5156i | 1 | | -0.061759+0.94822i | 0.45156+0.86667i | 0.85007+0.5156i | 1 |
| 20 | 1 | 0.47423+0.87441i | -0.53419+0.82071i | -0.9514-0.076598i | 200 | 1 | 0.47423-0.87441i | -0.53419-0.82071i | -0.9514+0.076598i |
| | 0.47423-0.87441i | 1 | 0.47423+0.87441i | -0.53419+0.82071i | | 0.47423+0.87441i | 1 | 0.47423-0.87441i | -0.53419-0.82071i |
| | -0.53419-0.82071i | 0.47423-0.87441i | 1 | 0.47423+0.87441i | | -0.53419+0.82071i | 0.47423+0.87441i | 1 | 0.47423-0.87441i |
| | -0.9514+0.076598i | -0.53419-0.82071i | 0.47423-0.87441i | 1 | | -0.9514-0.076598i | -0.53419+0.82071i | 0.47423+0.87441i | 1 |
| 30 | 1 | 0.00093097+0.99552i | -0.98231+0.001716i | -0.0022397-0.96106i | 210 | 1 | 0.00093097-0.99552i | -0.98231-0.001716i | -0.0022397+0.96106i |
| | 0.00093097-0.99552i | 1 | 0.00093097+0.99552i | -0.98231+0.001716i | | 0.00093097+0.99552i | 1 | 0.00093097-0.99552i | -0.98231-0.001716i |
| | -0.98231-0.001716i | 0.00093097-0.99552i | 1 | 0.00093097+0.99552i | | -0.98231+0.001716i | 0.00093097+0.99552i | 1 | 0.00093097-0.99552i |
| | -0.0022397+0.96106i | -0.98231-0.001716i | 0.00093097-0.99552i | 1 | | -0.0022397-0.96106i | -0.98231+0.001716i | 0.00093097+0.99552i | 1 |
| 40 | 1 | -0.43108+0.89842i | -0.61693-0.76929i | 0.94414-0.21927i | 220 | 1 | -0.43108-0.89842i | -0.61693+0.76929i | 0.94414+0.21927i |
| | -0.43108-0.89842i | 1 | -0.43108+0.89842i | -0.61693-0.76929i | | -0.43108+0.89842i | 1 | -0.43108-0.89842i | -0.61693+0.76929i |
| | -0.61693+0.76929i | -0.43108-0.89842i | 1 | -0.43108+0.89842i | | -0.61693-0.76929i | -0.43108+0.89842i | 1 | -0.43108-0.89842i |
| | 0.94414+0.21927i | -0.61693+0.76929i | -0.43108-0.89842i | 1 | | 0.94414-0.21927i | -0.61693-0.76929i | -0.43108+0.89842i | 1 |
| 50 | 1 | -0.73903+0.66999i | 0.096902-0.98541i | 0.58266+0.78567i | 230 | 1 | -0.73903+0.66999i | 0.096902+0.98541i | 0.58266-0.78567i |
| | -0.73903-0.66999i | 1 | -0.73903+0.66999i | 0.096902-0.98541i | | -0.73903+0.66999i | 1 | -0.73903-0.66999i | 0.096902+0.98541i |
| | 0.096902+0.98541i | -0.73903-0.66999i | 1 | -0.73903+0.66999i | | 0.096902-0.98541i | -0.73903+0.66999i | 1 | -0.73903-0.66999i |
| | 0.58266-0.78567i | 0.096902+0.98541i | -0.73903-0.66999i | 1 | | 0.58266+0.78567i | 0.096902-0.98541i | -0.73903+0.66999i | 1 |
| 60 | 1 | -0.91068+0.40946i | 0.65976-0.74349i | -0.29484+0.94155i | 240 | 1 | -0.91068-0.40946i | 0.65976+0.74349i | -0.29484-0.94155i |
| | -0.91068-0.40946i | 1 | -0.91068+0.40946i | 0.65976-0.74349i | | -0.91068+0.40946i | 1 | -0.91068-0.40946i | 0.65976+0.74349i |
| | 0.65976+0.74349i | -0.91068-0.40946i | 1 | -0.91068+0.40946i | | 0.65976-0.74349i | -0.91068+0.40946i | 1 | -0.91068-0.40946i |
| | -0.29484-0.94155i | 0.65976+0.74349i | -0.91068-0.40946i | 1 | | -0.29484+0.94155i | 0.65976-0.74349i | -0.91068+0.40946i | 1 |
| 70 | 1 | -0.98107+0.18995i | 0.92512-0.37215i | -0.83462+0.53922i | 250 | 1 | -0.98107-0.18995i | 0.92512+0.37215i | -0.83462-0.53922i |
| | -0.98107-0.18995i | 1 | -0.98107+0.18995i | 0.92512-0.37215i | | -0.98107+0.18995i | 1 | -0.98107-0.18995i | 0.92512+0.37215i |
| | 0.92512+0.37215i | -0.98107-0.18995i | 1 | -0.98107+0.18995i | | 0.92512-0.37215i | -0.98107+0.18995i | 1 | -0.98107-0.18995i |
| | -0.83462-0.53922i | 0.92512+0.37215i | -0.98107-0.18995i | 1 | | -0.83462+0.53922i | 0.92512-0.37215i | -0.98107+0.18995i | 1 |
| 80 | 1 | -0.99858+0.04958i | 0.99433-0.098971i | -0.98727+0.14799i | 260 | 1 | -0.99858-0.04958i | 0.99433+0.098971i | -0.98727-0.14799i |
| | -0.99858-0.04958i | 1 | -0.99858+0.04958i | 0.99433-0.098971i | | -0.99858+0.04958i | 1 | -0.99858-0.04958i | 0.99433+0.098971i |
| | 0.99433+0.098971i | -0.99858-0.04958i | 1 | -0.99858+0.04958i | | 0.99433-0.098971i | -0.99858+0.04958i | 1 | -0.99858-0.04958i |
| | -0.98727+0.14799i | 0.99433+0.098971i | -0.99858-0.04958i | 1 | | -0.98727+0.14799i | 0.99433-0.098971i | -0.99858+0.04958i | 1 |
| 90 | 1 | -0.99999+0.0019127i | 0.99996-0.0038248i | -0.9999+0.0057356i | 270 | 1 | -0.99999-0.0019127i | 0.99996+0.0038248i | -0.9999-0.0057356i |
| | -0.99999-0.0019127i | 1 | -0.99999+0.0019127i | 0.99996-0.0038248i | | -0.99999+0.0019127i | 1 | -0.99999-0.0019127i | 0.99996+0.0038248i |
| | 0.99996+0.0038248i | -0.99999-0.0019127i | 1 | -0.99999+0.0019127i | | 0.99996-0.0038248i | -0.99999+0.0019127i | 1 | -0.99999-0.0019127i |
| | -0.9999-0.0057356i | 0.99996+0.0038248i | -0.99999-0.0019127i | 1 | | -0.9999+0.0057356i | 0.99996-0.0038248i | -0.99999+0.0019127i | 1 |
| 100 | 1 | -0.99858+0.04958i | 0.99433-0.098971i | -0.98727+0.14799i | 280 | 1 | -0.99858-0.04958i | 0.99433+0.098971i | -0.98727-0.14799i |
| | -0.99858-0.04958i | 1 | -0.99858+0.04958i | 0.99433-0.098971i | | -0.99858+0.04958i | 1 | -0.99858-0.04958i | 0.99433+0.098971i |
| | 0.99433+0.098971i | -0.99858-0.04958i | 1 | -0.99858+0.04958i | | 0.99433-0.098971i | -0.99858+0.04958i | 1 | -0.99858-0.04958i |
| | -0.98727+0.14799i | 0.99433+0.098971i | -0.99858-0.04958i | 1 | | -0.98727+0.14799i | 0.99433-0.098971i | -0.99858+0.04958i | 1 |
| 110 | 1 | -0.98107+0.18995i | 0.92512-0.37215i | -0.83462+0.53922i | 290 | 1 | -0.98107-0.18995i | 0.92512+0.37215i | -0.83462-0.53922i |
| | -0.98107-0.18995i | 1 | -0.98107+0.18995i | 0.92512-0.37215i | | -0.98107+0.18995i | 1 | -0.98107-0.18995i | 0.92512+0.37215i |
| | 0.92512+0.37215i | -0.98107-0.18995i | 1 | -0.98107+0.18995i | | 0.92512-0.37215i | -0.98107+0.18995i | 1 | -0.98107-0.18995i |
| | -0.83462-0.53922i | 0.92512+0.37215i | -0.98107-0.18995i | 1 | | -0.83462+0.53922i | 0.92512-0.37215i | -0.98107+0.18995i | 1 |
| 120 | 1 | -0.91068+0.40946i | 0.65976-0.74349i | -0.29484+0.94155i | 300 | 1 | -0.91068-0.40946i | 0.65976+0.74349i | -0.29484-0.94155i |
| | -0.91068-0.40946i | 1 | -0.91068+0.40946i | 0.65976-0.74349i | | -0.91068+0.40946i | 1 | -0.91068-0.40946i | 0.65976+0.74349i |
| | 0.65976+0.74349i | -0.91068-0.40946i | 1 | -0.91068+0.40946i | | 0.65976-0.74349i | -0.91068+0.40946i | 1 | -0.91068-0.40946i |
| | -0.29484-0.94155i | 0.65976+0.74349i | -0.91068-0.40946i | 1 | | -0.29484+0.94155i | 0.65976-0.74349i | -0.91068+0.40946i | 1 |
| 130 | 1 | -0.73903+0.66999i | 0.096902-0.98541i | 0.58266+0.78567i | 310 | 1 | -0.73903-0.66999i | 0.096902+0.98541i | 0.58266-0.78567i |
| | -0.73903-0.66999i | 1 | -0.73903+0.66999i | 0.096902-0.98541i | | -0.73903+0.66999i | 1 | -0.73903-0.66999i | 0.096902+0.98541i |
| | 0.096902+0.98541i | -0.73903-0.66999i | 1 | -0.73903+0.66999i | | 0.096902-0.98541i | -0.73903+0.66999i | 1 | -0.73903-0.66999i |
| | 0.58266-0.78567i | 0.096902+0.98541i | -0.73903-0.66999i | 1 | | 0.58266+0.78567i | 0.096902-0.98541i | -0.73903+0.66999i | 1 |
| 140 | 1 | -0.43108+0.89842i | -0.61693-0.76929i | 0.94414-0.21927i | 320 | 1 | -0.43108-0.89842i | -0.61693+0.76929i | 0.94414+0.21927i |
| | -0.43108-0.89842i | 1 | -0.43108+0.89842i | -0.61693-0.76929i | | -0.43108+0.89842i | 1 | -0.43108-0.89842i | -0.61693+0.76929i |
| | -0.61693+0.76929i | -0.43108-0.89842i | 1 | -0.43108+0.89842i | | -0.61693-0.76929i | -0.43108+0.89842i | 1 | -0.43108-0.89842i |
| | 0.94414+0.21927i | -0.61693+0.76929i | -0.43108-0.89842i | 1 | | 0.94414-0.21927i | -0.61693-0.76929i | -0.43108+0.89842i | 1 |
| 150 | 1 | 0.00093097+0.99552i | -0.98231+0.001716i | -0.0022397-0.96106i | 330 | 1 | 0.00093097-0.99552i | -0.98231-0.001716i | -0.0022397+0.96106i |
| | 0.00093097-0.99552i | 1 | 0.00093097+0.99552i | -0.98231+0.001716i | | 0.00093097+0.99552i | 1 | 0.00093097-0.99552i | -0.98231-0.001716i |
| | -0.98231-0.001716i | 0.00093097-0.99552i | 1 | 0.00093097+0.99552i | | -0.98231+0.001716i | 0.00093097+0.99552i | 1 | 0.00093097-0.99552i |
| | -0.0022397+0.96106i | -0.98231-0.001716i | 0.00093097-0.99552i | 1 | | -0.0022397-0.96106i | -0.98231+0.001716i | 0.00093097+0.99552i | 1 |
| 160 | 1 | 0.47423+0.87441i | -0.53419+0.82071i | -0.9514-0.076598i | 340 | 1 | 0.47423-0.87441i | -0.53419-0.82071i | -0.9514+0.076598i |
| | 0.47423-0.87441i | 1 | 0.47423+0.87441i | -0.53419+0.82071i | | 0.47423+0.87441i | 1 | 0.47423-0.87441i | -0.53419-0.82071i |
| | -0.53419-0.82071i | 0.47423-0.87441i | 1 | 0.47423+0.87441i | | -0.53419+0.82071i | 0.47423+0.87441i | 1 | 0.47423-0.87441i |
| | -0.9514+0.076598i | -0.53419-0.82071i | 0.47423-0.87441i | 1 | | -0.9514-0.076598i | -0.53419+0.82071i | 0.47423+0.87441i | 1 |
| 170 | 1 | 0.85007+0.5156i | 0.45156+0.86667i | -0.061759+0.94822i | 350 | 1 | 0.85007-0.5156i | 0.45156-0.86667i | -0.061759-0.94822i |
| | 0.85007-0.5156i | 1 | 0.85007+0.5156i | 0.45156+0.86667i | | 0.85007+0.5156i | 1 | 0.85007-0.5156i | 0.45156-0.86667i |
| | 0.45156-0.86667i | 0.85007-0.5156i | 1 | 0.85007+0.5156i | | 0.45156+0.86667i | 0.85007+0.5156i | 1 | 0.85007-0.5156i |
| | -0.061759-0.94822i | 0.45156-0.86667i | 0.85007-0.5156i | 1 | | -0.061759+0.94822i | 0.45156+0.86667i | 0.85007+0.5156i | 1 |

# Table 5-4 Antenna Spacing 4 λ, Angular Spread 2 degrees, Laplacian Model

Angular Spread 2, Antenna Spacing 4xWavelength

| Angle of Arrival/Departure | | | | |
|---|---|---|---|---|
| 0 | 1 | 0.72227 | 0.39376 | 0.22399 |
| | 0.72227 | 1 | 0.72227 | 0.39376 |
| | 0.39376 | 0.72227 | 1 | 0.72227 |
| | 0.22399 | 0.39376 | 0.72227 | 1 |
| 10 | 1 | -0.24837-0.68473i | -0.30851+0.25633i | 0.19787+0.11599i |
| | -0.24837+0.68473i | 1 | -0.24837-0.68473i | -0.30851+0.25633i |
| | -0.30851-0.25633i | -0.24837+0.68473i | 1 | -0.24837-0.68473i |
| | 0.19787-0.11599i | -0.30851-0.25633i | -0.24837+0.68473i | 1 |
| 20 | 1 | -0.5045+0.55033i | -0.034356-0.42245i | 0.19419+0.15158i |
| | -0.5045-0.55033i | 1 | -0.5045+0.55033i | -0.034356-0.42245i |
| | -0.034356+0.42245i | -0.5045-0.55033i | 1 | -0.5045+0.55033i |
| | 0.19419+0.15158i | -0.034356+0.42245i | -0.5045-0.55033i | 1 |
| 30 | 1 | 0.77628+0.00048674i | 0.46419+0.003784i | 0.27788+0.0033531i |
| | 0.77628+0.00048674i | 1 | 0.77628-0.00048674i | 0.46419+0.003784i |
| | 0.46419-0.003784i | 0.77628+0.00048674i | 1 | 0.77628-0.00048674i |
| | 0.27788-0.0033531i | 0.46419-0.003784i | 0.77628+0.00048674i | 1 |
| 40 | 1 | -0.73662-0.35123i | 0.32532+0.41286i | -0.069781-0.32227i |
| | -0.73662+0.35123i | 1 | -0.73662-0.35123i | 0.32532+0.41286i |
| | 0.32532-0.41286i | -0.73662+0.35123i | 1 | -0.73662-0.35123i |
| | -0.069781+0.32227i | 0.32532-0.41286i | -0.73662+0.35123i | 1 |
| 50 | 1 | 0.79542+0.33502i | 0.41987-0.44501i | 0.13777-0.38778i |
| | 0.79542-0.33502i | 1 | 0.79542+0.33502i | 0.41987-0.44501i |
| | 0.41987+0.44501i | 0.79542-0.33502i | 1 | 0.79542+0.33502i |
| | 0.13777+0.38778i | 0.41987+0.44501i | 0.79542-0.33502i | 1 |
| 60 | 1 | -0.88763+0.21106i | 0.65145-0.31394i | -0.42471+0.32845i |
| | -0.88763-0.21106i | 1 | -0.88763+0.21106i | 0.65145-0.31394i |
| | 0.65145+0.31394i | -0.88763-0.21106i | 1 | -0.88763+0.21106i |
| | -0.42471-0.32845i | 0.65145+0.31394i | -0.88763-0.21106i | 1 |
| 70 | 1 | 0.0418-0.95588i | -0.84402-0.085075i | -0.12056+0.70389i |
| | 0.0418+0.95588i | 1 | 0.0418-0.95588i | -0.84402+0.085075i |
| | -0.84402+0.085075i | 0.0418+0.95588i | 1 | 0.0418-0.95588i |
| | -0.12056-0.70389i | -0.84402+0.085075i | 0.0418+0.95588i | 1 |
| 80 | 1 | 0.91162-0.38115i | 0.67381-0.67646i | 0.35206-0.83437i |
| | 0.91162+0.38115i | 1 | 0.91162-0.38115i | 0.67381-0.67646i |
| | 0.67381+0.67646i | 0.91162+0.38115i | 1 | 0.91162-0.38115i |
| | 0.35206+0.83437i | 0.67381+0.67646i | 0.91162+0.38115i | 1 |
| 90 | 1 | 0.9993-0.01525i | 0.99728-0.0302i | 0.99408+0.044615i |
| | 0.9993+0.01525i | 1 | 0.9993-0.01525i | 0.99728-0.0302i |
| | 0.99728+0.0302i | 0.9993+0.01525i | 1 | 0.9993-0.01525i |
| | 0.99408+0.044615i | 0.99728+0.0302i | 0.9993+0.01525i | 1 |
| 100 | 1 | 0.91162-0.38115i | 0.67381-0.67646i | 0.35206-0.83437i |
| | 0.91162+0.38115i | 1 | 0.91162-0.38115i | 0.67381-0.67646i |
| | 0.67381+0.67646i | 0.91162+0.38115i | 1 | 0.91162-0.38115i |
| | 0.35206+0.83437i | 0.67381+0.67646i | 0.91162+0.38115i | 1 |
| 110 | 1 | 0.0418-0.95588i | -0.84402-0.085075i | -0.12056+0.70389i |
| | 0.0418+0.95588i | 1 | 0.0418-0.95588i | -0.84402+0.085075i |
| | -0.84402+0.085075i | 0.0418+0.95588i | 1 | 0.0418-0.95588i |
| | -0.12056-0.70389i | -0.84402+0.085075i | 0.0418+0.95588i | 1 |
| 120 | 1 | -0.88763+0.21106i | 0.65145-0.31394i | -0.42471+0.32845i |
| | -0.88763-0.21106i | 1 | -0.88763+0.21106i | 0.65145-0.31394i |
| | 0.65145+0.31394i | -0.88763-0.21106i | 1 | -0.88763+0.21106i |
| | -0.42471-0.32845i | 0.65145+0.31394i | -0.88763-0.21106i | 1 |
| 130 | 1 | 0.79542+0.33502i | 0.41987+0.44501i | 0.13777+0.38778i |
| | 0.79542-0.33502i | 1 | 0.79542+0.33502i | 0.41987+0.44501i |
| | 0.41987-0.44501i | 0.79542-0.33502i | 1 | 0.79542+0.33502i |
| | 0.13777-0.38778i | 0.41987-0.44501i | 0.79542-0.33502i | 1 |
| 140 | 1 | -0.73662-0.35123i | 0.32532+0.41286i | -0.069781+0.32227i |
| | -0.73662+0.35123i | 1 | -0.73662-0.35123i | 0.32532+0.41286i |
| | 0.32532-0.41286i | -0.73662+0.35123i | 1 | -0.73662-0.35123i |
| | -0.069781+0.32227i | 0.32532-0.41286i | -0.73662+0.35123i | 1 |
| 150 | 1 | 0.77628-0.00048674i | 0.46419+0.003784i | 0.27788+0.0033531i |
| | 0.77628+0.00048674i | 1 | 0.77628-0.00048674i | 0.46419+0.003784i |
| | 0.46419-0.003784i | 0.77628+0.00048674i | 1 | 0.77628-0.00048674i |
| | 0.27788-0.0033531i | 0.46419-0.003784i | 0.77628+0.00048674i | 1 |
| 160 | 1 | -0.5045+0.55033i | -0.034356-0.42245i | 0.19419+0.15158i |
| | -0.5045-0.55033i | 1 | -0.5045+0.55033i | -0.034356-0.42245i |
| | -0.034356+0.42245i | -0.5045-0.55033i | 1 | -0.5045+0.55033i |
| | 0.19419-0.15158i | -0.034356+0.42245i | -0.5045-0.55033i | 1 |
| 170 | 1 | -0.24837-0.68473i | -0.30851+0.25633i | 0.19787+0.11599i |
| | -0.24837+0.68473i | 1 | -0.24837-0.68473i | -0.30851+0.25633i |
| | -0.30851-0.25633i | -0.24837+0.68473i | 1 | -0.24837-0.68473i |
| | 0.19787-0.11599i | -0.30851-0.25633i | -0.24837+0.68473i | 1 |
| 180 | 1 | 0.72227+1.5585e-15i | 0.39376-1.7454e-15i | 0.22399+8.6442e-16i |
| | 0.72227-1.5585e-15i | 1 | 0.72227+1.5585e-15i | 0.39376-1.7454e-15i |
| | 0.39376+1.7454e-15i | 0.72227-1.5585e-15i | 1 | 0.72227+1.5585e-15i |
| | 0.22399-8.6442e-16i | 0.39376+1.7454e-15i | 0.72227-1.5585e-15i | 1 |
| 190 | 1 | -0.24837+0.68473i | -0.30851-0.25633i | 0.19787-0.11599i |
| | -0.24837-0.68473i | 1 | -0.24837+0.68473i | -0.30851-0.25633i |
| | -0.30851+0.25633i | -0.24837-0.68473i | 1 | -0.24837+0.68473i |
| | 0.19787+0.11599i | -0.30851+0.25633i | -0.24837-0.68473i | 1 |
| 200 | 1 | -0.5045-0.55033i | -0.034356+0.42245i | 0.19419-0.15158i |
| | -0.5045+0.55033i | 1 | -0.5045-0.55033i | -0.034356+0.42245i |
| | -0.034356-0.42245i | -0.5045+0.55033i | 1 | -0.5045-0.55033i |
| | 0.19419+0.15158i | -0.034356-0.42245i | -0.5045+0.55033i | 1 |
| 210 | 1 | 0.77628+0.00048674i | 0.46419-0.003784i | 0.27788-0.0033531i |
| | 0.77628-0.00048674i | 1 | 0.77628+0.00048674i | 0.46419-0.003784i |
| | 0.46419+0.003784i | 0.77628-0.00048674i | 1 | 0.77628+0.00048674i |
| | 0.27788+0.0033531i | 0.46419+0.003784i | 0.77628-0.00048674i | 1 |
| 220 | 1 | -0.73662+0.35123i | 0.32532-0.41286i | -0.069781+0.32227i |
| | -0.73662-0.35123i | 1 | -0.73662+0.35123i | 0.32532-0.41286i |
| | 0.32532+0.41286i | -0.73662-0.35123i | 1 | -0.73662+0.35123i |
| | -0.069781-0.32227i | 0.32532+0.41286i | -0.73662-0.35123i | 1 |
| 230 | 1 | 0.79542-0.33502i | 0.41987-0.44501i | 0.13777-0.38778i |
| | 0.79542+0.33502i | 1 | 0.79542-0.33502i | 0.41987-0.44501i |
| | 0.41987+0.44501i | 0.79542+0.33502i | 1 | 0.79542-0.33502i |
| | 0.13777+0.38778i | 0.41987+0.44501i | 0.79542+0.33502i | 1 |
| 240 | 1 | -0.88763+0.21106i | 0.65145+0.31394i | -0.42471-0.32845i |
| | -0.88763-0.21106i | 1 | -0.88763+0.21106i | 0.65145+0.31394i |
| | 0.65145-0.31394i | -0.88763+0.21106i | 1 | -0.88763-0.21106i |
| | -0.42471+0.32845i | 0.65145-0.31394i | -0.88763+0.21106i | 1 |
| 250 | 1 | 0.0418+0.95588i | -0.84402+0.085075i | -0.12056-0.70389i |
| | 0.0418-0.95588i | 1 | 0.0418+0.95588i | -0.84402+0.085075i |
| | -0.84402-0.085075i | 0.0418-0.95588i | 1 | 0.0418+0.95588i |
| | -0.12056+0.70389i | -0.84402-0.085075i | 0.0418-0.95588i | 1 |
| 260 | 1 | 0.91162+0.38115i | 0.67381+0.67646i | 0.35206+0.83437i |
| | 0.91162-0.38115i | 1 | 0.91162+0.38115i | 0.67381+0.67646i |
| | 0.67381-0.67646i | 0.91162-0.38115i | 1 | 0.91162+0.38115i |
| | 0.35206-0.83437i | 0.67381-0.67646i | 0.91162-0.38115i | 1 |
| 270 | 1 | 0.9993+0.01525i | 0.99728+0.0302i | 0.99408+0.044615i |
| | 0.9993-0.01525i | 1 | 0.9993+0.01525i | 0.99728+0.0302i |
| | 0.99728-0.0302i | 0.9993-0.01525i | 1 | 0.9993+0.01525i |
| | 0.99408-0.044615i | 0.99728-0.0302i | 0.9993-0.01525i | 1 |
| 280 | 1 | 0.91162+0.38115i | 0.67381+0.67646i | 0.35206+0.83437i |
| | 0.91162-0.38115i | 1 | 0.91162+0.38115i | 0.67381+0.67646i |
| | 0.67381-0.67646i | 0.91162-0.38115i | 1 | 0.91162+0.38115i |
| | 0.35206-0.83437i | 0.67381-0.67646i | 0.91162-0.38115i | 1 |
| 290 | 1 | 0.0418+0.95588i | -0.84402+0.085075i | -0.12056-0.70389i |
| | 0.0418-0.95588i | 1 | 0.0418+0.95588i | -0.84402+0.085075i |
| | -0.84402-0.085075i | 0.0418-0.95588i | 1 | 0.0418+0.95588i |
| | -0.12056+0.70389i | -0.84402-0.085075i | 0.0418-0.95588i | 1 |
| 300 | 1 | -0.88763-0.21106i | 0.65145+0.31394i | -0.42471-0.32845i |
| | -0.88763+0.21106i | 1 | -0.88763-0.21106i | 0.65145+0.31394i |
| | 0.65145-0.31394i | -0.88763+0.21106i | 1 | -0.88763-0.21106i |
| | -0.42471+0.32845i | 0.65145-0.31394i | -0.88763+0.21106i | 1 |
| 310 | 1 | 0.79542-0.33502i | 0.41987-0.44501i | 0.13777-0.38778i |
| | 0.79542+0.33502i | 1 | 0.79542-0.33502i | 0.41987-0.44501i |
| | 0.41987+0.44501i | 0.79542+0.33502i | 1 | 0.79542-0.33502i |
| | 0.13777+0.38778i | 0.41987+0.44501i | 0.79542+0.33502i | 1 |
| 320 | 1 | -0.73662+0.35123i | 0.32532-0.41286i | -0.069781+0.32227i |
| | -0.73662-0.35123i | 1 | -0.73662+0.35123i | 0.32532-0.41286i |
| | 0.32532+0.41286i | -0.73662-0.35123i | 1 | -0.73662+0.35123i |
| | -0.069781-0.32227i | 0.32532+0.41286i | -0.73662-0.35123i | 1 |
| 330 | 1 | 0.77628+0.00048674i | 0.46419-0.003784i | 0.27788-0.0033531i |
| | 0.77628-0.00048674i | 1 | 0.77628+0.00048674i | 0.46419-0.003784i |
| | 0.46419+0.003784i | 0.77628-0.00048674i | 1 | 0.77628+0.00048674i |
| | 0.27788+0.0033531i | 0.46419+0.003784i | 0.77628-0.00048674i | 1 |
| 340 | 1 | -0.5045-0.55033i | -0.034356+0.42245i | 0.19419-0.15158i |
| | -0.5045+0.55033i | 1 | -0.5045-0.55033i | -0.034356+0.42245i |
| | -0.034356-0.42245i | -0.5045+0.55033i | 1 | -0.5045-0.55033i |
| | 0.19419+0.15158i | -0.034356-0.42245i | -0.5045+0.55033i | 1 |
| 350 | 1 | -0.24837+0.68473i | -0.30851-0.25633i | 0.19787-0.11599i |
| | -0.24837-0.68473i | 1 | -0.24837+0.68473i | -0.30851-0.25633i |
| | -0.30851+0.25633i | -0.24837-0.68473i | 1 | -0.24837+0.68473i |
| | 0.19787+0.11599i | -0.30851+0.25633i | -0.24837-0.68473i | 1 |

# Table 5-5 Antenna Spacing 10 λ, Angular Spread 2 degrees, Laplacian Model

Angular Spread 2, Antenna Spacing 10xWavelength

Angular Spread 2, Antenna Spacing 10 x Wavelength

| Angle of Arrival/Departure | | | | |
|---|---|---|---|---|
| 0 | 1 | 0.29361 | 0.09414 | 0.043947 |
| | 0.29361 | 1 | 0.29361 | 0.09414 |
| | 0.09414 | 0.29361 | 1 | 0.29361 |
| | 0.043947 | 0.09414 | 0.29361 | 1 |
| 10 | 1 | -0.024377-0.29901i | -0.095444+0.016041i | 0.011463+0.044225i |
| | -0.024377+0.29901i | 1 | -0.024377-0.29901i | -0.095444+0.016041i |
| | -0.095444-0.016041i | -0.024377+0.29901i | 1 | -0.024377-0.29901i |
| | 0.011463-0.044225i | -0.095444-0.016041i | -0.024377+0.29901i | 1 |
| 20 | 1 | -0.28177+0.15181i | 0.057273-0.088353i | -0.0035463+0.049333i |
| | -0.28177-0.15181i | 1 | -0.28177+0.15181i | 0.057273-0.088353i |
| | 0.057273+0.088353i | -0.28177-0.15181i | 1 | -0.28177+0.15181i |
| | -0.0035463-0.049333i | 0.057273+0.088353i | -0.28177-0.15181i | 1 |
| 30 | 1 | 0.3566+0.0038378i | 0.12168+0.0014242i | 0.057893+0.00072006i |
| | 0.3566-0.0038378i | 1 | 0.3566+0.0038378i | 0.12168+0.0014242i |
| | 0.12168-0.0014242i | 0.3566-0.0038378i | 1 | 0.3566+0.0038378i |
| | 0.057893-0.00072006i | 0.12168-0.0014242i | 0.3566-0.0038378i | 1 |
| 40 | 1 | -0.37536+0.17645i | 0.094834-0.11674i | -0.016221+0.071001i |
| | -0.37536-0.17645i | 1 | -0.37536+0.17645i | 0.094834-0.11674i |
| | 0.094834+0.11674i | -0.37536-0.17645i | 1 | -0.37536+0.17645i |
| | -0.016221-0.071001i | 0.094834+0.11674i | -0.37536-0.17645i | 1 |
| 50 | 1 | -0.26151-0.42845i | -0.091214+0.17899i | 0.099976-0.009446i |
| | -0.26151+0.42845i | 1 | -0.26151-0.42845i | -0.091214+0.17899i |
| | -0.091214-0.17899i | -0.26151+0.42845i | 1 | -0.26151-0.42845i |
| | 0.099976+0.009446i | -0.091214-0.17899i | -0.26151+0.42845i | 1 |
| 60 | 1 | -0.32888-0.53223i | -0.13526+0.26061i | 0.15525-0.013032i |
| | -0.32888+0.53223i | 1 | -0.32888-0.53223i | -0.13526+0.26061i |
| | -0.13526-0.26061i | -0.32888+0.53223i | 1 | -0.32888-0.53223i |
| | 0.15525+0.013032i | -0.13526-0.26061i | -0.32888+0.53223i | 1 |
| 70 | 1 | -0.622+0.47427i | 0.14593-0.44918i | 0.087545+0.26902i |
| | -0.622-0.47427i | 1 | -0.622+0.47427i | 0.14593-0.44918i |
| | 0.14593+0.44918i | -0.622-0.47427i | 1 | -0.622+0.47427i |
| | 0.087545-0.26902i | 0.14593+0.44918i | -0.622-0.47427i | 1 |
| 80 | 1 | 0.51873+0.77406i | -0.26635-0.73506i | -0.58773+0.19142i |
| | 0.51873+0.77406i | 1 | 0.51873-0.77406i | -0.26635-0.73506i |
| | -0.26635+0.73506i | 0.51873+0.77406i | 1 | 0.51873+0.77406i |
| | -0.58773+0.19142i | -0.26635+0.73506i | 0.51873+0.77406i | 1 |
| 90 | 1 | 0.99581-0.037485i | 0.98493-0.071321i | 0.97022-0.10048i |
| | 0.99581+0.037485i | 1 | 0.99581-0.037485i | 0.98493-0.071321i |
| | 0.98493+0.071321i | 0.99581+0.037485i | 1 | 0.99581-0.037485i |
| | 0.97022+0.10048i | 0.98493+0.071321i | 0.99581+0.037485i | 1 |
| 100 | 1 | 0.51873-0.77406i | -0.26635-0.73506i | -0.58773-0.19142i |
| | 0.51873+0.77406i | 1 | 0.51873-0.77406i | -0.26635-0.73506i |
| | -0.26635+0.73506i | 0.51873+0.77406i | 1 | 0.51873-0.77406i |
| | -0.58773+0.19142i | -0.26635+0.73506i | 0.51873+0.77406i | 1 |
| 110 | 1 | -0.622+0.47427i | 0.14593-0.44918i | 0.087545+0.26902i |
| | -0.622-0.47427i | 1 | -0.622+0.47427i | 0.14593-0.44918i |
| | 0.14593+0.44918i | -0.622-0.47427i | 1 | -0.622+0.47427i |
| | 0.087545-0.26902i | 0.14593+0.44918i | -0.622-0.47427i | 1 |
| 120 | 1 | -0.32888-0.53223i | -0.13526+0.26061i | 0.15525-0.013032i |
| | -0.32888+0.53223i | 1 | -0.32888-0.53223i | -0.13526+0.26061i |
| | -0.13526-0.26061i | -0.32888+0.53223i | 1 | -0.32888-0.53223i |
| | 0.15525+0.013032i | -0.13526-0.26061i | -0.32888+0.53223i | 1 |
| 130 | 1 | -0.26151-0.42845i | -0.091214+0.17899i | 0.099976-0.009446i |
| | -0.26151+0.42845i | 1 | -0.26151-0.42845i | -0.091214+0.17899i |
| | -0.091214-0.17899i | -0.26151+0.42845i | 1 | -0.26151-0.42845i |
| | 0.099976+0.009446i | -0.091214-0.17899i | -0.26151+0.42845i | 1 |
| 140 | 1 | -0.37536+0.17645i | 0.094834-0.11674i | -0.016221+0.071001i |
| | -0.37536-0.17645i | 1 | -0.37536+0.17645i | 0.094834-0.11674i |
| | 0.094834+0.11674i | -0.37536+0.17645i | 1 | -0.37536+0.17645i |
| | -0.016221-0.071001i | 0.094834+0.11674i | -0.37536-0.17645i | 1 |
| 150 | 1 | 0.3566+0.0038378i | 0.12168+0.0014242i | 0.057893+0.00072006i |
| | 0.3566-0.0038378i | 1 | 0.3566+0.0038378i | 0.12168+0.0014242i |
| | 0.12168-0.0014242i | 0.3566-0.0038378i | 1 | 0.3566+0.0038378i |
| | 0.057893-0.00072006i | 0.12168-0.0014242i | 0.3566-0.0038378i | 1 |
| 160 | 1 | -0.28177+0.15181i | 0.057273-0.088353i | -0.0035463+0.049333i |
| | -0.28177-0.15181i | 1 | -0.28177+0.15181i | 0.057273-0.088353i |
| | 0.057273+0.088353i | -0.28177-0.15181i | 1 | -0.28177+0.15181i |
| | -0.0035463-0.049333i | 0.057273+0.088353i | -0.28177-0.15181i | 1 |
| 170 | 1 | -0.024377-0.29901i | -0.095444+0.016041i | 0.011463+0.044225i |
| | -0.024377+0.29901i | 1 | -0.024377-0.29901i | -0.095444+0.016041i |
| | -0.095444-0.016041i | -0.024377+0.29901i | 1 | -0.024377-0.29901i |
| | 0.011463-0.044225i | -0.095444-0.016041i | -0.024377+0.29901i | 1 |
| 180 | 1 | 0.29361+2.0237e-15i | 0.09414+1.6958e-15i | 0.043947-3.9274e-15i |
| | 0.29361-2.0237e-15i | 1 | 0.29361+2.0237e-15i | 0.09414+1.6958e-15i |
| | 0.09414-1.6958e-15i | 0.29361-2.0237e-15i | 1 | 0.29361+2.0237e-15i |
| | 0.043947+3.9274e-15i | 0.09414-1.6958e-15i | 0.29361-2.0237e-15i | 1 |
| 190 | 1 | -0.024377+0.29901i | -0.095444-0.016041i | 0.011463-0.044225i |
| | -0.024377-0.29901i | 1 | -0.024377+0.29901i | -0.095444-0.016041i |
| | -0.095444+0.016041i | -0.024377-0.29901i | 1 | -0.024377+0.29901i |
| | 0.011463+0.044225i | -0.095444+0.016041i | -0.024377-0.29901i | 1 |
| 200 | 1 | -0.28177-0.15181i | 0.057273+0.088353i | -0.0035463-0.049333i |
| | -0.28177+0.15181i | 1 | -0.28177-0.15181i | 0.057273+0.088353i |
| | 0.057273-0.088353i | -0.28177+0.15181i | 1 | -0.28177-0.15181i |
| | -0.0035463+0.049333i | 0.057273-0.088353i | -0.28177+0.15181i | 1 |
| 210 | 1 | 0.3566-0.0038378i | 0.12168-0.0014242i | 0.057893-0.00072006i |
| | 0.3566+0.0038378i | 1 | 0.3566-0.0038378i | 0.12168-0.0014242i |
| | 0.12168+0.0014242i | 0.3566+0.0038378i | 1 | 0.3566-0.0038378i |
| | 0.057893+0.00072006i | 0.12168+0.0014242i | 0.3566+0.0038378i | 1 |
| 220 | 1 | -0.37536-0.17645i | 0.094834+0.11674i | -0.016221-0.071001i |
| | -0.37536+0.17645i | 1 | -0.37536-0.17645i | 0.094834+0.11674i |
| | 0.094834-0.11674i | -0.37536+0.17645i | 1 | -0.37536-0.17645i |
| | -0.016221+0.071001i | 0.094834-0.11674i | -0.37536+0.17645i | 1 |
| 230 | 1 | -0.26151+0.42845i | -0.091214-0.17899i | 0.099976+0.009446i |
| | -0.26151-0.42845i | 1 | -0.26151+0.42845i | -0.091214-0.17899i |
| | -0.091214+0.17899i | -0.26151-0.42845i | 1 | -0.26151+0.42845i |
| | 0.099976-0.009446i | -0.091214+0.17899i | -0.26151-0.42845i | 1 |
| 240 | 1 | -0.32888+0.53223i | -0.13526-0.26061i | 0.15525+0.013032i |
| | -0.32888-0.53223i | 1 | -0.32888+0.53223i | -0.13526-0.26061i |
| | -0.13526+0.26061i | -0.32888-0.53223i | 1 | -0.32888+0.53223i |
| | 0.15525-0.013032i | -0.13526+0.26061i | -0.32888-0.53223i | 1 |
| 250 | 1 | -0.622-0.47427i | 0.14593+0.44918i | 0.087545-0.26902i |
| | -0.622+0.47427i | 1 | -0.622-0.47427i | 0.14593+0.44918i |
| | 0.14593-0.44918i | -0.622+0.47427i | 1 | -0.622-0.47427i |
| | 0.087545+0.26902i | 0.14593-0.44918i | -0.622+0.47427i | 1 |
| 260 | 1 | 0.51873+0.77406i | -0.26635+0.73506i | -0.58773+0.19142i |
| | 0.51873-0.77406i | 1 | 0.51873+0.77406i | -0.26635+0.73506i |
| | -0.26635-0.73506i | 0.51873-0.77406i | 1 | 0.51873+0.77406i |
| | -0.58773-0.19142i | -0.26635-0.73506i | 0.51873-0.77406i | 1 |
| 270 | 1 | 0.99581+0.037485i | 0.98493+0.071321i | 0.97022+0.10048i |
| | 0.99581-0.037485i | 1 | 0.99581+0.037485i | 0.98493+0.071321i |
| | 0.98493-0.071321i | 0.99581-0.037485i | 1 | 0.99581+0.037485i |
| | 0.97022-0.10048i | 0.98493-0.071321i | 0.99581-0.037485i | 1 |
| 280 | 1 | 0.51873+0.77406i | -0.26635+0.73506i | -0.58773+0.19142i |
| | 0.51873-0.77406i | 1 | 0.51873+0.77406i | -0.26635+0.73506i |
| | -0.26635-0.73506i | 0.51873-0.77406i | 1 | 0.51873+0.77406i |
| | -0.58773-0.19142i | -0.26635-0.73506i | 0.51873-0.77406i | 1 |
| 290 | 1 | -0.622-0.47427i | 0.14593+0.44918i | 0.087545-0.26902i |
| | -0.622+0.47427i | 1 | -0.622-0.47427i | 0.14593+0.44918i |
| | 0.14593-0.44918i | -0.622+0.47427i | 1 | -0.622-0.47427i |
| | 0.087545+0.26902i | 0.14593-0.44918i | -0.622+0.47427i | 1 |
| 300 | 1 | -0.32888+0.53223i | -0.13526-0.26061i | 0.15525+0.013032i |
| | -0.32888-0.53223i | 1 | -0.32888+0.53223i | -0.13526-0.26061i |
| | -0.13526+0.26061i | -0.32888-0.53223i | 1 | -0.32888+0.53223i |
| | 0.15525-0.013032i | -0.13526+0.26061i | -0.32888-0.53223i | 1 |
| 310 | 1 | -0.26151+0.42845i | -0.091214-0.17899i | 0.099976+0.009446i |
| | -0.26151-0.42845i | 1 | -0.26151+0.42845i | -0.091214-0.17899i |
| | -0.091214+0.17899i | -0.26151-0.42845i | 1 | -0.26151+0.42845i |
| | 0.099976-0.009446i | -0.091214+0.17899i | -0.26151-0.42845i | 1 |
| 320 | 1 | -0.37536-0.17645i | 0.094834+0.11674i | -0.016221-0.071001i |
| | -0.37536+0.17645i | 1 | -0.37536-0.17645i | 0.094834+0.11674i |
| | 0.094834-0.11674i | -0.37536+0.17645i | 1 | -0.37536-0.17645i |
| | -0.016221+0.071001i | 0.094834-0.11674i | -0.37536+0.17645i | 1 |
| 330 | 1 | 0.3566-0.0038378i | 0.12168-0.0014242i | 0.057893-0.00072006i |
| | 0.3566+0.0038378i | 1 | 0.3566-0.0038378i | 0.12168-0.0014242i |
| | 0.12168+0.0014242i | 0.3566+0.0038378i | 1 | 0.3566-0.0038378i |
| | 0.057893+0.00072006i | 0.12168+0.0014242i | 0.3566+0.0038378i | 1 |
| 340 | 1 | -0.28177-0.15181i | 0.057273+0.088353i | -0.0035463-0.049333i |
| | -0.28177+0.15181i | 1 | -0.28177-0.15181i | 0.057273+0.088353i |
| | 0.057273-0.088353i | -0.28177+0.15181i | 1 | -0.28177-0.15181i |
| | -0.0035463+0.049333i | 0.057273-0.088353i | -0.28177+0.15181i | 1 |
| 350 | 1 | -0.024377+0.29901i | -0.095444-0.016041i | 0.011463-0.044225i |
| | -0.024377-0.29901i | 1 | -0.024377+0.29901i | -0.095444-0.016041i |
| | -0.095444+0.016041i | -0.024377-0.29901i | 1 | -0.024377+0.29901i |
| | 0.011463+0.044225i | -0.095444+0.016041i | -0.024377-0.29901i | 1 |

# Table 5-6 Antenna Spacing 0.5 λ, Angular Spread 5 degrees, Laplacian Model

Angular Spread 5, Antenna Spacing 0.5xWavelength

| Angle of Arrival/Departure | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 0.96425 | 0.87044 | 0.74834 | 180 | 1 | 0.96425+3.6983e-16i | 0.87044+6.8307e-16i | 0.74834+1.2131e-15i |
| | 0.96425 | 1 | 0.96425 | 0.87044 | | 0.96425-3.6983e-16i | 1 | 0.96425+3.6983e-16i | 0.87044+6.8307e-16i |
| | 0.87044 | 0.96425 | 1 | 0.96425 | | 0.87044-6.8307e-16i | 0.96425-3.6983e-16i | 1 | 0.96425+3.6983e-16i |
| | 0.74834 | 0.87044 | 0.96425 | 1 | | 0.74834-1.2131e-15i | 0.87044-6.8307e-16i | 0.96425-3.6983e-16i | 1 |
| 10 | 1 | 0.82604+0.49943i | 0.40474+0.7745i | -0.04953+0.75251i | 190 | 1 | 0.82604-0.49943i | 0.40474-0.7745i | -0.04953-0.75251i |
| | 0.82604-0.49943i | 1 | 0.82604+0.49943i | 0.40474+0.7745i | | 0.82604+0.49943i | 1 | 0.82604-0.49943i | 0.40474-0.7745i |
| | 0.40474-0.7745i | 0.82604-0.49943i | 1 | 0.82604+0.49943i | | 0.40474+0.7745i | 0.82604+0.49943i | 1 | 0.82604-0.49943i |
| | -0.04953-0.75251i | 0.40474-0.7745i | 0.82604-0.49943i | 1 | | -0.04953+0.75251i | 0.40474+0.7745i | 0.82604+0.49943i | 1 |
| 20 | 1 | 0.46403+0.84985i | -0.48015+0.74213i | -0.76882-0.06245i | 200 | 1 | 0.46403-0.84985i | -0.48015-0.74213i | -0.76882+0.06245i |
| | 0.46403-0.84985i | 1 | 0.46403+0.84985i | -0.48015+0.74213i | | 0.46403+0.84985i | 1 | 0.46403-0.84985i | -0.48015-0.74213i |
| | -0.48015-0.74213i | 0.46403-0.84985i | 1 | 0.46403+0.84985i | | -0.48015+0.74213i | 0.46403+0.84985i | 1 | 0.46403-0.84985i |
| | -0.76882+0.06245i | -0.48015-0.74213i | 0.46403-0.84985i | 1 | | -0.76882-0.06245i | -0.48015+0.74213i | 0.46403+0.84985i | 1 |
| 30 | 1 | 0.0050506+0.97289i | -0.89968+0.0058631i | -0.0023102-0.79922i | 210 | 1 | 0.0050506-0.97289i | -0.89968-0.0058631i | -0.0023102+0.79922i |
| | 0.0050506-0.97289i | 1 | 0.0050506+0.97289i | -0.89968+0.0058631i | | 0.0050506+0.97289i | 1 | 0.0050506-0.97289i | -0.89968-0.0058631i |
| | -0.89968-0.0058631i | 0.0050506-0.97289i | 1 | 0.0050506+0.97289i | | -0.89968+0.0058631i | 0.0050506+0.97289i | 1 | 0.0050506-0.97289i |
| | -0.0023102+0.79922i | -0.89968-0.0058631i | 0.0050506-0.97289i | 1 | | -0.0023102-0.79922i | -0.89968+0.0058631i | 0.0050506+0.97289i | 1 |
| 40 | 1 | -0.41834+0.8847i | -0.58072-0.71325i | 0.81371-0.19212i | 220 | 1 | -0.41834-0.8847i | -0.58072+0.71325i | 0.81371+0.19212i |
| | -0.41834-0.8847i | 1 | -0.41834+0.8847i | -0.58072-0.71325i | | -0.41834+0.8847i | 1 | -0.41834-0.8847i | -0.58072+0.71325i |
| | -0.58072+0.71325i | -0.41834-0.8847i | 1 | -0.41834+0.8847i | | -0.58072-0.71325i | -0.41834+0.8847i | 1 | -0.41834-0.8847i |
| | 0.81371+0.19212i | -0.58072+0.71325i | -0.41834-0.8847i | 1 | | 0.81371-0.19212i | -0.58072-0.71325i | -0.41834+0.8847i | 1 |
| 50 | 1 | -0.72492+0.66652i | 0.082283-0.93837i | 0.52968+0.70126i | 230 | 1 | -0.72492-0.66652i | 0.082283+0.93837i | 0.52968-0.70126i |
| | -0.72492-0.66652i | 1 | -0.72492+0.66652i | 0.082283-0.93837i | | -0.72492+0.66652i | 1 | -0.72492-0.66652i | 0.082283+0.93837i |
| | 0.082283+0.93837i | -0.72492-0.66652i | 1 | -0.72492+0.66652i | | 0.082283-0.93837i | -0.72492+0.66652i | 1 | -0.72492-0.66652i |
| | 0.52968-0.70126i | 0.082283+0.93837i | -0.72492-0.66652i | 1 | | 0.52968+0.70126i | 0.082283-0.93837i | -0.72492+0.66652i | 1 |
| 60 | 1 | -0.90011+0.41363i | 0.62954-0.72965i | -0.26207+0.88458i | 240 | 1 | -0.90011-0.41363i | 0.62954+0.72965i | -0.26207-0.88458i |
| | -0.90011-0.41363i | 1 | -0.90011+0.41363i | 0.62954-0.72965i | | -0.90011+0.41363i | 1 | -0.90011-0.41363i | 0.62954+0.72965i |
| | 0.62954+0.72965i | -0.90011-0.41363i | 1 | -0.90011+0.41363i | | 0.62954-0.72965i | -0.90011+0.41363i | 1 | -0.90011-0.41363i |
| | -0.26207-0.88458i | 0.62954+0.72965i | -0.90011-0.41363i | 1 | | -0.26207+0.88458i | 0.62954-0.72965i | -0.90011+0.41363i | 1 |
| 70 | 1 | -0.97548+0.19816i | 0.90473-0.38189i | -0.79537+0.53939i | 250 | 1 | -0.97548-0.19816i | 0.90473+0.38189i | -0.79537-0.53939i |
| | -0.97548-0.19816i | 1 | -0.97548+0.19816i | 0.90473-0.38189i | | -0.97548+0.19816i | 1 | -0.97548-0.19816i | 0.90473+0.38189i |
| | 0.90473+0.38189i | -0.97548-0.19816i | 1 | -0.97548+0.19816i | | 0.90473-0.38189i | -0.97548+0.19816i | 1 | -0.97548-0.19816i |
| | -0.79537-0.53939i | 0.90473+0.38189i | -0.97548-0.19816i | 1 | | -0.79537+0.53939i | 0.90473-0.38189i | -0.97548+0.19816i | 1 |
| 80 | 1 | -0.99679+0.059261i | 0.98735-0.11734i | -0.97219+0.17323i | 260 | 1 | -0.99679-0.059261i | 0.98735+0.11734i | -0.97219-0.17323i |
| | -0.99679-0.059261i | 1 | -0.99679+0.059261i | 0.98735-0.11734i | | -0.99679+0.059261i | 1 | -0.99679-0.059261i | 0.98735+0.11734i |
| | 0.98735+0.11734i | -0.99679-0.059261i | 1 | -0.99679+0.059261i | | 0.98735-0.11734i | -0.99679+0.059261i | 1 | -0.99679-0.059261i |
| | -0.97219-0.17323i | 0.98735+0.11734i | -0.99679-0.059261i | 1 | | -0.97219+0.17323i | 0.98735-0.11734i | -0.99679+0.059261i | 1 |
| 90 | 1 | -0.99958+0.011893i | 0.99834-0.023645i | -0.99635+0.035134i | 270 | 1 | -0.99958-0.011893i | 0.99834+0.023645i | -0.99635-0.035134i |
| | -0.99958-0.011893i | 1 | -0.99958+0.011893i | 0.99834-0.023645i | | -0.99958+0.011893i | 1 | -0.99958-0.011893i | 0.99834+0.023645i |
| | 0.99834+0.023645i | -0.99958-0.011893i | 1 | -0.99958+0.011893i | | 0.99834-0.023645i | -0.99958+0.011893i | 1 | -0.99958-0.011893i |
| | -0.99635-0.035134i | 0.99834+0.023645i | -0.99958-0.011893i | 1 | | -0.99635+0.035134i | 0.99834-0.023645i | -0.99958+0.011893i | 1 |
| 100 | 1 | -0.99679+0.059261i | 0.98735-0.11734i | -0.97219+0.17323i | 280 | 1 | -0.99679-0.059261i | 0.98735+0.11734i | -0.97219-0.17323i |
| | -0.99679-0.059261i | 1 | -0.99679+0.059261i | 0.98735-0.11734i | | -0.99679+0.059261i | 1 | -0.99679-0.059261i | 0.98735+0.11734i |
| | 0.98735+0.11734i | -0.99679-0.059261i | 1 | -0.99679+0.059261i | | 0.98735-0.11734i | -0.99679+0.059261i | 1 | -0.99679-0.059261i |
| | -0.97219-0.17323i | 0.98735+0.11734i | -0.99679-0.059261i | 1 | | -0.97219+0.17323i | 0.98735-0.11734i | -0.99679+0.059261i | 1 |
| 110 | 1 | -0.97548+0.19816i | 0.90473-0.38189i | -0.79537+0.53939i | 290 | 1 | -0.97548-0.19816i | 0.90473+0.38189i | -0.79537-0.53939i |
| | -0.97548-0.19816i | 1 | -0.97548+0.19816i | 0.90473-0.38189i | | -0.97548+0.19816i | 1 | -0.97548-0.19816i | 0.90473+0.38189i |
| | 0.90473+0.38189i | -0.97548-0.19816i | 1 | -0.97548+0.19816i | | 0.90473-0.38189i | -0.97548+0.19816i | 1 | -0.97548-0.19816i |
| | -0.79537-0.53939i | 0.90473+0.38189i | -0.97548-0.19816i | 1 | | -0.79537+0.53939i | 0.90473-0.38189i | -0.97548+0.19816i | 1 |
| 120 | 1 | -0.90011+0.41363i | 0.62954-0.72965i | -0.26207+0.88458i | 300 | 1 | -0.90011-0.41363i | 0.62954+0.72965i | -0.26207-0.88458i |
| | -0.90011-0.41363i | 1 | -0.90011+0.41363i | 0.62954-0.72965i | | -0.90011+0.41363i | 1 | -0.90011-0.41363i | 0.62954+0.72965i |
| | 0.62954+0.72965i | -0.90011-0.41363i | 1 | -0.90011+0.41363i | | 0.62954-0.72965i | -0.90011+0.41363i | 1 | -0.90011-0.41363i |
| | -0.26207-0.88458i | 0.62954+0.72965i | -0.90011-0.41363i | 1 | | -0.26207+0.88458i | 0.62954-0.72965i | -0.90011+0.41363i | 1 |
| 130 | 1 | -0.72492+0.66652i | 0.082283-0.93837i | 0.52968+0.70126i | 310 | 1 | -0.72492-0.66652i | 0.082283+0.93837i | 0.52968-0.70126i |
| | -0.72492-0.66652i | 1 | -0.72492+0.66652i | 0.082283-0.93837i | | -0.72492+0.66652i | 1 | -0.72492-0.66652i | 0.082283+0.93837i |
| | 0.082283+0.93837i | -0.72492-0.66652i | 1 | -0.72492+0.66652i | | 0.082283-0.93837i | -0.72492+0.66652i | 1 | -0.72492-0.66652i |
| | 0.52968-0.70126i | 0.082283+0.93837i | -0.72492-0.66652i | 1 | | 0.52968+0.70126i | 0.082283-0.93837i | -0.72492+0.66652i | 1 |
| 140 | 1 | -0.41834+0.8847i | -0.58072-0.71325i | 0.81371-0.19212i | 320 | 1 | -0.41834-0.8847i | -0.58072+0.71325i | 0.81371+0.19212i |
| | -0.41834-0.8847i | 1 | -0.41834+0.8847i | -0.58072-0.71325i | | -0.41834+0.8847i | 1 | -0.41834-0.8847i | -0.58072+0.71325i |
| | -0.58072+0.71325i | -0.41834-0.8847i | 1 | -0.41834+0.8847i | | -0.58072-0.71325i | -0.41834+0.8847i | 1 | -0.41834-0.8847i |
| | 0.81371+0.19212i | -0.58072+0.71325i | -0.41834-0.8847i | 1 | | 0.81371-0.19212i | -0.58072-0.71325i | -0.41834+0.8847i | 1 |
| 150 | 1 | 0.0050506+0.97289i | -0.89968+0.0058631i | -0.0023102-0.79922i | 330 | 1 | 0.0050506-0.97289i | -0.89968-0.0058631i | -0.0023102+0.79922i |
| | 0.0050506-0.97289i | 1 | 0.0050506+0.97289i | -0.89968+0.0058631i | | 0.0050506+0.97289i | 1 | 0.0050506-0.97289i | -0.89968-0.0058631i |
| | -0.89968-0.0058631i | 0.0050506-0.97289i | 1 | 0.0050506+0.97289i | | -0.89968+0.0058631i | 0.0050506+0.97289i | 1 | 0.0050506-0.97289i |
| | -0.0023102+0.79922i | -0.89968-0.0058631i | 0.0050506-0.97289i | 1 | | -0.0023102-0.79922i | -0.89968+0.0058631i | 0.0050506+0.97289i | 1 |
| 160 | 1 | 0.46403+0.84985i | -0.48015+0.74213i | -0.76882-0.06245i | 340 | 1 | 0.46403-0.84985i | -0.48015-0.74213i | -0.76882+0.06245i |
| | 0.46403-0.84985i | 1 | 0.46403+0.84985i | -0.48015+0.74213i | | 0.46403+0.84985i | 1 | 0.46403-0.84985i | -0.48015-0.74213i |
| | -0.48015-0.74213i | 0.46403-0.84985i | 1 | 0.46403+0.84985i | | -0.48015+0.74213i | 0.46403+0.84985i | 1 | 0.46403-0.84985i |
| | -0.76882+0.06245i | -0.48015-0.74213i | 0.46403-0.84985i | 1 | | -0.76882-0.06245i | -0.48015+0.74213i | 0.46403+0.84985i | 1 |
| 170 | 1 | 0.82604+0.49943i | 0.40474+0.7745i | -0.04953+0.75251i | 350 | 1 | 0.82604-0.49943i | 0.40474-0.7745i | -0.04953-0.75251i |
| | 0.82604-0.49943i | 1 | 0.82604+0.49943i | 0.40474+0.7745i | | 0.82604+0.49943i | 1 | 0.82604-0.49943i | 0.40474-0.7745i |
| | 0.40474-0.7745i | 0.82604-0.49943i | 1 | 0.82604+0.49943i | | 0.40474+0.7745i | 0.82604+0.49943i | 1 | 0.82604-0.49943i |
| | -0.04953-0.75251i | 0.40474-0.7745i | 0.82604-0.49943i | 1 | | -0.04953+0.75251i | 0.40474+0.7745i | 0.82604+0.49943i | 1 |

# Table 5-7 Antenna Spacing 4 λ, Angular Spread 5 degrees, Laplacian Model

Angular Spread 5, Antenna Spacing 4xWavelength

| Angle of Arrival/Departure | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 0.29329 | 0.094057 | 0.044131 | 180 | 1 | 0.29329+3.4466e-16i | 0.094057-1.2264e-15i | 0.044131-4.7768e-16i |
| | 0.29329 | 1 | 0.29329 | 0.094057 | | 0.29329-3.4466e-16i | 1 | 0.29329+3.4466e-16i | 0.094057-1.2264e-15i |
| | 0.094057 | 0.29329 | 1 | 0.29329 | | 0.094057+1.2264e-15i | 0.29329-3.4466e-16i | 1 | 0.29329+3.4466e-16i |
| | 0.044131 | 0.094057 | 0.29329 | 1 | | 0.044131+4.7768e-16i | 0.094057+1.2264e-15i | 0.29329-3.4466e-16i | 1 |
| 10 | 1 | -0.099688-0.28261i | -0.074702+0.061389i | 0.039141+0.023079i | 190 | 1 | -0.099688+0.28261i | -0.074702-0.061389i | 0.039141-0.023079i |
| | -0.099688+0.28261i | 1 | -0.099688-0.28261i | -0.074702+0.061389i | | -0.099688-0.28261i | 1 | -0.099688+0.28261i | -0.074702-0.061389i |
| | -0.074702-0.061389i | -0.099688+0.28261i | 1 | -0.099688-0.28261i | | -0.074702+0.061389i | -0.099688-0.28261i | 1 | -0.099688+0.28261i |
| | 0.039141-0.023079i | -0.074702-0.061389i | -0.099688+0.28261i | 1 | | 0.039141+0.023079i | -0.074702+0.061389i | -0.099688-0.28261i | 1 |
| 20 | 1 | -0.2203+0.23176i | -0.0072744-0.10492i | 0.038978+0.030793i | 200 | 1 | -0.2203-0.23176i | -0.0072744+0.10492i | 0.038978-0.030793i |
| | -0.2203-0.23176i | 1 | -0.2203+0.23176i | -0.0072744-0.10492i | | -0.2203+0.23176i | 1 | -0.2203-0.23176i | -0.0072744+0.10492i |
| | -0.0072744+0.10492i | -0.2203-0.23176i | 1 | -0.2203+0.23176i | | -0.0072744-0.10492i | -0.2203+0.23176i | 1 | -0.2203-0.23176i |
| | 0.038978-0.030793i | -0.0072744+0.10492i | -0.2203-0.23176i | 1 | | 0.038978+0.030793i | -0.0072744-0.10492i | -0.2203+0.23176i | 1 |
| 30 | 1 | 0.3563+0.0096902i | 0.12143+0.0035451i | 0.057933+0.0013317i | 210 | 1 | 0.3563-0.0096902i | 0.12143-0.0035451i | 0.057933-0.0013317i |
| | 0.3563-0.0096902i | 1 | 0.3563+0.0096902i | 0.12143+0.0035451i | | 0.3563+0.0096902i | 1 | 0.3563-0.0096902i | 0.12143-0.0035451i |
| | 0.12143-0.0035451i | 0.3563-0.0096902i | 1 | 0.3563+0.0096902i | | 0.12143+0.0035451i | 0.3563+0.0096902i | 1 | 0.3563-0.0096902i |
| | 0.057933-0.0013317i | 0.12143-0.0035451i | 0.3563-0.0096902i | 1 | | 0.057933+0.0013317i | 0.12143+0.0035451i | 0.3563+0.0096902i | 1 |
| 40 | 1 | -0.36778-0.19243i | 0.088691+0.12103i | -0.013992-0.071464i | 220 | 1 | -0.36778+0.19243i | 0.088691-0.12103i | -0.013992+0.071464i |
| | -0.36778+0.19243i | 1 | -0.36778-0.19243i | 0.088691+0.12103i | | -0.36778-0.19243i | 1 | -0.36778+0.19243i | 0.088691-0.12103i |
| | 0.088691-0.12103i | -0.36778+0.19243i | 1 | -0.36778-0.19243i | | 0.088691+0.12103i | -0.36778-0.19243i | 1 | -0.36778+0.19243i |
| | -0.013992+0.071464i | 0.088691-0.12103i | -0.36778+0.19243i | 1 | | -0.013992-0.071464i | 0.088691+0.12103i | -0.36778-0.19243i | 1 |
| 50 | 1 | 0.45586+0.21529i | 0.12888+0.15323i | 0.029955+0.09555i | 230 | 1 | 0.45586-0.21529i | 0.12888-0.15323i | 0.029955-0.09555i |
| | 0.45586-0.21529i | 1 | 0.45586+0.21529i | 0.12888+0.15323i | | 0.45586+0.21529i | 1 | 0.45586-0.21529i | 0.12888-0.15323i |
| | 0.12888-0.15323i | 0.45586-0.21529i | 1 | 0.45586+0.21529i | | 0.12888+0.15323i | 0.45586+0.21529i | 1 | 0.45586-0.21529i |
| | 0.029955-0.09555i | 0.12888-0.15323i | 0.45586-0.21529i | 1 | | 0.029955+0.09555i | 0.12888+0.15323i | 0.45586+0.21529i | 1 |
| 60 | 1 | -0.61986+0.12583i | 0.2737-0.10297i | -0.12944+0.085174i | 240 | 1 | -0.61986-0.12583i | 0.2737+0.10297i | -0.12944-0.085174i |
| | -0.61986-0.12583i | 1 | -0.61986+0.12583i | 0.2737-0.10297i | | -0.61986+0.12583i | 1 | -0.61986-0.12583i | 0.2737+0.10297i |
| | 0.2737+0.10297i | -0.61986-0.12583i | 1 | -0.61986+0.12583i | | 0.2737-0.10297i | -0.61986+0.12583i | 1 | -0.61986-0.12583i |
| | -0.12944-0.085174i | 0.2737+0.10297i | -0.61986-0.12583i | 1 | | -0.12944+0.085174i | 0.2737-0.10297i | -0.61986+0.12583i | 1 |
| 70 | 1 | 0.031776-0.78946i | -0.47785-0.10382i | -0.093555+0.26222i | 250 | 1 | 0.031776+0.78946i | -0.47785+0.10382i | -0.093555-0.26222i |
| | 0.031776+0.78946i | 1 | 0.031776-0.78946i | -0.47785-0.10382i | | 0.031776-0.78946i | 1 | 0.031776+0.78946i | -0.47785+0.10382i |
| | -0.47785+0.10382i | 0.031776+0.78946i | 1 | 0.031776-0.78946i | | -0.47785-0.10382i | 0.031776-0.78946i | 1 | 0.031776+0.78946i |
| | -0.093555+0.26222i | -0.47785+0.10382i | 0.031776+0.78946i | 1 | | -0.093555+0.26222i | -0.47785-0.10382i | 0.031776-0.78946i | 1 |
| 80 | 1 | 0.83607-0.40081i | 0.54711-0.57946i | 0.28778-0.60257i | 260 | 1 | 0.83607+0.40081i | 0.54711+0.57946i | 0.28778+0.60257i |
| | 0.83607+0.40081i | 1 | 0.83607-0.40081i | 0.54711-0.57946i | | 0.83607-0.40081i | 1 | 0.83607+0.40081i | 0.54711+0.57946i |
| | 0.54711+0.57946i | 0.83607+0.40081i | 1 | 0.83607-0.40081i | | 0.54711-0.57946i | 0.83607-0.40081i | 1 | 0.83607+0.40081i |
| | 0.28778+0.60257i | 0.54711+0.57946i | 0.83607+0.40081i | 1 | | 0.28778-0.60257i | 0.54711-0.57946i | 0.83607-0.40081i | 1 |
| 90 | 1 | 0.97804-0.086342i | 0.93619-0.1455i | 0.89299-0.18437i | 270 | 1 | 0.97804+0.086342i | 0.93619+0.1455i | 0.89299+0.18437i |
| | 0.97804+0.086342i | 1 | 0.97804-0.086342i | 0.93619-0.1455i | | 0.97804-0.086342i | 1 | 0.97804+0.086342i | 0.93619+0.1455i |
| | 0.93619+0.1455i | 0.97804+0.086342i | 1 | 0.97804-0.086342i | | 0.93619-0.1455i | 0.97804+0.086342i | 1 | 0.97804+0.086342i |
| | 0.89299+0.18437i | 0.93619+0.1455i | 0.97804+0.086342i | 1 | | 0.89299-0.18437i | 0.93619-0.1455i | 0.97804-0.086342i | 1 |
| 100 | 1 | 0.83607-0.40081i | 0.54711-0.57946i | 0.28778-0.60257i | 280 | 1 | 0.83607+0.40081i | 0.54711+0.57946i | 0.28778+0.60257i |
| | 0.83607+0.40081i | 1 | 0.83607-0.40081i | 0.54711-0.57946i | | 0.83607-0.40081i | 1 | 0.83607+0.40081i | 0.54711+0.57946i |
| | 0.54711+0.57946i | 0.83607+0.40081i | 1 | 0.83607-0.40081i | | 0.54711-0.57946i | 0.83607-0.40081i | 1 | 0.83607+0.40081i |
| | 0.28778+0.60257i | 0.54711+0.57946i | 0.83607+0.40081i | 1 | | 0.28778-0.60257i | 0.54711-0.57946i | 0.83607-0.40081i | 1 |
| 110 | 1 | 0.031776-0.78946i | -0.47785-0.10382i | -0.093555+0.26222i | 290 | 1 | 0.031776+0.78946i | -0.47785+0.10382i | -0.093555-0.26222i |
| | 0.031776+0.78946i | 1 | 0.031776-0.78946i | -0.47785-0.10382i | | 0.031776-0.78946i | 1 | 0.031776+0.78946i | -0.47785+0.10382i |
| | -0.47785+0.10382i | 0.031776+0.78946i | 1 | 0.031776-0.78946i | | -0.47785-0.10382i | 0.031776-0.78946i | 1 | 0.031776+0.78946i |
| | -0.093555+0.26222i | -0.47785+0.10382i | 0.031776+0.78946i | 1 | | -0.093555+0.26222i | -0.47785-0.10382i | 0.031776-0.78946i | 1 |
| 120 | 1 | -0.61986+0.12583i | 0.2737-0.10297i | -0.12944+0.085174i | 300 | 1 | -0.61986-0.12583i | 0.2737+0.10297i | -0.12944-0.085174i |
| | -0.61986-0.12583i | 1 | -0.61986+0.12583i | 0.2737-0.10297i | | -0.61986+0.12583i | 1 | -0.61986-0.12583i | 0.2737+0.10297i |
| | 0.2737+0.10297i | -0.61986-0.12583i | 1 | -0.61986+0.12583i | | 0.2737-0.10297i | -0.61986+0.12583i | 1 | -0.61986-0.12583i |
| | -0.12944-0.085174i | 0.2737+0.10297i | -0.61986-0.12583i | 1 | | -0.12944+0.085174i | 0.2737-0.10297i | -0.61986+0.12583i | 1 |
| 130 | 1 | 0.45586+0.21529i | 0.12888+0.15323i | 0.029955+0.09555i | 310 | 1 | 0.45586-0.21529i | 0.12888-0.15323i | 0.029955-0.09555i |
| | 0.45586-0.21529i | 1 | 0.45586+0.21529i | 0.12888+0.15323i | | 0.45586+0.21529i | 1 | 0.45586-0.21529i | 0.12888-0.15323i |
| | 0.12888-0.15323i | 0.45586-0.21529i | 1 | 0.45586+0.21529i | | 0.12888+0.15323i | 0.45586+0.21529i | 1 | 0.45586-0.21529i |
| | 0.029955-0.09555i | 0.12888-0.15323i | 0.45586-0.21529i | 1 | | 0.029955+0.09555i | 0.12888+0.15323i | 0.45586+0.21529i | 1 |
| 140 | 1 | -0.36778-0.19243i | 0.088691+0.12103i | -0.013992-0.071464i | 320 | 1 | -0.36778+0.19243i | 0.088691-0.12103i | -0.013992+0.071464i |
| | -0.36778+0.19243i | 1 | -0.36778-0.19243i | 0.088691+0.12103i | | -0.36778-0.19243i | 1 | -0.36778+0.19243i | 0.088691-0.12103i |
| | 0.088691-0.12103i | -0.36778+0.19243i | 1 | -0.36778-0.19243i | | 0.088691+0.12103i | -0.36778-0.19243i | 1 | -0.36778+0.19243i |
| | -0.013992+0.071464i | 0.088691-0.12103i | -0.36778+0.19243i | 1 | | -0.013992-0.071464i | 0.088691+0.12103i | -0.36778-0.19243i | 1 |
| 150 | 1 | 0.3563+0.0096902i | 0.12143+0.0035451i | 0.057933+0.0013317i | 330 | 1 | 0.3563-0.0096902i | 0.12143-0.0035451i | 0.057933-0.0013317i |
| | 0.3563-0.0096902i | 1 | 0.3563+0.0096902i | 0.12143+0.0035451i | | 0.3563+0.0096902i | 1 | 0.3563-0.0096902i | 0.12143-0.0035451i |
| | 0.12143-0.0035451i | 0.3563-0.0096902i | 1 | 0.3563+0.0096902i | | 0.12143+0.0035451i | 0.3563+0.0096902i | 1 | 0.3563-0.0096902i |
| | 0.057933-0.0013317i | 0.12143-0.0035451i | 0.3563-0.0096902i | 1 | | 0.057933+0.0013317i | 0.12143+0.0035451i | 0.3563+0.0096902i | 1 |
| 160 | 1 | -0.2203+0.23176i | -0.0072744-0.10492i | 0.038978+0.030793i | 340 | 1 | -0.2203-0.23176i | -0.0072744+0.10492i | 0.038978-0.030793i |
| | -0.2203-0.23176i | 1 | -0.2203+0.23176i | -0.0072744-0.10492i | | -0.2203+0.23176i | 1 | -0.2203-0.23176i | -0.0072744+0.10492i |
| | -0.0072744+0.10492i | -0.2203-0.23176i | 1 | -0.2203+0.23176i | | -0.0072744-0.10492i | -0.2203+0.23176i | 1 | -0.2203-0.23176i |
| | 0.038978-0.030793i | -0.0072744+0.10492i | -0.2203-0.23176i | 1 | | 0.038978+0.030793i | -0.0072744-0.10492i | -0.2203+0.23176i | 1 |
| 170 | 1 | -0.099688-0.28261i | -0.074702+0.061389i | 0.039141+0.023079i | 350 | 1 | -0.099688+0.28261i | -0.074702-0.061389i | 0.039141-0.023079i |
| | -0.099688+0.28261i | 1 | -0.099688-0.28261i | -0.074702+0.061389i | | -0.099688-0.28261i | 1 | -0.099688+0.28261i | -0.074702-0.061389i |
| | -0.074702-0.061389i | -0.099688+0.28261i | 1 | -0.099688-0.28261i | | -0.074702+0.061389i | -0.099688-0.28261i | 1 | -0.099688+0.28261i |
| | 0.039141-0.023079i | -0.074702-0.061389i | -0.099688+0.28261i | 1 | | 0.039141+0.023079i | -0.074702+0.061389i | -0.099688-0.28261i | 1 |

# Table 5-8 Antenna Spacing 10 λ, Angular Spread 5 degrees, Laplacian Model

Angular Spread 5, Antenna Spacing 10xWavelength

| Angle of Arrival/Departure | | | | |
|---|---|---|---|---|
| 0 | 1 | 0.062326 | 0.016355 | 0.0073024 |
| | 0.062326 | 1 | 0.062326 | 0.016355 |
| | 0.016355 | 0.062326 | 1 | 0.062326 |
| | 0.0073024 | 0.016355 | 0.062326 | 1 |
| 10 | 1 | -0.0049744-0.063941i | -0.016623+0.0027812i | 0.0019051+0.0073571i |
| | -0.0049744+0.063941i | 1 | -0.0049744-0.063941i | -0.016623+0.0027812i |
| | -0.016623-0.0027812i | -0.0049744+0.063941i | 1 | -0.0049744-0.063941i |
| | 0.0019051-0.0073571i | -0.016623-0.0027812i | -0.0049744+0.063941i | 1 |
| 20 | 1 | -0.061884+0.032678i | 0.010079-0.015489i | -0.00059694+0.0082371i |
| | -0.061884-0.032678i | 1 | -0.061884+0.032678i | 0.010079-0.015489i |
| | 0.010079+0.015489i | -0.061884-0.032678i | 1 | -0.061884+0.032678i |
| | -0.00059694-0.0082371i | 0.010079+0.015489i | -0.061884-0.032678i | 1 |
| 30 | 1 | 0.081314+0.0021124i | 0.021679+0.00032722i | 0.0097371+0.00013171i |
| | 0.081314-0.0021124i | 1 | 0.081314+0.0021124i | 0.021679+0.00032722i |
| | 0.021679-0.00032722i | 0.081314-0.0021124i | 1 | 0.081314+0.0021124i |
| | 0.0097371-0.00013171i | 0.021679-0.00032722i | 0.081314-0.0021124i | 1 |
| 40 | 1 | -0.093031+0.040736i | 0.0175-0.021254i | -0.0027931+0.012093i |
| | -0.093031-0.040736i | 1 | -0.093031+0.040736i | 0.0175-0.021254i |
| | 0.0175+0.021254i | -0.093031-0.040736i | 1 | -0.093031+0.040736i |
| | -0.0027931-0.012093i | 0.0175+0.021254i | -0.093031-0.040736i | 1 |
| 50 | 1 | -0.066323-0.12113i | -0.018024+0.034123i | 0.017474-0.0015759i |
| | -0.066323+0.12113i | 1 | -0.066323-0.12113i | -0.018024+0.034123i |
| | -0.018024-0.034123i | -0.066323+0.12113i | 1 | -0.066323-0.12113i |
| | 0.017474+0.0015759i | -0.018024-0.034123i | -0.066323+0.12113i | 1 |
| 60 | 1 | -0.094927-0.18641i | -0.030551+0.05366i | 0.028584-0.002291i |
| | -0.094927+0.18641i | 1 | -0.094927-0.18641i | -0.030551+0.05366i |
| | -0.030551-0.05366i | -0.094927+0.18641i | 1 | -0.094927-0.18641i |
| | 0.028584+0.002291i | -0.030551-0.05366i | -0.094927+0.18641i | 1 |
| 70 | 1 | -0.32602+0.17441i | 0.047468-0.11812i | 0.015763+0.051498i |
| | -0.32602-0.17441i | 1 | -0.32602+0.17441i | 0.047468-0.11812i |
| | 0.047468+0.11812i | -0.32602-0.17441i | 1 | -0.32602+0.17441i |
| | 0.015763-0.051498i | 0.047468+0.11812i | -0.32602-0.17441i | 1 |
| 80 | 1 | 0.41023+0.60515i | -0.037843-0.4451i | -0.1467-0.18659i |
| | 0.41023+0.60515i | 1 | 0.41023-0.60515i | -0.037843-0.4451i |
| | -0.037843+0.4451i | 0.41023+0.60515i | 1 | 0.41023-0.60515i |
| | -0.1467+0.18659i | -0.037843+0.4451i | 0.41023+0.60515i | 1 |
| 90 | 1 | 0.91432-0.1669i | 0.81721-0.229i | 0.74314-0.25526i |
| | 0.91432+0.1669i | 1 | 0.91432-0.1669i | 0.81721-0.229i |
| | 0.81721+0.229i | 0.91432+0.1669i | 1 | 0.91432-0.1669i |
| | 0.74314+0.25526i | 0.81721+0.229i | 0.91432+0.1669i | 1 |
| 100 | 1 | 0.41023-0.60515i | -0.037843-0.4451i | -0.1467-0.18659i |
| | 0.41023+0.60515i | 1 | 0.41023-0.60515i | -0.037843-0.4451i |
| | -0.037843+0.4451i | 0.41023+0.60515i | 1 | 0.41023-0.60515i |
| | -0.1467+0.18659i | -0.037843+0.4451i | 0.41023+0.60515i | 1 |
| 110 | 1 | -0.32602+0.17441i | 0.047468-0.11812i | 0.015763+0.051498i |
| | -0.32602-0.17441i | 1 | -0.32602+0.17441i | 0.047468-0.11812i |
| | 0.047468+0.11812i | -0.32602-0.17441i | 1 | -0.32602+0.17441i |
| | 0.015763-0.051498i | 0.047468+0.11812i | -0.32602-0.17441i | 1 |
| 120 | 1 | -0.094927-0.18641i | -0.030551+0.05366i | 0.028584-0.002291i |
| | -0.094927+0.18641i | 1 | -0.094927-0.18641i | -0.030551+0.05366i |
| | -0.030551-0.05366i | -0.094927+0.18641i | 1 | -0.094927-0.18641i |
| | 0.028584+0.002291i | -0.030551-0.05366i | -0.094927+0.18641i | 1 |
| 130 | 1 | -0.066323-0.12113i | -0.018024+0.034123i | 0.017474-0.0015759i |
| | -0.066323+0.12113i | 1 | -0.066323-0.12113i | -0.018024+0.034123i |
| | -0.018024-0.034123i | -0.066323+0.12113i | 1 | -0.066323-0.12113i |
| | 0.017474+0.0015759i | -0.018024-0.034123i | -0.066323+0.12113i | 1 |
| 140 | 1 | -0.093031+0.040736i | 0.0175-0.021254i | -0.0027931+0.012093i |
| | -0.093031-0.040736i | 1 | -0.093031+0.040736i | 0.0175-0.021254i |
| | 0.0175+0.021254i | -0.093031-0.040736i | 1 | -0.093031+0.040736i |
| | -0.0027931-0.012093i | 0.0175+0.021254i | -0.093031-0.040736i | 1 |
| 150 | 1 | 0.081314+0.0021124i | 0.021679+0.00032722i | 0.0097371+0.00013171i |
| | 0.081314-0.0021124i | 1 | 0.081314+0.0021124i | 0.021679+0.00032722i |
| | 0.021679-0.00032722i | 0.081314-0.0021124i | 1 | 0.081314+0.0021124i |
| | 0.0097371-0.00013171i | 0.021679-0.00032722i | 0.081314-0.0021124i | 1 |
| 160 | 1 | -0.061884+0.032678i | 0.010079-0.015489i | -0.00059694+0.0082371i |
| | -0.061884-0.032678i | 1 | -0.061884+0.032678i | 0.010079-0.015489i |
| | 0.010079+0.015489i | -0.061884-0.032678i | 1 | -0.061884+0.032678i |
| | -0.00059694-0.0082371i | 0.010079+0.015489i | -0.061884-0.032678i | 1 |
| 170 | 1 | -0.0049744-0.063941i | -0.016623+0.0027812i | 0.0019051+0.0073571i |
| | -0.0049744+0.063941i | 1 | -0.0049744-0.063941i | -0.016623+0.0027812i |
| | -0.016623-0.0027812i | -0.0049744+0.063941i | 1 | -0.0049744-0.063941i |
| | 0.0019051-0.0073571i | -0.016623-0.0027812i | -0.0049744+0.063941i | 1 |
| 180 | 1 | 0.062326-2.2067e-16i | 0.016355-2.1361e-17i | 0.0073024-9.1875e-16i |
| | 0.062326+2.2067e-16i | 1 | 0.062326-2.2067e-16i | 0.016355-2.1361e-17i |
| | 0.016355+2.1361e-17i | 0.062326+2.2067e-16i | 1 | 0.062326-2.2067e-16i |
| | 0.0073024+9.1875e-16i | 0.016355+2.1361e-17i | 0.062326+2.2067e-16i | 1 |
| 190 | 1 | -0.0049744+0.063941i | -0.016623-0.0027812i | 0.0019051-0.0073571i |
| | -0.0049744-0.063941i | 1 | -0.0049744+0.063941i | -0.016623-0.0027812i |
| | -0.016623+0.0027812i | -0.0049744-0.063941i | 1 | -0.0049744+0.063941i |
| | 0.0019051+0.0073571i | -0.016623+0.0027812i | -0.0049744-0.063941i | 1 |
| 200 | 1 | -0.061884-0.032678i | 0.010079+0.015489i | -0.00059694-0.0082371i |
| | -0.061884+0.032678i | 1 | -0.061884-0.032678i | 0.010079+0.015489i |
| | 0.010079-0.015489i | -0.061884+0.032678i | 1 | -0.061884-0.032678i |
| | -0.00059694+0.0082371i | 0.010079-0.015489i | -0.061884+0.032678i | 1 |
| 210 | 1 | 0.081314-0.0021124i | 0.021679-0.00032722i | 0.0097371-0.00013171i |
| | 0.081314+0.0021124i | 1 | 0.081314-0.0021124i | 0.021679-0.00032722i |
| | 0.021679+0.00032722i | 0.081314+0.0021124i | 1 | 0.081314-0.0021124i |
| | 0.0097371+0.00013171i | 0.021679+0.00032722i | 0.081314+0.0021124i | 1 |
| 220 | 1 | -0.093031-0.040736i | 0.0175+0.021254i | -0.0027931-0.012093i |
| | -0.093031+0.040736i | 1 | -0.093031-0.040736i | 0.0175+0.021254i |
| | 0.0175-0.021254i | -0.093031+0.040736i | 1 | -0.093031-0.040736i |
| | -0.0027931+0.012093i | 0.0175-0.021254i | -0.093031+0.040736i | 1 |
| 230 | 1 | -0.066323+0.12113i | -0.018024-0.034123i | 0.017474+0.0015759i |
| | -0.066323-0.12113i | 1 | -0.066323+0.12113i | -0.018024-0.034123i |
| | -0.018024+0.034123i | -0.066323-0.12113i | 1 | -0.066323+0.12113i |
| | 0.017474-0.0015759i | -0.018024+0.034123i | -0.066323-0.12113i | 1 |
| 240 | 1 | -0.094927+0.18641i | -0.030551-0.05366i | 0.028584+0.002291i |
| | -0.094927-0.18641i | 1 | -0.094927+0.18641i | -0.030551-0.05366i |
| | -0.030551+0.05366i | -0.094927-0.18641i | 1 | -0.094927+0.18641i |
| | 0.028584-0.002291i | -0.030551+0.05366i | -0.094927-0.18641i | 1 |
| 250 | 1 | -0.32602-0.17441i | 0.047468+0.11812i | 0.015763-0.051498i |
| | -0.32602+0.17441i | 1 | -0.32602-0.17441i | 0.047468+0.11812i |
| | 0.047468-0.11812i | -0.32602+0.17441i | 1 | -0.32602-0.17441i |
| | 0.015763+0.051498i | 0.047468-0.11812i | -0.32602+0.17441i | 1 |
| 260 | 1 | 0.41023+0.60515i | -0.037843+0.4451i | -0.1467+0.18659i |
| | 0.41023-0.60515i | 1 | 0.41023+0.60515i | -0.037843+0.4451i |
| | -0.037843-0.4451i | 0.41023-0.60515i | 1 | 0.41023+0.60515i |
| | -0.1467-0.18659i | -0.037843-0.4451i | 0.41023-0.60515i | 1 |
| 270 | 1 | 0.91432+0.1669i | 0.81721+0.229i | 0.74314+0.25526i |
| | 0.91432-0.1669i | 1 | 0.91432+0.1669i | 0.81721+0.229i |
| | 0.81721-0.229i | 0.91432-0.1669i | 1 | 0.91432+0.1669i |
| | 0.74314-0.25526i | 0.81721-0.229i | 0.91432-0.1669i | 1 |
| 280 | 1 | 0.41023+0.60515i | -0.037843+0.4451i | -0.1467+0.18659i |
| | 0.41023-0.60515i | 1 | 0.41023+0.60515i | -0.037843+0.4451i |
| | -0.037843-0.4451i | 0.41023-0.60515i | 1 | 0.41023+0.60515i |
| | -0.1467-0.18659i | -0.037843-0.4451i | 0.41023-0.60515i | 1 |
| 290 | 1 | -0.32602-0.17441i | 0.047468+0.11812i | 0.015763-0.051498i |
| | -0.32602+0.17441i | 1 | -0.32602-0.17441i | 0.047468+0.11812i |
| | 0.047468-0.11812i | -0.32602+0.17441i | 1 | -0.32602-0.17441i |
| | 0.015763+0.051498i | 0.047468-0.11812i | -0.32602+0.17441i | 1 |
| 300 | 1 | -0.094927+0.18641i | -0.030551-0.05366i | 0.028584+0.002291i |
| | -0.094927-0.18641i | 1 | -0.094927+0.18641i | -0.030551-0.05366i |
| | -0.030551+0.05366i | -0.094927-0.18641i | 1 | -0.094927+0.18641i |
| | 0.028584-0.002291i | -0.030551+0.05366i | -0.094927-0.18641i | 1 |
| 310 | 1 | -0.066323+0.12113i | -0.018024-0.034123i | 0.017474+0.0015759i |
| | -0.066323-0.12113i | 1 | -0.066323+0.12113i | -0.018024-0.034123i |
| | -0.018024+0.034123i | -0.066323-0.12113i | 1 | -0.066323+0.12113i |
| | 0.017474-0.0015759i | -0.018024+0.034123i | -0.066323-0.12113i | 1 |
| 320 | 1 | -0.093031-0.040736i | 0.0175+0.021254i | -0.0027931-0.012093i |
| | -0.093031+0.040736i | 1 | -0.093031-0.040736i | 0.0175+0.021254i |
| | 0.0175-0.021254i | -0.093031+0.040736i | 1 | -0.093031-0.040736i |
| | -0.0027931+0.012093i | 0.0175-0.021254i | -0.093031+0.040736i | 1 |
| 330 | 1 | 0.081314-0.0021124i | 0.021679-0.00032722i | 0.0097371-0.00013171i |
| | 0.081314+0.0021124i | 1 | 0.081314-0.0021124i | 0.021679-0.00032722i |
| | 0.021679+0.00032722i | 0.081314+0.0021124i | 1 | 0.081314-0.0021124i |
| | 0.0097371+0.00013171i | 0.021679+0.00032722i | 0.081314+0.0021124i | 1 |
| 340 | 1 | -0.061884-0.032678i | 0.010079+0.015489i | -0.00059694-0.0082371i |
| | -0.061884+0.032678i | 1 | -0.061884-0.032678i | 0.010079+0.015489i |
| | 0.010079-0.015489i | -0.061884+0.032678i | 1 | -0.061884-0.032678i |
| | -0.00059694+0.0082371i | 0.010079-0.015489i | -0.061884+0.032678i | 1 |
| 350 | 1 | -0.0049744+0.063941i | -0.016623-0.0027812i | 0.0019051-0.0073571i |
| | -0.0049744-0.063941i | 1 | -0.0049744+0.063941i | -0.016623-0.0027812i |
| | -0.016623+0.0027812i | -0.0049744-0.063941i | 1 | -0.0049744+0.063941i |
| | 0.0019051+0.0073571i | -0.016623+0.0027812i | -0.0049744-0.063941i | 1 |

# Table 5-9 Antenna Spacing 0.5 λ, Angular Spread 35 degrees, Laplacian Model

Angular Spread 35, Antenna Spacing 0.5xWavelength

| Angle of Arrival/Departure | | | | |
|---|---|---|---|---|
| 0 | 1 | 0.33158 | 0.1334 | 0.031942 |
| | 0.33158 | 1 | 0.33158 | 0.1334 |
| | 0.1334 | 0.33158 | 1 | 0.33158 |
| | 0.031942 | 0.1334 | 0.33158 | 1 |
| 10 | 1 | 0.2783+0.22283i | 0.069558+0.082724i | -0.031302+0.074244i |
| | 0.2783-0.22283i | 1 | 0.2783+0.22283i | 0.069558+0.082724i |
| | 0.069558-0.082724i | 0.2783-0.22283i | 1 | 0.2783+0.22283i |
| | -0.031302-0.074244i | 0.069558-0.082724i | 0.2783-0.22283i | 1 |
| 20 | 1 | 0.13285+0.39877i | -0.052408+0.045867i | -0.091366+0.028151i |
| | 0.13285-0.39877i | 1 | 0.13285+0.39877i | -0.052408+0.045867i |
| | -0.052408-0.045867i | 0.13285-0.39877i | 1 | 0.13285+0.39877i |
| | -0.091366-0.028151i | -0.052408-0.045867i | 0.13285-0.39877i | 1 |
| 30 | 1 | -0.068085+0.49833i | -0.10084-0.11086i | -0.031538-0.0029628i |
| | -0.068085-0.49833i | 1 | -0.068085+0.49833i | -0.10084-0.11086i |
| | -0.10084+0.11086i | -0.068085-0.49833i | 1 | -0.068085+0.49833i |
| | -0.031538+0.0029628i | -0.10084+0.11086i | -0.068085-0.49833i | 1 |
| 40 | 1 | -0.28091+0.51769i | -0.012397-0.28702i | 0.02431+0.10525i |
| | -0.28091-0.51769i | 1 | -0.28091+0.51769i | -0.012397-0.28702i |
| | -0.012397+0.28702i | -0.28091-0.51769i | 1 | -0.28091+0.51769i |
| | 0.02431-0.10525i | -0.012397+0.28702i | -0.28091-0.51769i | 1 |
| 50 | 1 | -0.47023+0.47521i | 0.1725-0.38943i | -0.056707+0.26501i |
| | -0.47023-0.47521i | 1 | -0.47023+0.47521i | 0.1725-0.38943i |
| | 0.1725+0.38943i | -0.47023-0.47521i | 1 | -0.47023+0.47521i |
| | -0.056707+0.26501i | 0.1725+0.38943i | -0.47023-0.47521i | 1 |
| 60 | 1 | -0.6165+0.40065i | 0.37177-0.39789i | -0.23835+0.34841i |
| | -0.6165-0.40065i | 1 | -0.6165+0.40065i | 0.37177-0.39789i |
| | 0.37177+0.39789i | -0.6165-0.40065i | 1 | -0.6165+0.40065i |
| | -0.23835-0.34841i | 0.37177+0.39789i | -0.6165-0.40065i | 1 |
| 70 | 1 | -0.71515+0.32409i | 0.52663-0.35021i | -0.41482+0.33932i |
| | -0.71515-0.32409i | 1 | -0.71515+0.32409i | 0.52663-0.35021i |
| | 0.52663+0.35021i | -0.71515-0.32409i | 1 | -0.71515+0.32409i |
| | -0.41482-0.33932i | 0.52663+0.35021i | -0.71515-0.32409i | 1 |
| 80 | 1 | -0.77032+0.26884i | 0.61759-0.2977i | -0.52601+0.29662i |
| | -0.77032-0.26884i | 1 | -0.77032+0.26884i | 0.61759-0.2977i |
| | 0.61759+0.2977i | -0.77032-0.26884i | 1 | -0.77032+0.26884i |
| | -0.52601-0.29662i | 0.61759+0.2977i | -0.77032-0.26884i | 1 |
| 90 | 1 | -0.78787+0.2489i | 0.64679-0.27615i | -0.56218+0.27576i |
| | -0.78787-0.2489i | 1 | -0.78787+0.2489i | 0.64679-0.27615i |
| | 0.64679+0.27615i | -0.78787-0.2489i | 1 | -0.78787+0.2489i |
| | -0.56218+0.27576i | 0.64679+0.27615i | -0.78787-0.2489i | 1 |
| 100 | 1 | -0.77032+0.26884i | 0.61759-0.2977i | -0.52601+0.29662i |
| | -0.77032-0.26884i | 1 | -0.77032+0.26884i | 0.61759-0.2977i |
| | 0.61759+0.2977i | -0.77032-0.26884i | 1 | -0.77032+0.26884i |
| | -0.52601-0.29662i | 0.61759+0.2977i | -0.77032-0.26884i | 1 |
| 110 | 1 | -0.71515+0.32409i | 0.52663-0.35021i | -0.41482+0.33932i |
| | -0.71515-0.32409i | 1 | -0.71515+0.32409i | 0.52663-0.35021i |
| | 0.52663+0.35021i | -0.71515-0.32409i | 1 | -0.71515+0.32409i |
| | -0.41482-0.33932i | 0.52663+0.35021i | -0.71515-0.32409i | 1 |
| 120 | 1 | -0.6165+0.40065i | 0.37177-0.39789i | -0.23835+0.34841i |
| | -0.6165-0.40065i | 1 | -0.6165+0.40065i | 0.37177-0.39789i |
| | 0.37177+0.39789i | -0.6165-0.40065i | 1 | -0.6165+0.40065i |
| | -0.23835+0.34841i | 0.37177+0.39789i | -0.6165-0.40065i | 1 |
| 130 | 1 | -0.47023+0.47521i | 0.1725-0.38943i | -0.056707+0.26501i |
| | -0.47023-0.47521i | 1 | -0.47023+0.47521i | 0.1725+0.38943i |
| | 0.1725+0.38943i | -0.47023-0.47521i | 1 | -0.47023+0.47521i |
| | -0.056707+0.26501i | 0.1725+0.38943i | -0.47023-0.47521i | 1 |
| 140 | 1 | -0.28091+0.51769i | -0.012397-0.28702i | 0.02431+0.10525i |
| | -0.28091-0.51769i | 1 | -0.28091+0.51769i | -0.012397-0.28702i |
| | -0.012397+0.28702i | -0.28091-0.51769i | 1 | -0.28091+0.51769i |
| | 0.02431-0.10525i | -0.012397+0.28702i | -0.28091-0.51769i | 1 |
| 150 | 1 | -0.068085+0.49833i | -0.10084-0.11086i | -0.031538-0.0029628i |
| | -0.068085-0.49833i | 1 | -0.068085+0.49833i | -0.10084-0.11086i |
| | -0.10084+0.11086i | -0.068085-0.49833i | 1 | -0.068085+0.49833i |
| | -0.031538+0.0029628i | -0.10084+0.11086i | -0.068085-0.49833i | 1 |
| 160 | 1 | 0.13285+0.39877i | -0.052408+0.045867i | -0.091366+0.028151i |
| | 0.13285-0.39877i | 1 | 0.13285+0.39877i | -0.052408+0.045867i |
| | -0.052408-0.045867i | 0.13285-0.39877i | 1 | 0.13285+0.39877i |
| | -0.091366-0.028151i | -0.052408-0.045867i | 0.13285-0.39877i | 1 |
| 170 | 1 | 0.2783+0.22283i | 0.069558+0.082724i | -0.031302+0.074244i |
| | 0.2783-0.22283i | 1 | 0.2783+0.22283i | 0.069558+0.082724i |
| | 0.069558-0.082724i | 0.2783-0.22283i | 1 | 0.2783+0.22283i |
| | -0.031302-0.074244i | 0.069558-0.082724i | 0.2783-0.22283i | 1 |
| 180 | 1 | 0.33158+1.623e-16i | 0.1334+7.6752e-17i | 0.031942+1.0001e-16i |
| | 0.33158-1.623e-16i | 1 | 0.33158+1.623e-16i | 0.1334+7.6752e-17i |
| | 0.1334-7.6752e-17i | 0.33158-1.623e-16i | 1 | 0.33158+1.623e-16i |
| | 0.031942-1.0001e-16i | 0.1334-7.6752e-17i | 0.33158-1.623e-16i | 1 |
| 190 | 1 | 0.2783-0.22283i | 0.069558-0.082724i | -0.031302-0.074244i |
| | 0.2783+0.22283i | 1 | 0.2783-0.22283i | 0.069558-0.082724i |
| | 0.069558+0.082724i | 0.2783+0.22283i | 1 | 0.2783-0.22283i |
| | -0.031302+0.074244i | 0.069558+0.082724i | 0.2783+0.22283i | 1 |
| 200 | 1 | 0.13285-0.39877i | -0.052408-0.045867i | -0.091366-0.028151i |
| | 0.13285+0.39877i | 1 | 0.13285-0.39877i | -0.052408-0.045867i |
| | -0.052408+0.045867i | 0.13285+0.39877i | 1 | 0.13285-0.39877i |
| | -0.091366+0.028151i | -0.052408+0.045867i | 0.13285+0.39877i | 1 |
| 210 | 1 | -0.068085-0.49833i | -0.10084+0.11086i | -0.031538+0.0029628i |
| | -0.068085+0.49833i | 1 | -0.068085-0.49833i | -0.10084+0.11086i |
| | -0.10084-0.11086i | -0.068085+0.49833i | 1 | -0.068085-0.49833i |
| | -0.031538-0.0029628i | -0.10084-0.11086i | -0.068085+0.49833i | 1 |
| 220 | 1 | -0.28091-0.51769i | -0.012397+0.28702i | 0.02431-0.10525i |
| | -0.28091+0.51769i | 1 | -0.28091-0.51769i | -0.012397+0.28702i |
| | -0.012397-0.28702i | -0.28091+0.51769i | 1 | -0.28091-0.51769i |
| | 0.02431+0.10525i | -0.012397-0.28702i | -0.28091+0.51769i | 1 |
| 230 | 1 | -0.47023-0.47521i | 0.1725+0.38943i | -0.056707-0.26501i |
| | -0.47023+0.47521i | 1 | -0.47023-0.47521i | 0.1725+0.38943i |
| | 0.1725-0.38943i | -0.47023+0.47521i | 1 | -0.47023-0.47521i |
| | -0.056707+0.26501i | 0.1725-0.38943i | -0.47023+0.47521i | 1 |
| 240 | 1 | -0.6165-0.40065i | 0.37177+0.39789i | -0.23835-0.34841i |
| | -0.6165+0.40065i | 1 | -0.6165-0.40065i | 0.37177+0.39789i |
| | 0.37177-0.39789i | -0.6165+0.40065i | 1 | -0.6165-0.40065i |
| | -0.23835+0.34841i | 0.37177-0.39789i | -0.6165+0.40065i | 1 |
| 250 | 1 | -0.71515-0.32409i | 0.52663+0.35021i | -0.41482-0.33932i |
| | -0.71515+0.32409i | 1 | -0.71515-0.32409i | 0.52663+0.35021i |
| | 0.52663-0.35021i | -0.71515+0.32409i | 1 | -0.71515-0.32409i |
| | -0.41482+0.33932i | 0.52663-0.35021i | -0.71515+0.32409i | 1 |
| 260 | 1 | -0.77032-0.26884i | 0.61759+0.2977i | -0.52601-0.29662i |
| | -0.77032+0.26884i | 1 | -0.77032-0.26884i | 0.61759+0.2977i |
| | 0.61759-0.2977i | -0.77032+0.26884i | 1 | -0.77032-0.26884i |
| | -0.52601+0.29662i | 0.61759-0.2977i | -0.77032+0.26884i | 1 |
| 270 | 1 | -0.78787-0.2489i | 0.64679+0.27615i | -0.56218-0.27576i |
| | -0.78787+0.2489i | 1 | -0.78787-0.2489i | 0.64679+0.27615i |
| | 0.64679-0.27615i | -0.78787+0.2489i | 1 | -0.78787-0.2489i |
| | -0.56218+0.27576i | 0.64679-0.27615i | -0.78787+0.2489i | 1 |
| 280 | 1 | -0.77032-0.26884i | 0.61759+0.2977i | -0.52601-0.29662i |
| | -0.77032+0.26884i | 1 | -0.77032-0.26884i | 0.61759+0.2977i |
| | 0.61759-0.2977i | -0.77032+0.26884i | 1 | -0.77032-0.26884i |
| | -0.52601+0.29662i | 0.61759-0.2977i | -0.77032+0.26884i | 1 |
| 290 | 1 | -0.71515-0.32409i | 0.52663+0.35021i | -0.41482-0.33932i |
| | -0.71515+0.32409i | 1 | -0.71515-0.32409i | 0.52663+0.35021i |
| | 0.52663-0.35021i | -0.71515+0.32409i | 1 | -0.71515-0.32409i |
| | -0.41482+0.33932i | 0.52663-0.35021i | -0.71515+0.32409i | 1 |
| 300 | 1 | -0.6165-0.40065i | 0.37177+0.39789i | -0.23835-0.34841i |
| | -0.6165+0.40065i | 1 | -0.6165-0.40065i | 0.37177+0.39789i |
| | 0.37177-0.39789i | -0.6165+0.40065i | 1 | -0.6165-0.40065i |
| | -0.23835+0.34841i | 0.37177-0.39789i | -0.6165+0.40065i | 1 |
| 310 | 1 | -0.47023-0.47521i | 0.1725+0.38943i | -0.056707-0.26501i |
| | -0.47023+0.47521i | 1 | -0.47023-0.47521i | 0.1725+0.38943i |
| | 0.1725-0.38943i | -0.47023+0.47521i | 1 | -0.47023-0.47521i |
| | -0.056707+0.26501i | 0.1725-0.38943i | -0.47023+0.47521i | 1 |
| 320 | 1 | -0.28091-0.51769i | -0.012397+0.28702i | 0.02431-0.10525i |
| | -0.28091+0.51769i | 1 | -0.28091-0.51769i | -0.012397+0.28702i |
| | -0.012397-0.28702i | -0.28091+0.51769i | 1 | -0.28091-0.51769i |
| | 0.02431+0.10525i | -0.012397-0.28702i | -0.28091+0.51769i | 1 |
| 330 | 1 | -0.068085-0.49833i | -0.10084+0.11086i | -0.031538+0.0029628i |
| | -0.068085+0.49833i | 1 | -0.068085-0.49833i | -0.10084+0.11086i |
| | -0.10084-0.11086i | -0.068085+0.49833i | 1 | -0.068085-0.49833i |
| | -0.031538-0.0029628i | -0.10084-0.11086i | -0.068085+0.49833i | 1 |
| 340 | 1 | 0.13285-0.39877i | -0.052408-0.045867i | -0.091366-0.028151i |
| | 0.13285+0.39877i | 1 | 0.13285-0.39877i | -0.052408-0.045867i |
| | -0.052408+0.045867i | 0.13285+0.39877i | 1 | 0.13285-0.39877i |
| | -0.091366+0.028151i | -0.052408+0.045867i | 0.13285+0.39877i | 1 |
| 350 | 1 | 0.2783-0.22283i | 0.069558-0.082724i | -0.031302-0.074244i |
| | 0.2783+0.22283i | 1 | 0.2783-0.22283i | 0.069558-0.082724i |
| | 0.069558+0.082724i | 0.2783+0.22283i | 1 | 0.2783-0.22283i |
| | -0.031302+0.074244i | 0.069558+0.082724i | 0.2783+0.22283i | 1 |

## Table 5-10 Antenna Spacing 10 λ, Angular Spread 2 degrees, SCM Model

| Angular Spread 2, Antenna Spacing 10xWavelength, SCM Model | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Angle of Arrival/Departure | | | | | | | | | | |
| 0 | 1 | 0.0067-0.0033i | -0.0003+0.0009i | 0.0008+0.0017i | | 180 | 1 | -0.2075+0.0049i | 0.1401-0.0004i | -0.1430-0.0099i |
| | 0.0067+0.0033i | 1 | 0.0060-0.0026i | -0.0012+0.0000i | | | -0.2075-0.0049i | 1 | -0.2066+0.0097i | 0.1683+0.0057i |
| | -0.0003-0.0009i | 0.0060+0.0026i | 1 | 0.0060-0.0014i | | | 0.1401+0.0004i | -0.2066-0.0097i | 1 | -0.2124+0.0108i |
| | 0.0008-0.0017i | -0.0012-0.0000i | 0.0060+0.0014i | 1 | | | -0.1430+0.0099i | 0.1683-0.0057i | -0.2124-0.0108i | 1 |
| 10 | 1 | -0.0034+0.0008i | -0.0009-0.0019i | -0.0003+0.0006i | | 190 | 1 | 0.0034+0.0489i | -0.0131-0.0202i | 0.0300-0.0195i |
| | -0.0034-0.0008i | 1 | -0.0040+0.0021i | 0.0024-0.0013i | | | 0.0034-0.0489i | 1 | -0.0374+0.0552i | -0.0304-0.0048i |
| | -0.0009+0.0019i | -0.0040-0.0021i | 1 | -0.0046+0.0025i | | | -0.0131+0.0202i | -0.0374-0.0552i | 1 | -0.0020+0.0511i |
| | -0.0003-0.0006i | 0.0024+0.0013i | -0.0046-0.0025i | 1 | | | 0.0300+0.0195i | -0.0304+0.0048i | -0.0020-0.0511i | 1 |
| 20 | 1 | 0.0050+0.0050i | 0.0001-0.0004i | -0.0038-0.0019i | | 200 | 1 | 0.0979-0.1250i | -0.0461-0.0443i | 0.0238-0.0433i |
| | 0.0050-0.0050i | 1 | 0.0035+0.0071i | -0.0005+0.0002i | | | 0.0979+0.1250i | 1 | 0.1278-0.1169i | -0.0686-0.0519i |
| | 0.0001+0.0004i | 0.0035-0.0071i | 1 | 0.0034+0.0068i | | | -0.0461+0.0443i | 0.1278+0.1169i | 1 | 0.1167-0.1411i |
| | -0.0038+0.0019i | -0.0005-0.0002i | 0.0034-0.0068i | 1 | | | 0.0238+0.0433i | -0.0686+0.0519i | 0.1167+0.1411i | 1 |
| 30 | 1 | -0.0013+0.0112i | -0.0047-0.0009i | -0.0003+0.0001i | | 210 | 1 | -0.4794-0.2222i | 0.3094+0.2503i | -0.2468-0.2281i |
| | -0.0013-0.0112i | 1 | -0.0018+0.0106i | -0.0030-0.0018i | | | -0.4794+0.2222i | 1 | -0.4792-0.2245i | 0.3171+0.2454i |
| | -0.0047+0.0009i | -0.0018-0.0106i | 1 | -0.0003+0.0089i | | | 0.3094-0.2503i | -0.4792+0.2245i | 1 | -0.4867-0.2147i |
| | -0.0003-0.0001i | -0.0030+0.0018i | -0.0003-0.0089i | 1 | | | -0.2468+0.2281i | 0.3171-0.2454i | -0.4867+0.2147i | 1 |
| 40 | 1 | 0.0076+0.0068i | -0.0034+0.0021i | 0.0010-0.0028i | | 220 | 1 | -0.5027+0.3071i | 0.3792-0.2696i | -0.2996+0.2482i |
| | 0.0076-0.0068i | 1 | 0.0086+0.0082i | -0.0052-0.0002i | | | -0.5027-0.3071i | 1 | -0.4998+0.2976i | 0.3863-0.2751i |
| | -0.0034-0.0021i | 0.0086-0.0082i | 1 | 0.0078+0.0077i | | | 0.3792+0.2696i | -0.4998-0.2976i | 1 | -0.5044+0.2930i |
| | 0.0010+0.0028i | -0.0052+0.0002i | 0.0078-0.0077i | 1 | | | -0.2996-0.2482i | 0.3863+0.2751i | -0.5044-0.2930i | 1 |
| 50 | 1 | 0.0113+0.0048i | 0.0044+0.0053i | -0.0048+0.0017i | | 230 | 1 | -0.0228-0.0497i | 0.0071-0.0130i | 0.0229-0.0241i |
| | 0.0113-0.0048i | 1 | 0.0076+0.0066i | 0.0014+0.0060i | | | -0.0228+0.0497i | 1 | -0.0063-0.0614i | -0.0060-0.0011i |
| | 0.0044-0.0053i | 0.0076-0.0066i | 1 | 0.0110+0.0041i | | | 0.0071+0.0130i | -0.0063+0.0614i | 1 | 0.0130-0.0643i |
| | -0.0048-0.0017i | 0.0014-0.0060i | 0.0110-0.0041i | 1 | | | 0.0229+0.0241i | -0.0060+0.0011i | 0.0130+0.0643i | 1 |
| 60 | 1 | 0.0231+0.0240i | -0.0035+0.0085i | 0.0055+0.0000i | | 240 | 1 | -0.0727+0.0256i | 0.0370+0.0329i | -0.0280-0.0048i |
| | 0.0231-0.0240i | 1 | 0.0208+0.0223i | -0.0025+0.0130i | | | -0.0727-0.0256i | 1 | -0.0654+0.0224i | 0.0381+0.0263i |
| | -0.0035-0.0085i | 0.0208-0.0223i | 1 | 0.0178+0.0225i | | | 0.0370-0.0329i | -0.0654-0.0224i | 1 | -0.0628+0.0177i |
| | 0.0055-0.0000i | -0.0025-0.0130i | 0.0178-0.0225i | 1 | | | -0.0280+0.0048i | 0.0381-0.0263i | -0.0628-0.0177i | 1 |
| 70 | 1 | -0.1512+0.0399i | -0.0093-0.0241i | 0.0024-0.0007i | | 250 | 1 | -0.3027-0.0121i | 0.0856+0.0220i | 0.0398+0.0471i |
| | -0.1512-0.0399i | 1 | -0.1513+0.0366i | -0.0098-0.0244i | | | -0.3027+0.0121i | 1 | -0.3006-0.0098i | 0.0846+0.0231i |
| | -0.0093+0.0241i | -0.1513-0.0366i | 1 | -0.1507+0.0377i | | | 0.0856-0.0220i | -0.3006+0.0098i | 1 | -0.3018-0.0111i |
| | 0.0024+0.0007i | -0.0098+0.0244i | -0.1507-0.0377i | 1 | | | 0.0398-0.0471i | 0.0846-0.0231i | -0.3018+0.0111i | 1 |
| 80 | 1 | 0.2782-0.4263i | 0.0889-0.2620i | 0.0840-0.1380i | | 260 | 1 | 0.4166+0.4326i | 0.2399+0.2524i | 0.1906+0.2141i |
| | 0.2782+0.4263i | 1 | 0.2778-0.4276i | 0.0886-0.2592i | | | 0.4166-0.4326i | 1 | 0.4155+0.4323i | 0.2407+0.2531i |
| | 0.0889+0.2620i | 0.2778+0.4276i | 1 | 0.2773-0.4278i | | | 0.2399-0.2524i | 0.4155-0.4323i | 1 | 0.4147+0.4323i |
| | 0.0840+0.1380i | 0.0886+0.2592i | 0.2773+0.4278i | 1 | | | 0.1906-0.2141i | 0.2407-0.2531i | 0.4147-0.4323i | 1 |
| 90 | 1 | 0.8500-0.2532i | 0.6688-0.2801i | 0.5763-0.2570i | | 270 | 1 | 0.7549+0.3215i | 0.5287+0.3182i | 0.4500+0.2509i |
| | 0.8500+0.2532i | 1 | 0.8497-0.2529i | 0.6699-0.2798i | | | 0.7549-0.3215i | 1 | 0.7547+0.3213i | 0.5288+0.3193i |
| | 0.6688+0.2801i | 0.8497+0.2529i | 1 | 0.8498-0.2523i | | | 0.5287-0.3182i | 0.7547-0.3213i | 1 | 0.7549+0.3204i |
| | 0.5763+0.2570i | 0.6699+0.2798i | 0.8498+0.2523i | 1 | | | 0.4500-0.2509i | 0.5288-0.3193i | 0.7549-0.3204i | 1 |
| 100 | 1 | 0.4373-0.3689i | 0.3789-0.2032i | 0.2980-0.2558i | | 280 | 1 | 0.3328+0.4564i | 0.1142+0.2642i | 0.1040+0.1396i |
| | 0.4373+0.3689i | 1 | 0.4370-0.3704i | 0.3790-0.2032i | | | 0.3328-0.4564i | 1 | 0.3320+0.4567i | 0.1136+0.2649i |
| | 0.3789+0.2032i | 0.4370+0.3704i | 1 | 0.4374-0.3691i | | | 0.1142-0.2642i | 0.3320-0.4567i | 1 | 0.3313+0.4568i |
| | 0.2980+0.2558i | 0.3790+0.2032i | 0.4374+0.3691i | 1 | | | 0.1040-0.1396i | 0.1136-0.2649i | 0.3313-0.4568i | 1 |
| 110 | 1 | -0.2034-0.1698i | -0.0600+0.0438i | 0.0279+0.0190i | | 290 | 1 | -0.0825+0.0318i | -0.0198+0.0312i | -0.0025+0.0172i |
| | -0.2034+0.1698i | 1 | -0.2049-0.1704i | -0.0582+0.0453i | | | -0.0825-0.0318i | 1 | -0.0821+0.0334i | -0.0193+0.0274i |
| | -0.0600-0.0438i | -0.2049+0.1704i | 1 | -0.2066-0.1713i | | | -0.0198-0.0312i | -0.0821-0.0334i | 1 | -0.0803+0.0311i |
| | 0.0279-0.0190i | -0.0582-0.0453i | -0.2066+0.1713i | 1 | | | -0.0025-0.0172i | -0.0193-0.0274i | -0.0803-0.0311i | 1 |
| 120 | 1 | 0.0856-0.0885i | 0.0189-0.0408i | 0.0035+0.0061i | | 300 | 1 | -0.0525+0.0090i | 0.0070+0.0182i | -0.0010-0.0082i |
| | 0.0856+0.0885i | 1 | 0.0827-0.0835i | 0.0364-0.0411i | | | -0.0525-0.0090i | 1 | -0.0539+0.0113i | 0.0109+0.0152i |
| | 0.0189+0.0408i | 0.0827+0.0835i | 1 | 0.0913-0.0916i | | | 0.0070-0.0182i | -0.0539-0.0113i | 1 | -0.0531+0.0097i |
| | 0.0035-0.0061i | 0.0364+0.0411i | 0.0913+0.0916i | 1 | | | -0.0010+0.0082i | 0.0109-0.0152i | -0.0531-0.0097i | 1 |
| 130 | 1 | 0.0085-0.0408i | 0.0144+0.0236i | -0.0101-0.0403i | | 310 | 1 | -0.0074+0.0218i | -0.0039-0.0004i | -0.0027-0.0031i |
| | 0.0085+0.0408i | 1 | 0.0182-0.0541i | 0.0175+0.0092i | | | -0.0074-0.0218i | 1 | -0.0083+0.0176i | -0.0038-0.0007i |
| | 0.0144-0.0236i | 0.0182+0.0541i | 1 | 0.0208-0.0590i | | | -0.0039+0.0004i | -0.0083-0.0176i | 1 | -0.0067+0.0192i |
| | -0.0101+0.0403i | 0.0175-0.0092i | 0.0208+0.0590i | 1 | | | -0.0027+0.0031i | -0.0038+0.0007i | -0.0067-0.0192i | 1 |
| 140 | 1 | 0.0062-0.0287i | -0.0070+0.0014i | 0.0234+0.0085i | | 320 | 1 | 0.0030+0.0165i | -0.0025+0.0038i | -0.0029+0.0002i |
| | 0.0062+0.0287i | 1 | -0.0126-0.0145i | -0.0089-0.0024i | | | 0.0030-0.0165i | 1 | 0.0020+0.0164i | -0.0017+0.0041i |
| | -0.0070-0.0014i | -0.0126+0.0145i | 1 | -0.0113-0.0361i | | | -0.0025-0.0038i | 0.0020-0.0164i | 1 | 0.0002+0.0203i |
| | 0.0234-0.0085i | -0.0089+0.0024i | -0.0113+0.0361i | 1 | | | -0.0029-0.0002i | -0.0017-0.0041i | 0.0002-0.0203i | 1 |
| 150 | 1 | -0.0439+0.0257i | -0.0183-0.0199i | 0.0289+0.0148i | | 330 | 1 | -0.0038-0.0150i | -0.0024+0.0002i | -0.0027+0.0009i |
| | -0.0439-0.0257i | 1 | -0.0363+0.0016i | 0.0176-0.0158i | | | -0.0038+0.0150i | 1 | -0.0048-0.0146i | -0.0013+0.0015i |
| | -0.0183+0.0199i | -0.0363-0.0016i | 1 | -0.0307+0.0163i | | | -0.0024-0.0002i | -0.0048+0.0146i | 1 | -0.0049-0.0156i |
| | 0.0289-0.0148i | 0.0176+0.0158i | -0.0307-0.0163i | 1 | | | -0.0027-0.0009i | -0.0013-0.0015i | -0.0049+0.0156i | 1 |
| 160 | 1 | 0.0069-0.0606i | -0.0045+0.0139i | 0.0037-0.0157i | | 340 | 1 | 0.0082+0.0076i | -0.0019-0.0013i | -0.0002+0.0011i |
| | 0.0069+0.0606i | 1 | 0.0140-0.0767i | -0.0394-0.0167i | | | 0.0082-0.0076i | 1 | 0.0069+0.0073i | 0.0000+0.0020i |
| | -0.0045-0.0139i | 0.0140+0.0767i | 1 | 0.0175-0.0659i | | | -0.0019+0.0013i | 0.0069-0.0073i | 1 | 0.0049+0.0048i |
| | 0.0037+0.0157i | -0.0394+0.0167i | 0.0175+0.0659i | 1 | | | -0.0002-0.0011i | 0.0000-0.0020i | 0.0049-0.0048i | 1 |
| 170 | 1 | -0.2934+0.1433i | 0.1973-0.0989i | -0.1919+0.0790i | | 350 | 1 | -0.0045-0.0017i | -0.0002-0.0010i | -0.0003+0.0008i |
| | -0.2934-0.1433i | 1 | -0.2945+0.1525i | 0.1944-0.0967i | | | -0.0045+0.0017i | 1 | -0.0055-0.0011i | -0.0003+0.0012i |
| | 0.1973+0.0989i | -0.2945-0.1525i | 1 | -0.2986+0.1652i | | | -0.0002+0.0010i | -0.0055+0.0011i | 1 | -0.0053+0.0001i |
| | -0.1919-0.0790i | 0.1944+0.0967i | -0.2986-0.1652i | 1 | | | -0.0003-0.0008i | -0.0003-0.0012i | -0.0053-0.0001i | 1 |

## Table 5-11 Antenna Spacing 0.5 λ, Angular Spread 35 degrees, SCM Model

| Angular Spread 35, Antenna Spacing 0.5xWavelength, SCM Model | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Angle of Arrival/Departure | | | | | | | | | | |
| 0 | 1 | -0.3205+0.0182i | 0.2254-0.0082i | -0.1876+0.0061i | | 180 | 1 | -0.3205+0.0182i | 0.2254-0.0082i | -0.1876+0.0061i |
| | -0.3205-0.0182i | 1 | -0.3204+0.0188i | 0.2262-0.0084i | | | -0.3205-0.0182i | 1 | -0.3204+0.0188i | 0.2262-0.0084i |
| | 0.2254+0.0082i | -0.3204-0.0188i | 1 | -0.3198+0.0196i | | | 0.2254+0.0082i | -0.3204-0.0188i | 1 | -0.3198+0.0196i |
| | -0.1876-0.0061i | 0.2262+0.0084i | -0.3198-0.0196i | 1 | | | -0.1876-0.0061i | 0.2262+0.0084i | -0.3198-0.0196i | 1 |
| 10 | 1 | -0.3205+0.0182i | 0.2254-0.0082i | -0.1876+0.0061i | | 190 | 1 | -0.3205+0.0182i | 0.2254-0.0082i | -0.1876+0.0061i |
| | -0.3205-0.0182i | 1 | -0.3204+0.0188i | 0.2262-0.0084i | | | -0.3205-0.0182i | 1 | -0.3204+0.0188i | 0.2262-0.0084i |
| | 0.2254+0.0082i | -0.3204-0.0188i | 1 | -0.3198+0.0196i | | | 0.2254+0.0082i | -0.3204-0.0188i | 1 | -0.3198+0.0196i |
| | -0.1876-0.0061i | 0.2262+0.0084i | -0.3198-0.0196i | 1 | | | -0.1876-0.0061i | 0.2262+0.0084i | -0.3198-0.0196i | 1 |
| 20 | 1 | -0.3205+0.0182i | 0.2254-0.0082i | -0.1876+0.0061i | | 200 | 1 | -0.3205+0.0182i | 0.2254-0.0082i | -0.1876+0.0061i |
| | -0.3205-0.0182i | 1 | -0.3204+0.0188i | 0.2262-0.0084i | | | -0.3205-0.0182i | 1 | -0.3204+0.0188i | 0.2262-0.0084i |
| | 0.2254+0.0082i | -0.3204-0.0188i | 1 | -0.3198+0.0196i | | | 0.2254+0.0082i | -0.3204-0.0188i | 1 | -0.3198+0.0196i |
| | -0.1876-0.0061i | 0.2262+0.0084i | -0.3198-0.0196i | 1 | | | -0.1876-0.0061i | 0.2262+0.0084i | -0.3198-0.0196i | 1 |
| 30 | 1 | -0.3205+0.0182i | 0.2254-0.0082i | -0.1876+0.0061i | | 210 | 1 | -0.3205+0.0182i | 0.2254-0.0082i | -0.1876+0.0061i |
| | -0.3205-0.0182i | 1 | -0.3204+0.0188i | 0.2262-0.0084i | | | -0.3205-0.0182i | 1 | -0.3204+0.0188i | 0.2262-0.0084i |
| | 0.2254+0.0082i | -0.3204-0.0188i | 1 | -0.3198+0.0196i | | | 0.2254+0.0082i | -0.3204-0.0188i | 1 | -0.3198+0.0196i |
| | -0.1876-0.0061i | 0.2262+0.0084i | -0.3198-0.0196i | 1 | | | -0.1876-0.0061i | 0.2262+0.0084i | -0.3198-0.0196i | 1 |
| 40 | 1 | -0.3205+0.0182i | 0.2254-0.0082i | -0.1876+0.0061i | | 220 | 1 | -0.3205+0.0182i | 0.2254-0.0082i | -0.1876+0.0061i |
| | -0.3205-0.0182i | 1 | -0.3204+0.0188i | 0.2262-0.0084i | | | -0.3205-0.0182i | 1 | -0.3204+0.0188i | 0.2262-0.0084i |
| | 0.2254+0.0082i | -0.3204-0.0188i | 1 | -0.3198+0.0196i | | | 0.2254+0.0082i | -0.3204-0.0188i | 1 | -0.3198+0.0196i |
| | -0.1876-0.0061i | 0.2262+0.0084i | -0.3198-0.0196i | 1 | | | -0.1876-0.0061i | 0.2262+0.0084i | -0.3198-0.0196i | 1 |
| 50 | 1 | -0.3205+0.0182i | 0.2254-0.0082i | -0.1876+0.0061i | | 230 | 1 | -0.3205+0.0182i | 0.2254-0.0082i | -0.1876+0.0061i |
| | -0.3205-0.0182i | 1 | -0.3204+0.0188i | 0.2262-0.0084i | | | -0.3205-0.0182i | 1 | -0.3204+0.0188i | 0.2262-0.0084i |
| | 0.2254+0.0082i | -0.3204-0.0188i | 1 | -0.3198+0.0196i | | | 0.2254+0.0082i | -0.3204-0.0188i | 1 | -0.3198+0.0196i |
| | -0.1876-0.0061i | 0.2262+0.0084i | -0.3198-0.0196i | 1 | | | -0.1876-0.0061i | 0.2262+0.0084i | -0.3198-0.0196i | 1 |
| 60 | 1 | -0.3205+0.0182i | 0.2254-0.0082i | -0.1876+0.0061i | | 240 | 1 | -0.3205+0.0182i | 0.2254-0.0082i | -0.1876+0.0061i |
| | -0.3205-0.0182i | 1 | -0.3204+0.0188i | 0.2262-0.0084i | | | -0.3205-0.0182i | 1 | -0.3204+0.0188i | 0.2262-0.0084i |
| | 0.2254+0.0082i | -0.3204-0.0188i | 1 | -0.3198+0.0196i | | | 0.2254+0.0082i | -0.3204-0.0188i | 1 | -0.3198+0.0196i |
| | -0.1876-0.0061i | 0.2262+0.0084i | -0.3198-0.0196i | 1 | | | -0.1876-0.0061i | 0.2262+0.0084i | -0.3198-0.0196i | 1 |
| 70 | 1 | -0.3205+0.0182i | 0.2254-0.0082i | -0.1876+0.0061i | | 250 | 1 | -0.3205+0.0182i | 0.2254-0.0082i | -0.1876+0.0061i |
| | -0.3205-0.0182i | 1 | -0.3204+0.0188i | 0.2262-0.0084i | | | -0.3205-0.0182i | 1 | -0.3204+0.0188i | 0.2262-0.0084i |
| | 0.2254+0.0082i | -0.3204-0.0188i | 1 | -0.3198+0.0196i | | | 0.2254+0.0082i | -0.3204-0.0188i | 1 | -0.3198+0.0196i |
| | -0.1876-0.0061i | 0.2262+0.0084i | -0.3198-0.0196i | 1 | | | -0.1876-0.0061i | 0.2262+0.0084i | -0.3198-0.0196i | 1 |
| 80 | 1 | -0.3205+0.0182i | 0.2254-0.0082i | -0.1876+0.0061i | | 260 | 1 | -0.3205+0.0182i | 0.2254-0.0082i | -0.1876+0.0061i |
| | -0.3205-0.0182i | 1 | -0.3204+0.0188i | 0.2262-0.0084i | | | -0.3205-0.0182i | 1 | -0.3204+0.0188i | 0.2262-0.0084i |
| | 0.2254+0.0082i | -0.3204-0.0188i | 1 | -0.3198+0.0196i | | | 0.2254+0.0082i | -0.3204-0.0188i | 1 | -0.3198+0.0196i |
| | -0.1876-0.0061i | 0.2262+0.0084i | -0.3198-0.0196i | 1 | | | -0.1876-0.0061i | 0.2262+0.0084i | -0.3198-0.0196i | 1 |
| 90 | 1 | -0.3205+0.0182i | 0.2254-0.0082i | -0.1876+0.0061i | | 270 | 1 | -0.3205+0.0182i | 0.2254-0.0082i | -0.1876+0.0061i |
| | -0.3205-0.0182i | 1 | -0.3204+0.0188i | 0.2262-0.0084i | | | -0.3205-0.0182i | 1 | -0.3204+0.0188i | 0.2262-0.0084i |
| | 0.2254+0.0082i | -0.3204-0.0188i | 1 | -0.3198+0.0196i | | | 0.2254+0.0082i | -0.3204-0.0188i | 1 | -0.3198+0.0196i |
| | -0.1876-0.0061i | 0.2262+0.0084i | -0.3198-0.0196i | 1 | | | -0.1876-0.0061i | 0.2262+0.0084i | -0.3198-0.0196i | 1 |
| 100 | 1 | -0.3205+0.0182i | 0.2254-0.0082i | -0.1876+0.0061i | | 280 | 1 | -0.3205+0.0182i | 0.2254-0.0082i | -0.1876+0.0061i |
| | -0.3205-0.0182i | 1 | -0.3204+0.0188i | 0.2262-0.0084i | | | -0.3205-0.0182i | 1 | -0.3204+0.0188i | 0.2262-0.0084i |
| | 0.2254+0.0082i | -0.3204-0.0188i | 1 | -0.3198+0.0196i | | | 0.2254+0.0082i | -0.3204-0.0188i | 1 | -0.3198+0.0196i |
| | -0.1876-0.0061i | 0.2262+0.0084i | -0.3198-0.0196i | 1 | | | -0.1876-0.0061i | 0.2262+0.0084i | -0.3198-0.0196i | 1 |
| 110 | 1 | -0.3205+0.0182i | 0.2254-0.0082i | -0.1876+0.0061i | | 290 | 1 | -0.3205+0.0182i | 0.2254-0.0082i | -0.1876+0.0061i |
| | -0.3205-0.0182i | 1 | -0.3204+0.0188i | 0.2262-0.0084i | | | -0.3205-0.0182i | 1 | -0.3204+0.0188i | 0.2262-0.0084i |
| | 0.2254+0.0082i | -0.3204-0.0188i | 1 | -0.3198+0.0196i | | | 0.2254+0.0082i | -0.3204-0.0188i | 1 | -0.3198+0.0196i |
| | -0.1876-0.0061i | 0.2262+0.0084i | -0.3198-0.0196i | 1 | | | -0.1876-0.0061i | 0.2262+0.0084i | -0.3198-0.0196i | 1 |
| 120 | 1 | -0.3205+0.0182i | 0.2254-0.0082i | -0.1876+0.0061i | | 300 | 1 | -0.3205+0.0182i | 0.2254-0.0082i | -0.1876+0.0061i |
| | -0.3205-0.0182i | 1 | -0.3204+0.0188i | 0.2262-0.0084i | | | -0.3205-0.0182i | 1 | -0.3204+0.0188i | 0.2262-0.0084i |
| | 0.2254+0.0082i | -0.3204-0.0188i | 1 | -0.3198+0.0196i | | | 0.2254+0.0082i | -0.3204-0.0188i | 1 | -0.3198+0.0196i |
| | -0.1876-0.0061i | 0.2262+0.0084i | -0.3198-0.0196i | 1 | | | -0.1876-0.0061i | 0.2262+0.0084i | -0.3198-0.0196i | 1 |
| 130 | 1 | -0.3205+0.0182i | 0.2254-0.0082i | -0.1876+0.0061i | | 310 | 1 | -0.3205+0.0182i | 0.2254-0.0082i | -0.1876+0.0061i |
| | -0.3205-0.0182i | 1 | -0.3204+0.0188i | 0.2262-0.0084i | | | -0.3205-0.0182i | 1 | -0.3204+0.0188i | 0.2262-0.0084i |
| | 0.2254+0.0082i | -0.3204-0.0188i | 1 | -0.3198+0.0196i | | | 0.2254+0.0082i | -0.3204-0.0188i | 1 | -0.3198+0.0196i |
| | -0.1876-0.0061i | 0.2262+0.0084i | -0.3198-0.0196i | 1 | | | -0.1876-0.0061i | 0.2262+0.0084i | -0.3198-0.0196i | 1 |
| 140 | 1 | -0.3205+0.0182i | 0.2254-0.0082i | -0.1876+0.0061i | | 320 | 1 | -0.3205+0.0182i | 0.2254-0.0082i | -0.1876+0.0061i |
| | -0.3205-0.0182i | 1 | -0.3204+0.0188i | 0.2262-0.0084i | | | -0.3205-0.0182i | 1 | -0.3204+0.0188i | 0.2262-0.0084i |
| | 0.2254+0.0082i | -0.3204-0.0188i | 1 | -0.3198+0.0196i | | | 0.2254+0.0082i | -0.3204-0.0188i | 1 | -0.3198+0.0196i |
| | -0.1876-0.0061i | 0.2262+0.0084i | -0.3198-0.0196i | 1 | | | -0.1876-0.0061i | 0.2262+0.0084i | -0.3198-0.0196i | 1 |
| 150 | 1 | -0.3205+0.0182i | 0.2254-0.0082i | -0.1876+0.0061i | | 330 | 1 | -0.3205+0.0182i | 0.2254-0.0082i | -0.1876+0.0061i |
| | -0.3205-0.0182i | 1 | -0.3204+0.0188i | 0.2262-0.0084i | | | -0.3205-0.0182i | 1 | -0.3204+0.0188i | 0.2262-0.0084i |
| | 0.2254+0.0082i | -0.3204-0.0188i | 1 | -0.3198+0.0196i | | | 0.2254+0.0082i | -0.3204-0.0188i | 1 | -0.3198+0.0196i |
| | -0.1876-0.0061i | 0.2262+0.0084i | -0.3198-0.0196i | 1 | | | -0.1876-0.0061i | 0.2262+0.0084i | -0.3198-0.0196i | 1 |
| 160 | 1 | -0.3205+0.0182i | 0.2254-0.0082i | -0.1876+0.0061i | | 340 | 1 | -0.3205+0.0182i | 0.2254-0.0082i | -0.1876+0.0061i |
| | -0.3205-0.0182i | 1 | -0.3204+0.0188i | 0.2262-0.0084i | | | -0.3205-0.0182i | 1 | -0.3204+0.0188i | 0.2262-0.0084i |
| | 0.2254+0.0082i | -0.3204-0.0188i | 1 | -0.3198+0.0196i | | | 0.2254+0.0082i | -0.3204-0.0188i | 1 | -0.3198+0.0196i |
| | -0.1876-0.0061i | 0.2262+0.0084i | -0.3198-0.0196i | 1 | | | -0.1876-0.0061i | 0.2262+0.0084i | -0.3198-0.0196i | 1 |
| 170 | 1 | -0.3205+0.0182i | 0.2254-0.0082i | -0.1876+0.0061i | | 350 | 1 | -0.3205+0.0182i | 0.2254-0.0082i | -0.1876+0.0061i |
| | -0.3205-0.0182i | 1 | -0.3204+0.0188i | 0.2262-0.0084i | | | -0.3205-0.0182i | 1 | -0.3204+0.0188i | 0.2262-0.0084i |
| | 0.2254+0.0082i | -0.3204-0.0188i | 1 | -0.3198+0.0196i | | | 0.2254+0.0082i | -0.3204-0.0188i | 1 | -0.3198+0.0196i |
| | -0.1876-0.0061i | 0.2262+0.0084i | -0.3198-0.0196i | 1 | | | -0.1876-0.0061i | 0.2262+0.0084i | -0.3198-0.0196i | 1 |

# Appendix C FER vs. $E_b/N_0$ Curves for Forward Link Packet Formats

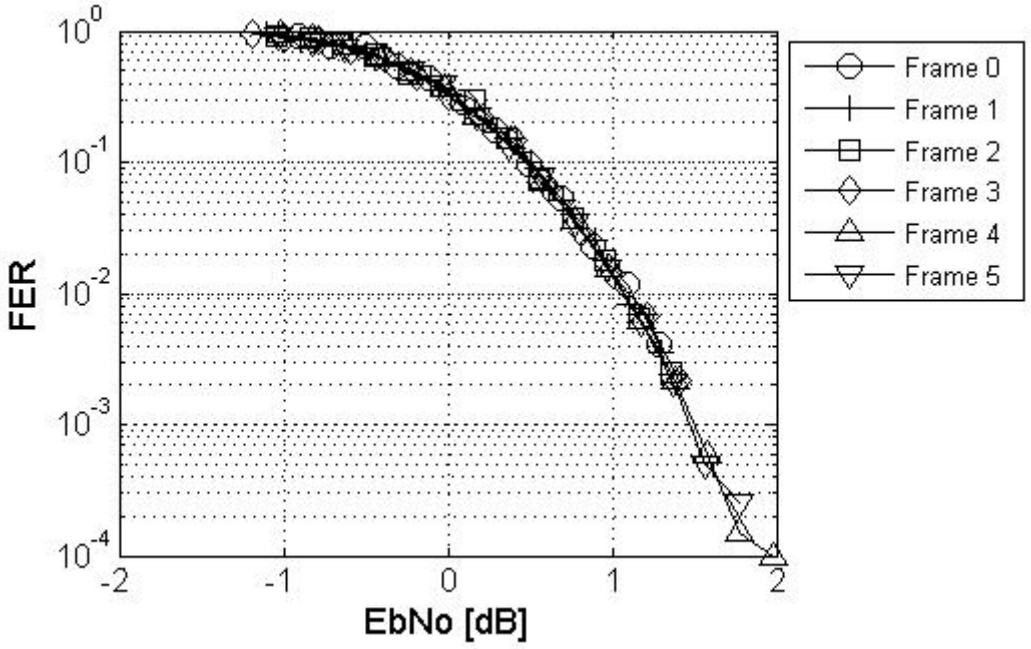


**Figure 5-1 FL FER vs. $E_b/N_0$ for packet format 0**

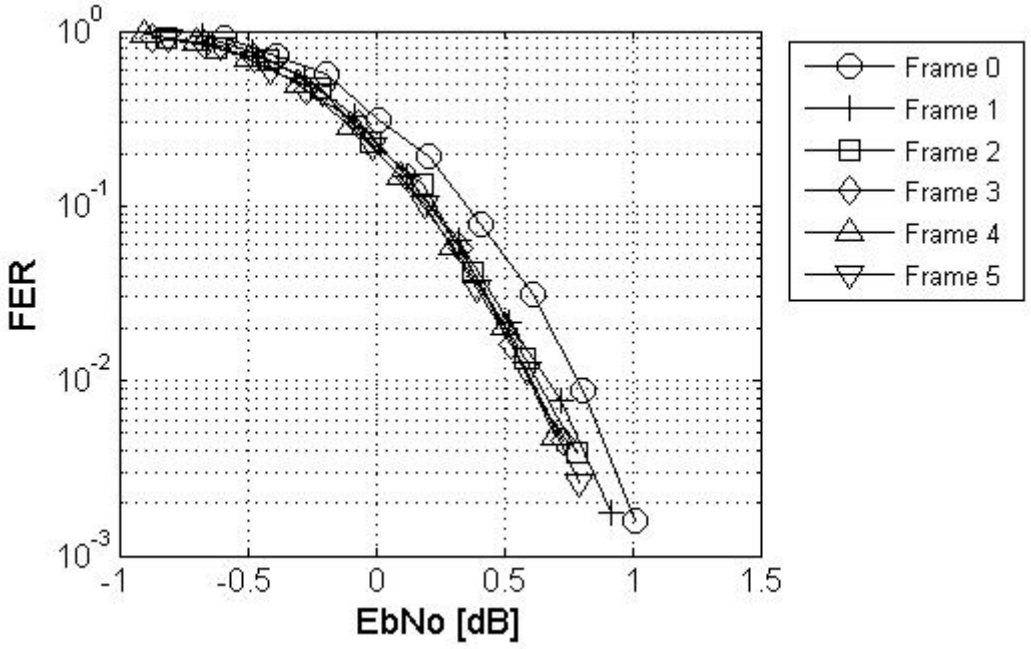


**Figure 5-2 FL FER vs. $E_b/N_0$ for packet format 1**

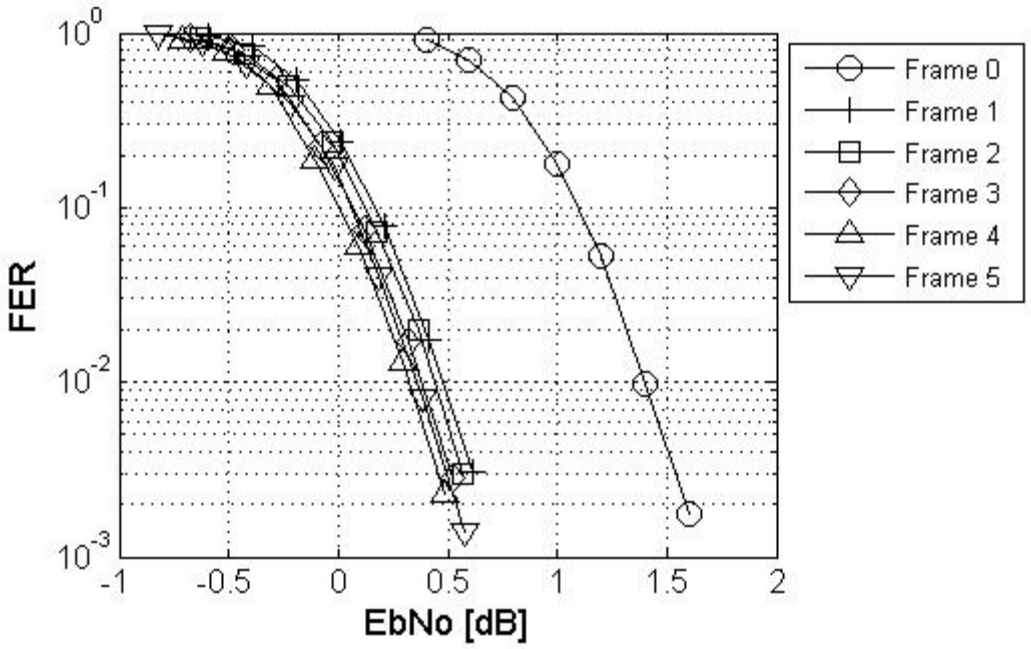


**Figure 5-3 FL FER vs. $E_b/N_0$ for packet format 2**

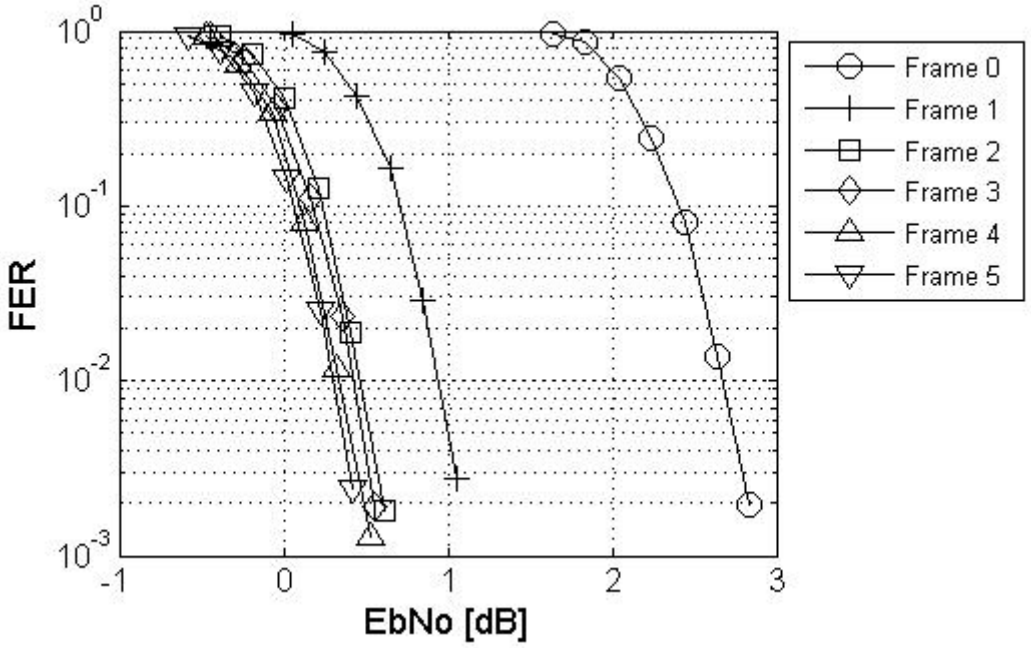


**Figure 5-4 FL FER vs. $E_b/N_0$ for packet format 3**

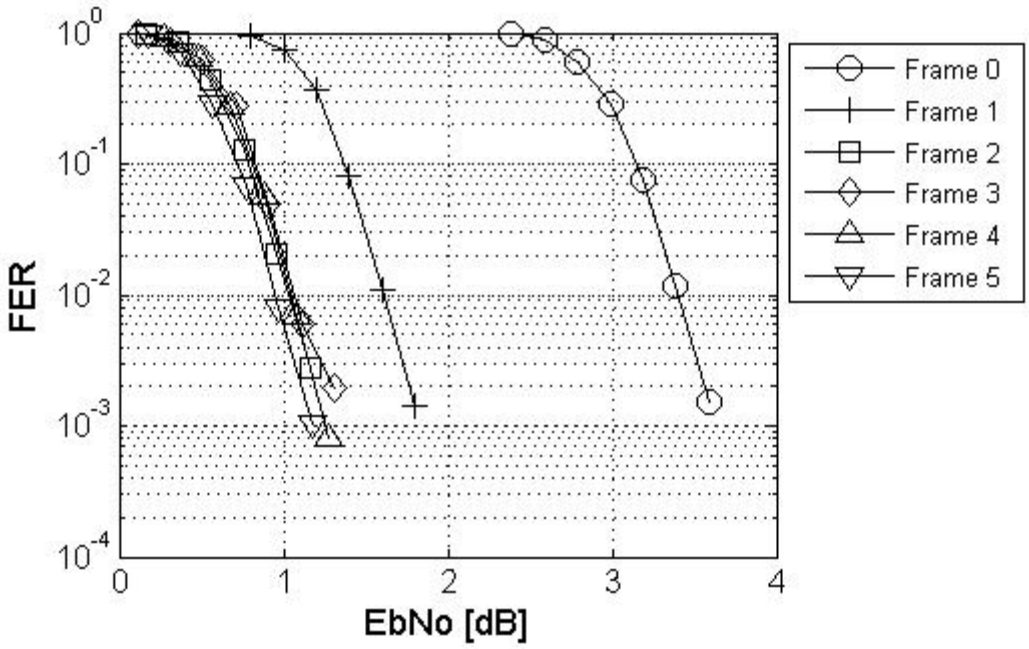


**Figure 5-5 FL FER vs. $E_b/N_0$ for packet format 4**

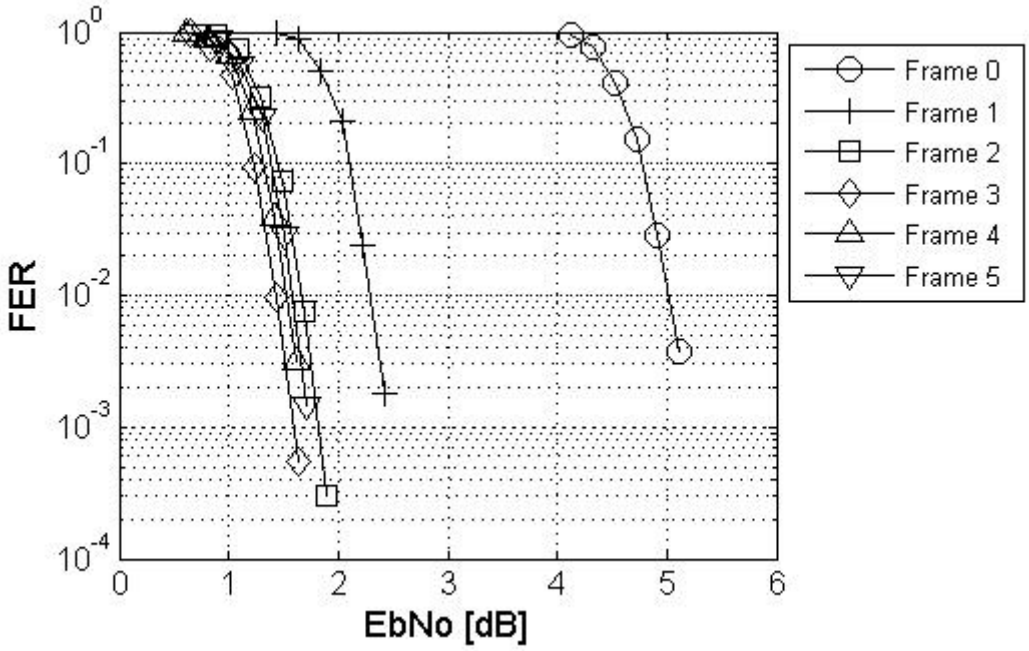


**Figure 5-6 FL FER vs. $E_b/N_0$ for packet format 5**

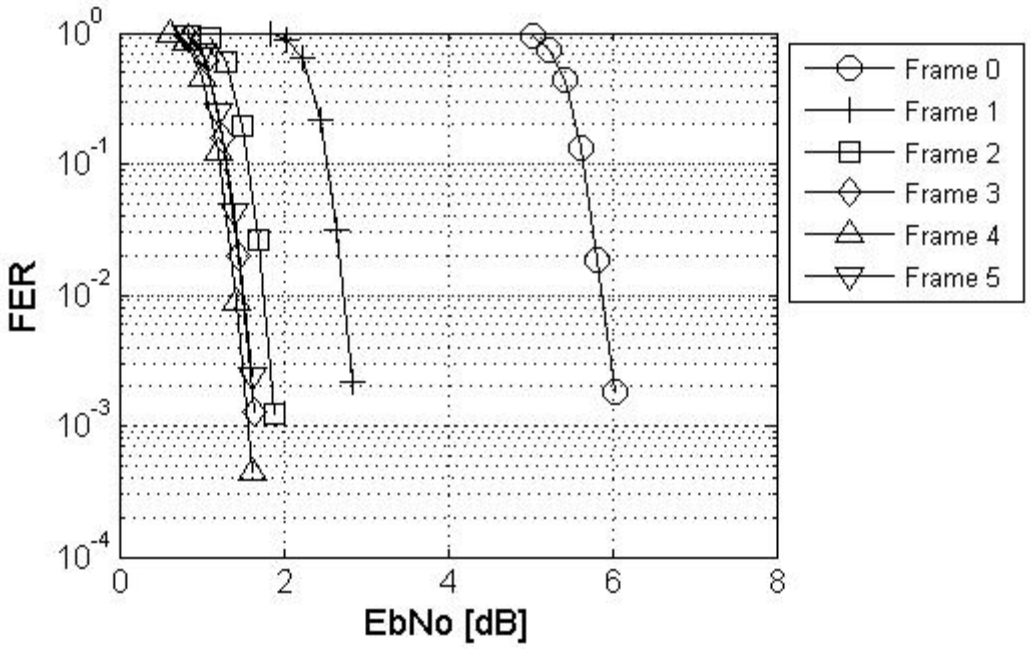


**Figure 5-7 FL FER vs. $E_b/N_0$ for packet format 6**

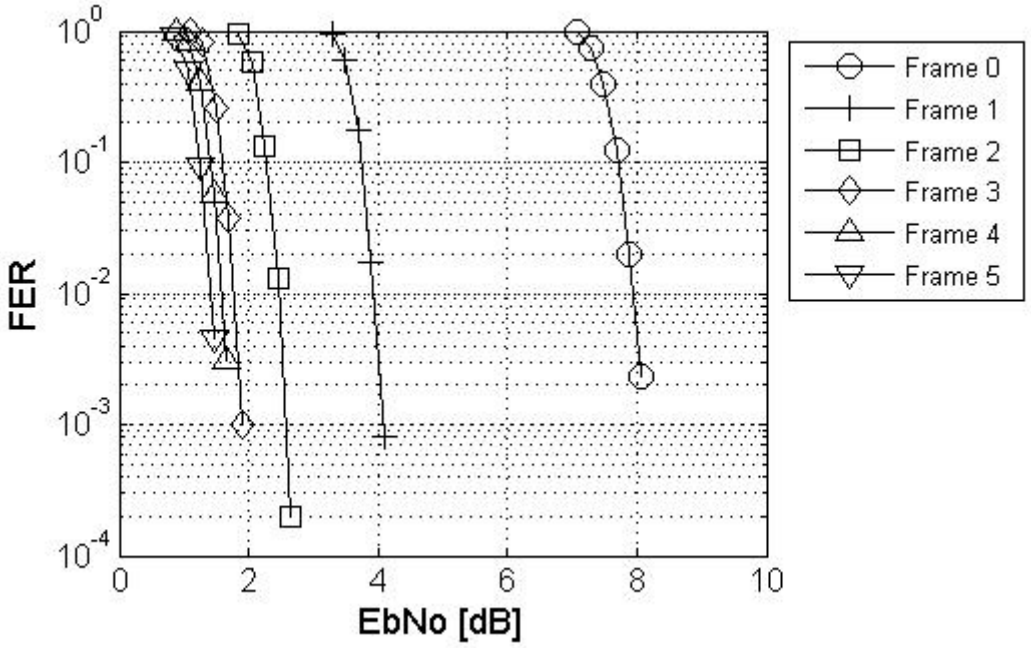


**Figure 5-8 FL FER vs. $E_b/N_0$ for packet format 7**

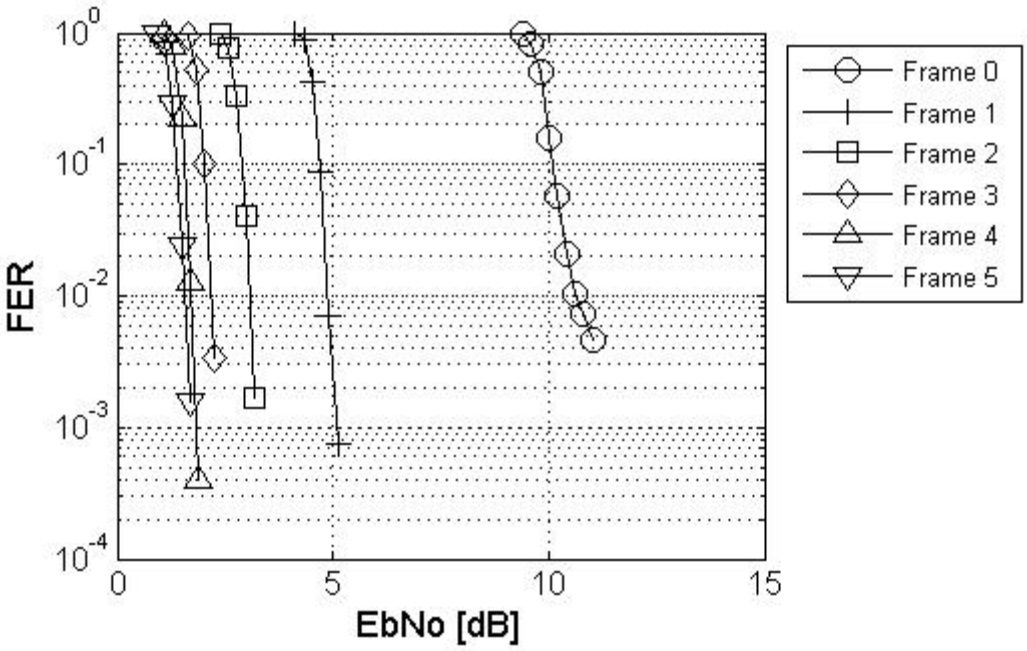


**Figure 5-9 FL FER vs. $E_b/N_0$ for packet format 8**

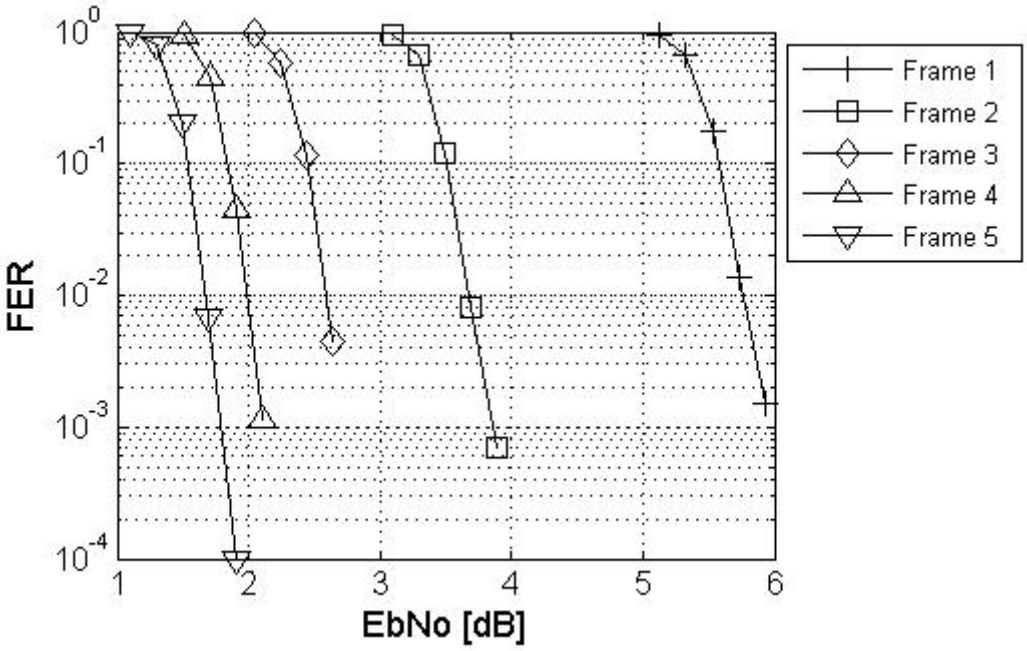


**Figure 5-10 FL FER vs. $E_b/N_0$ for packet format 9**

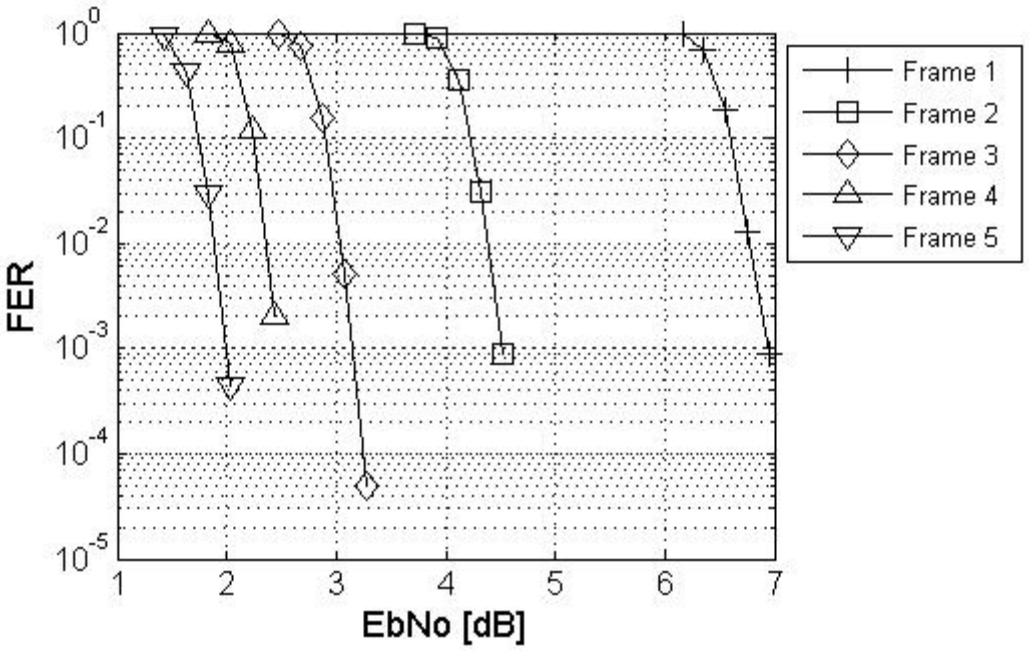


**Figure 5-11 FL FER vs. $E_b/N_0$ for packet format 10**

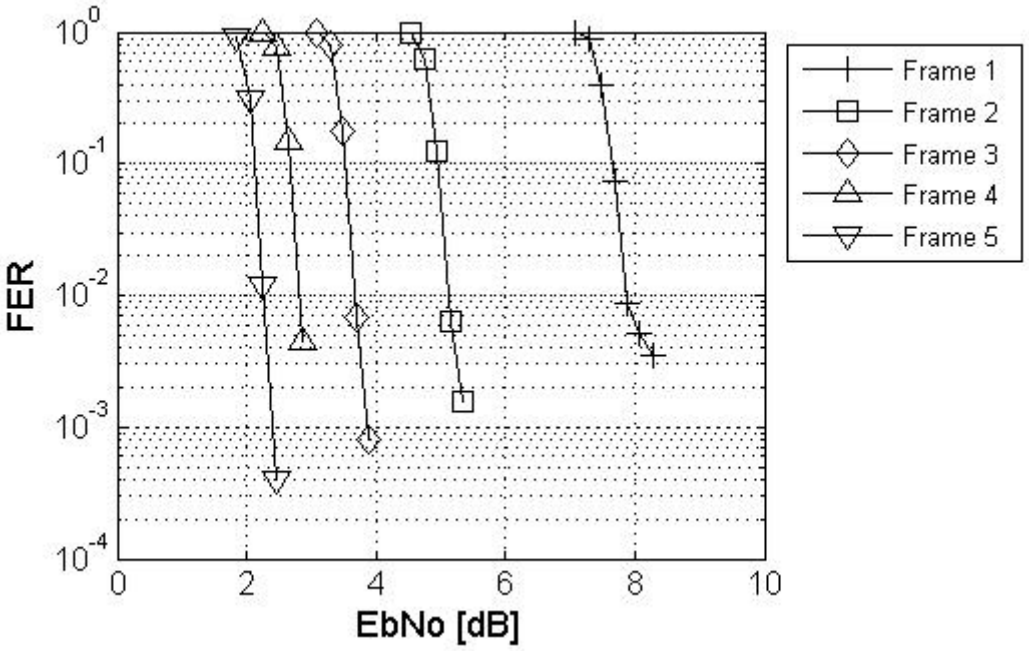


**Figure 5-12 FL FER vs. $E_b/N_0$ for packet format 11**

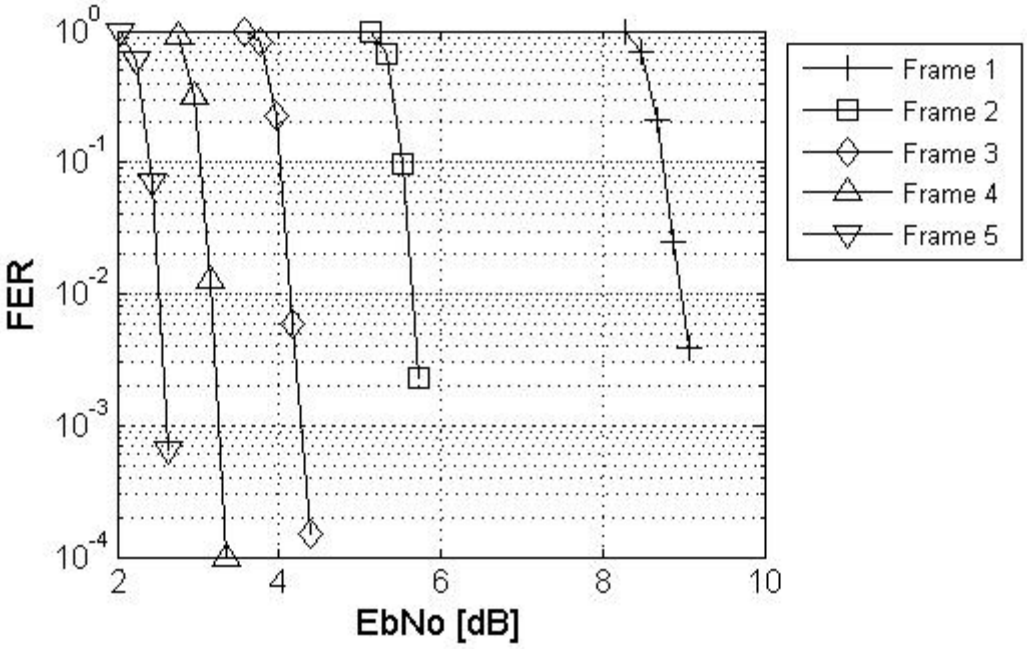


**Figure 5-13 FL FER vs. $E_b/N_0$ for packet format 12**

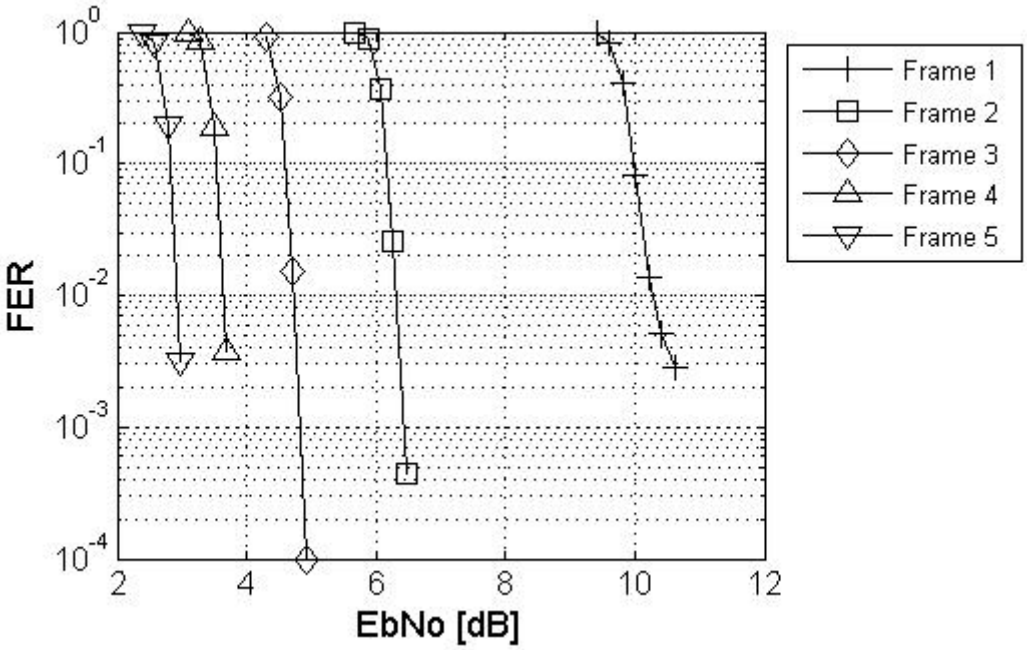


**Figure 5-14 FL FER vs. $E_b/N_0$ for packet format 13**

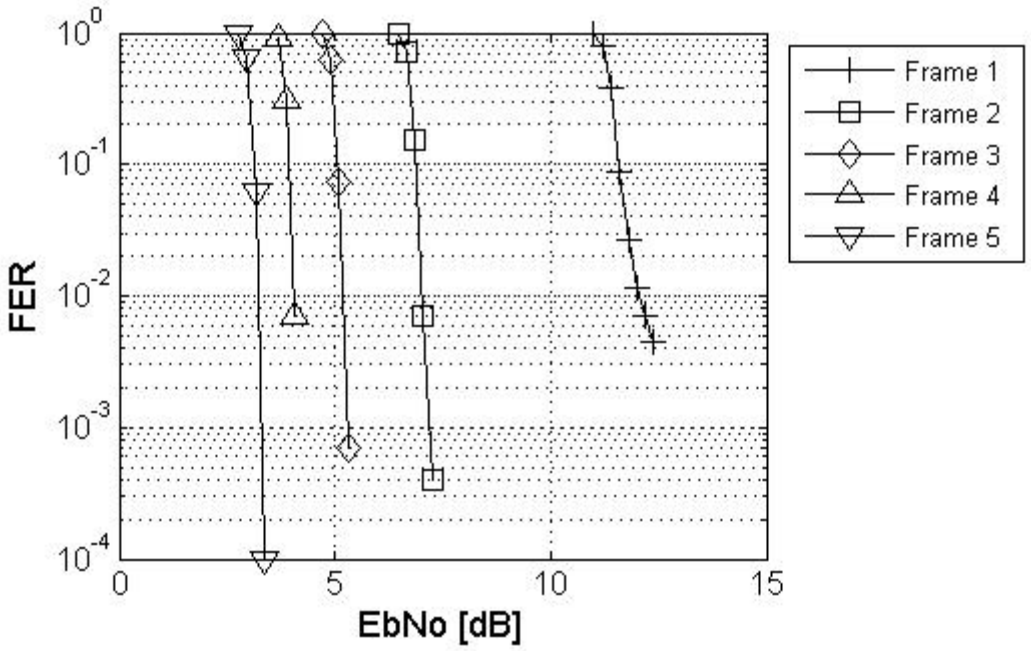


**Figure 5-15 FL FER vs. $E_b/N_0$ for packet format 14**

# Appendix D FER vs. $E_b/N_0$ Curves for Reverse Link Packet Formats

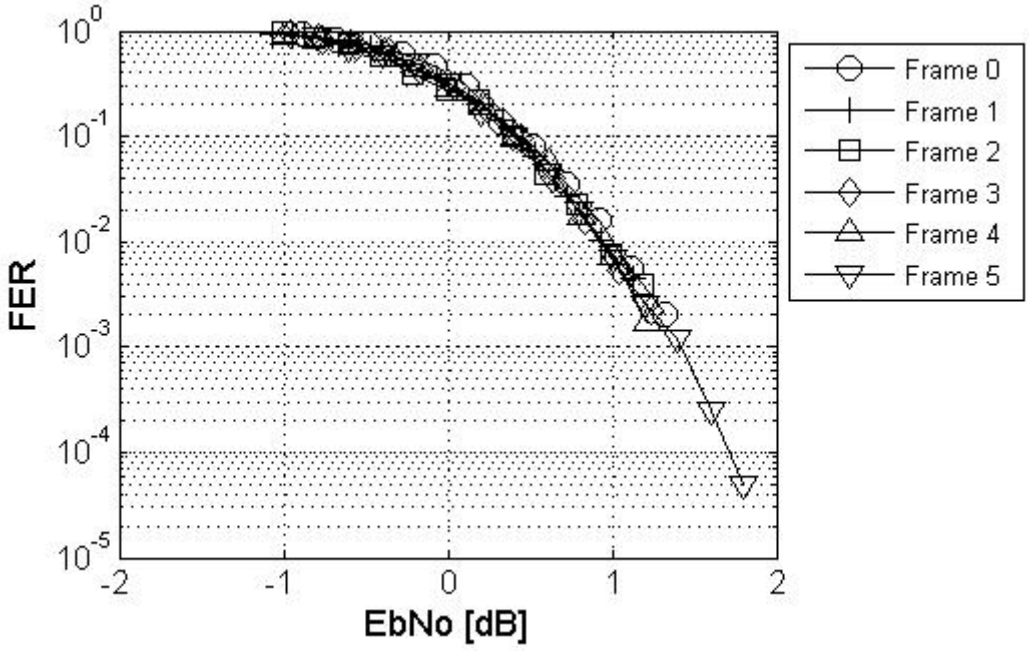


**Figure 5-16 RL FER vs. $E_b/N_0$ for packet format 0**

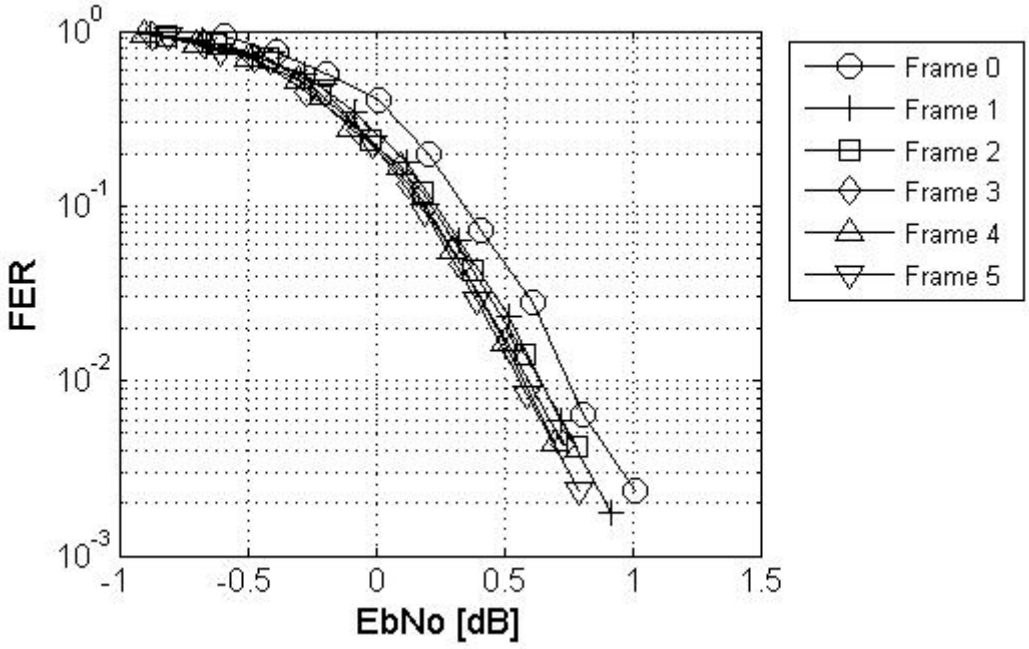


**Figure 5-17 RL FER vs. $E_b/N_0$ for packet format 1**

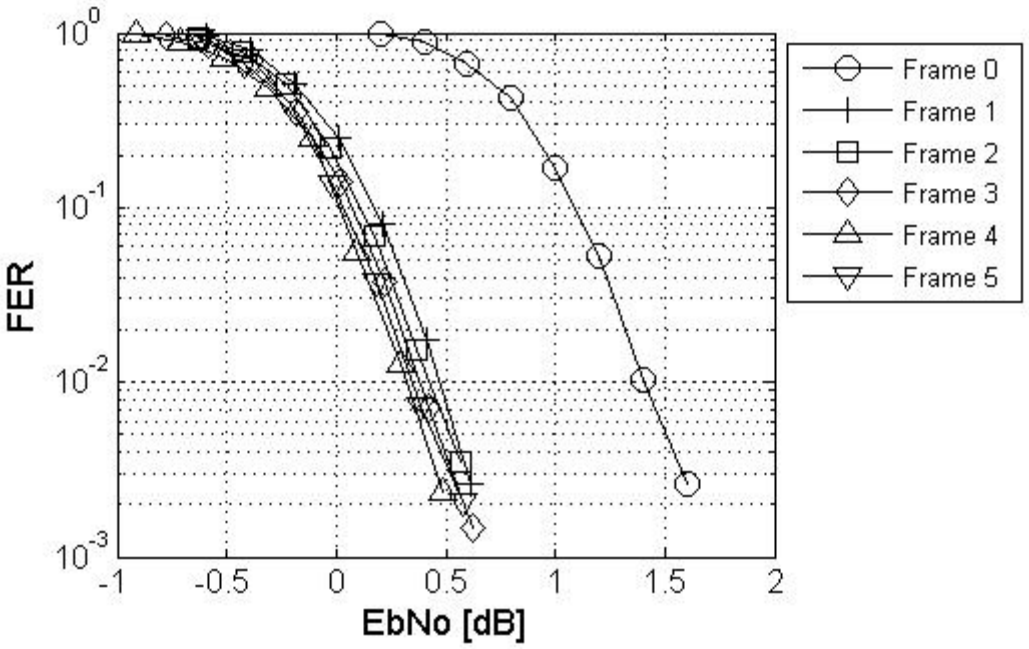


**Figure 5-18 RL FER vs. $E_b/N_0$ for packet format 2**

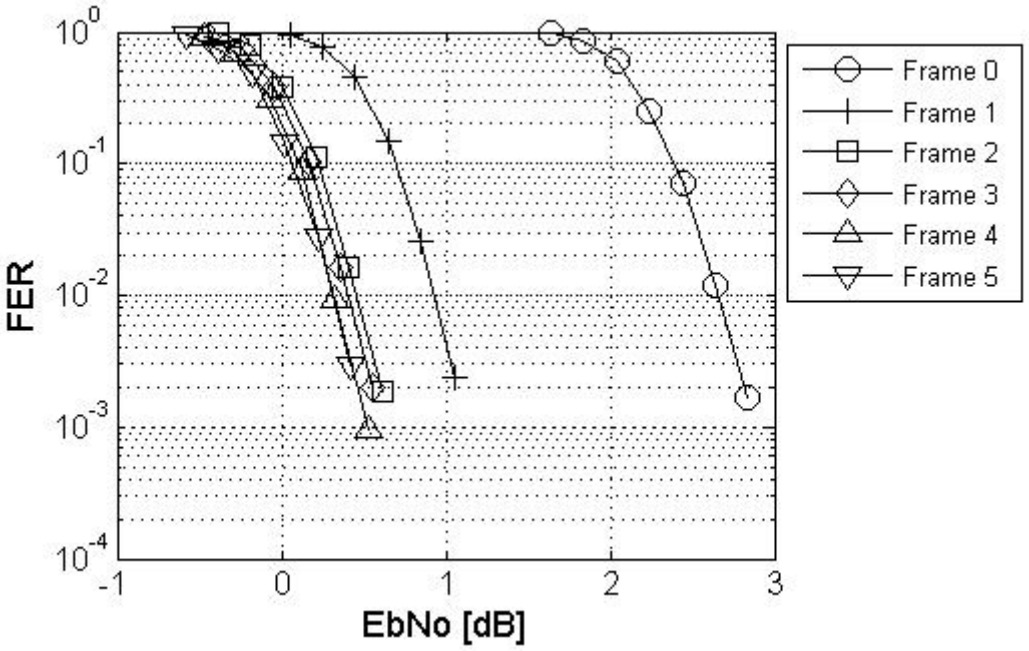


**Figure 5-19 RL FER vs. $E_b/N_0$ for packet format 3**

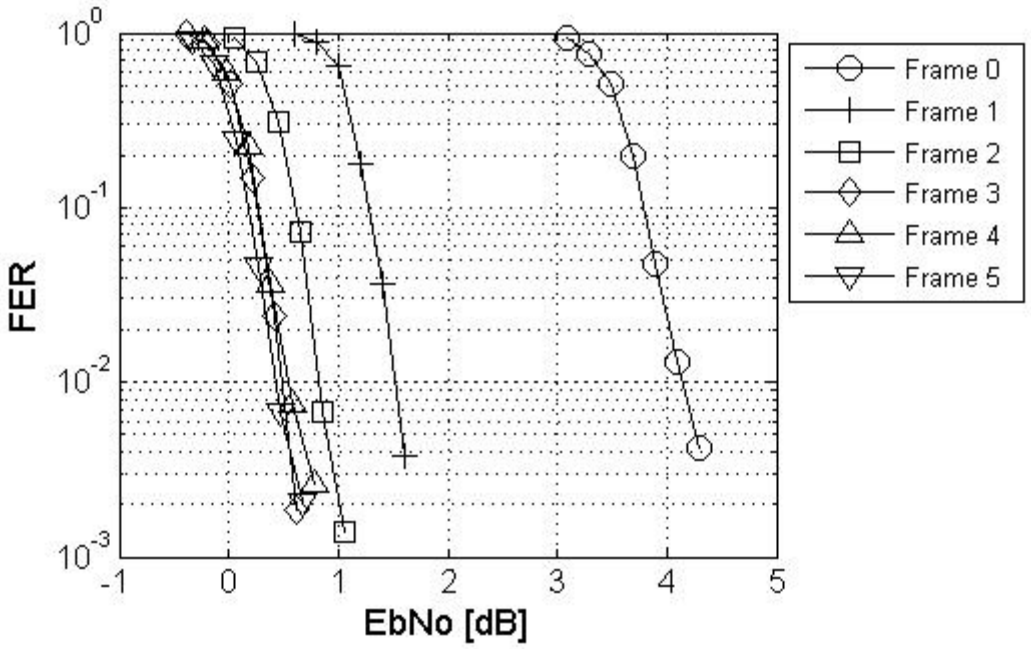


**Figure 5-20 RL FER vs. $E_b/N_0$ for packet format 4**

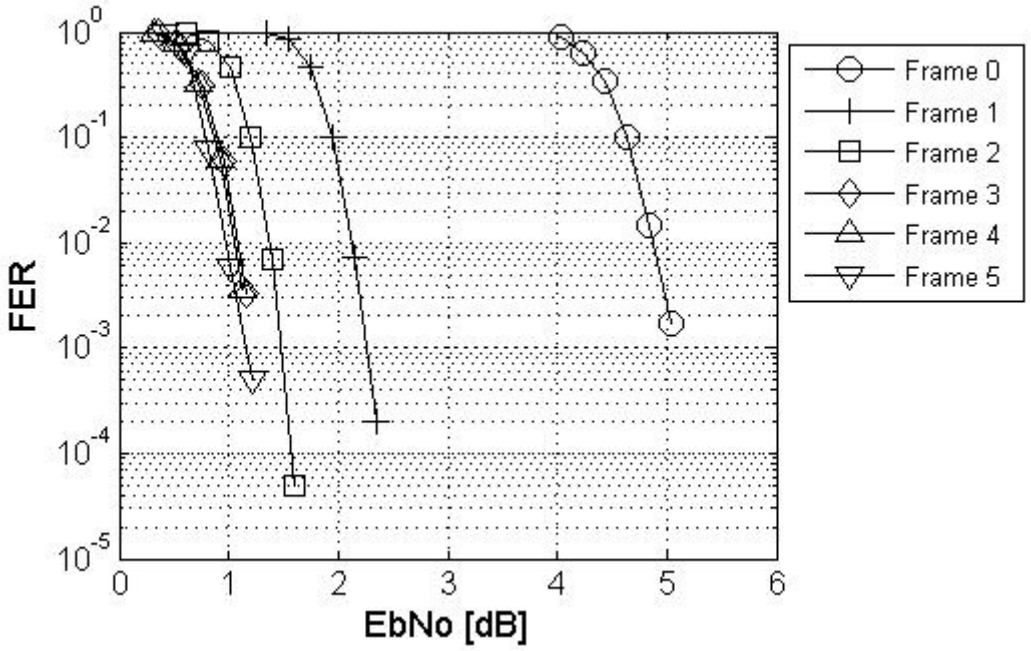


**Figure 5-21 RL FER vs. $E_b/N_0$ for packet format 5**

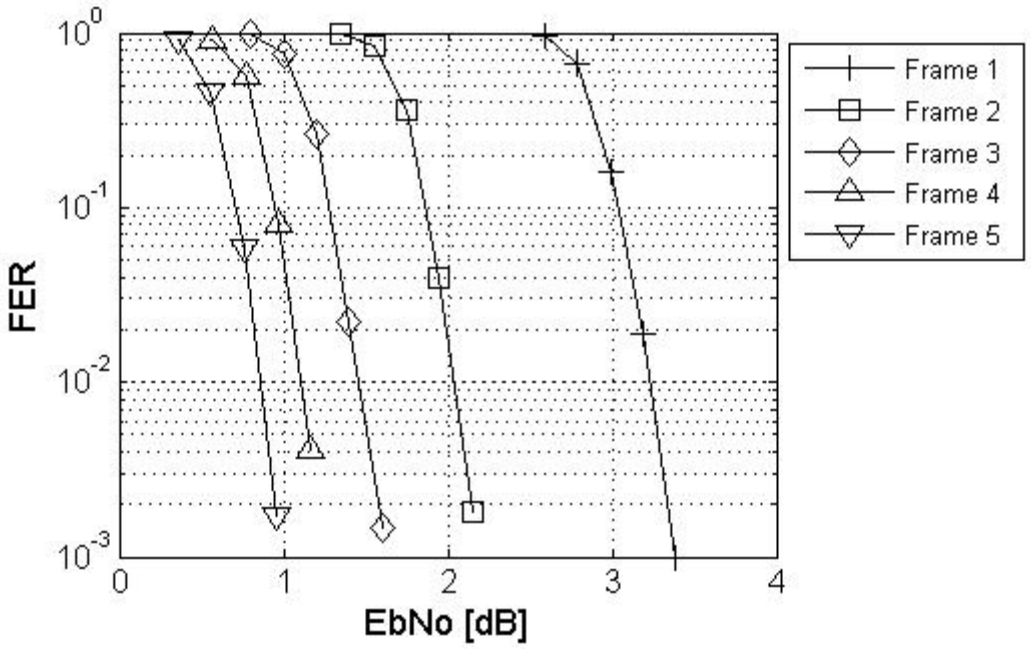


**Figure 5-22 RL FER vs. $E_b/N_0$ for packet format 6**

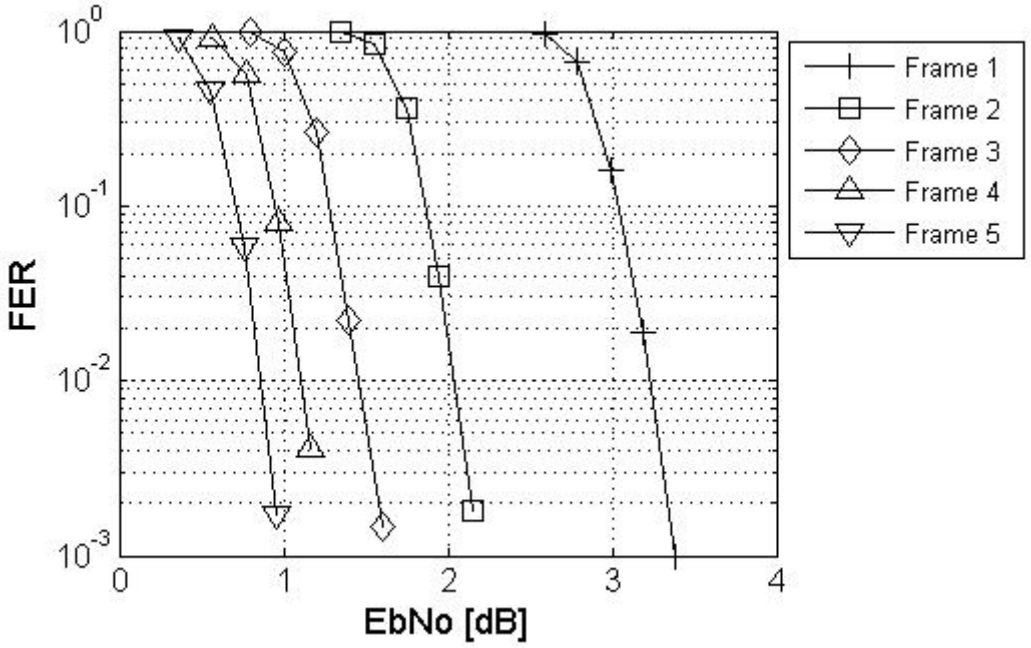


**Figure 5-23 RL FER vs. $E_b/N_0$ for packet format 7**

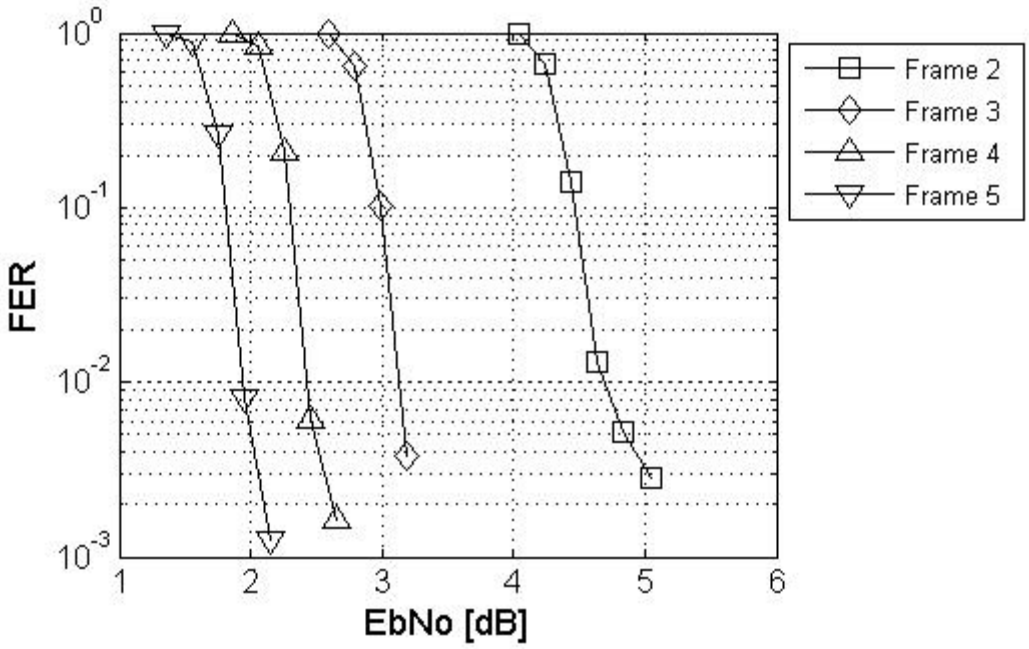


**Figure 5-24 RL FER vs. $E_b/N_0$ for packet format 8**

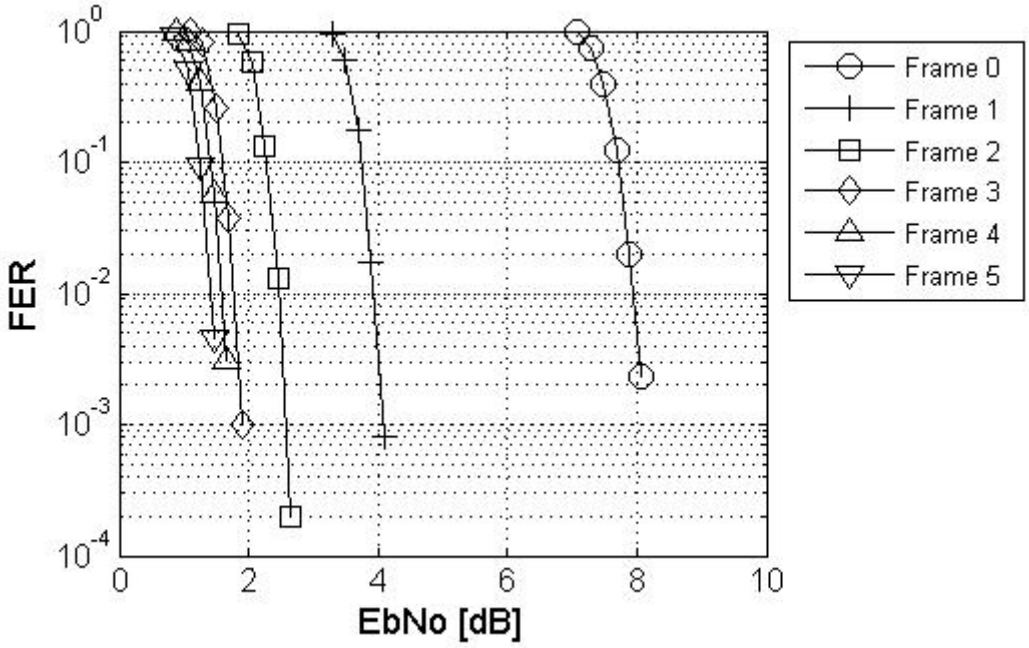


**Figure 5-25 RL FER vs. $E_b/N_0$ for packet format 9**

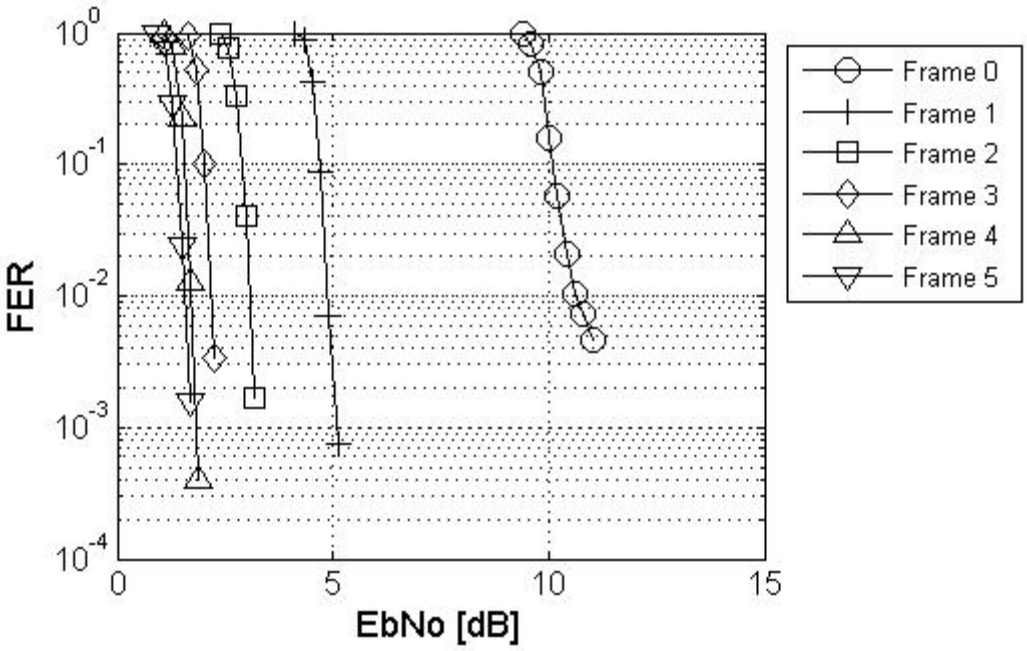


**Figure 5-26 RL FER vs. $E_b/N_0$ for packet format 10**

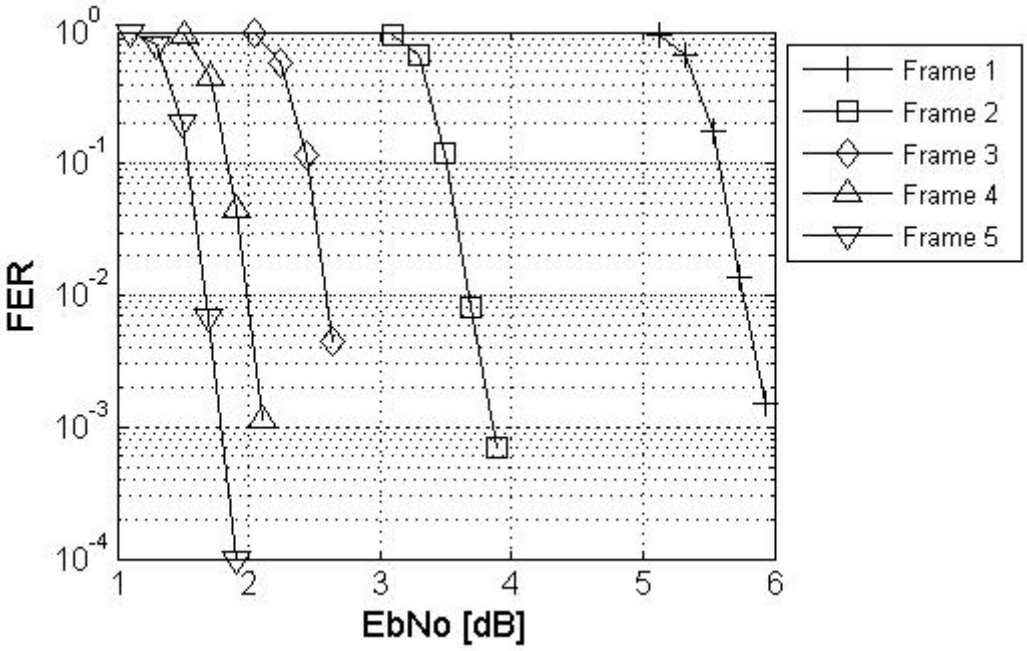


**Figure 5-27 RL FER vs. $E_b/N_0$ for packet format 11**

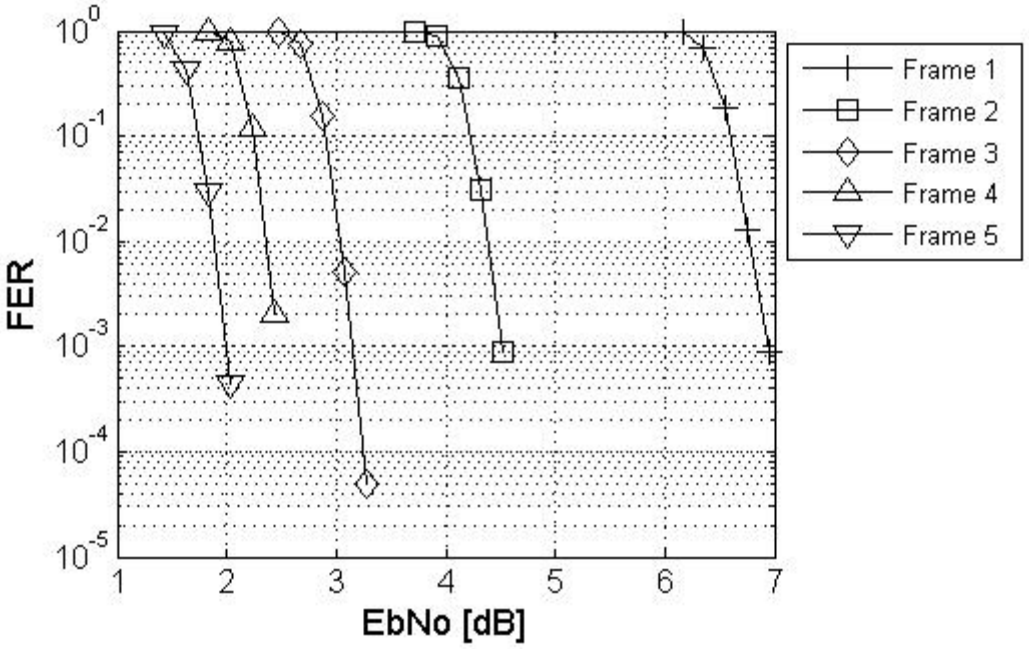


**Figure 5-28 RL FER vs. $E_b/N_0$ for packet format 12**

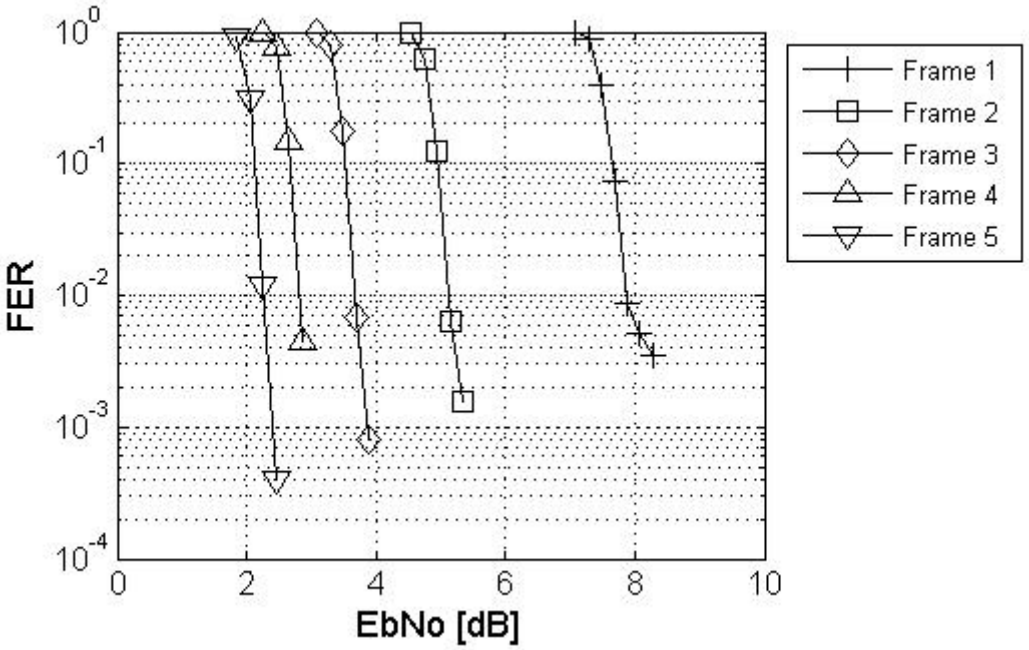


**Figure 5-29 RL FER vs. $E_b/N_0$ for packet format 13**

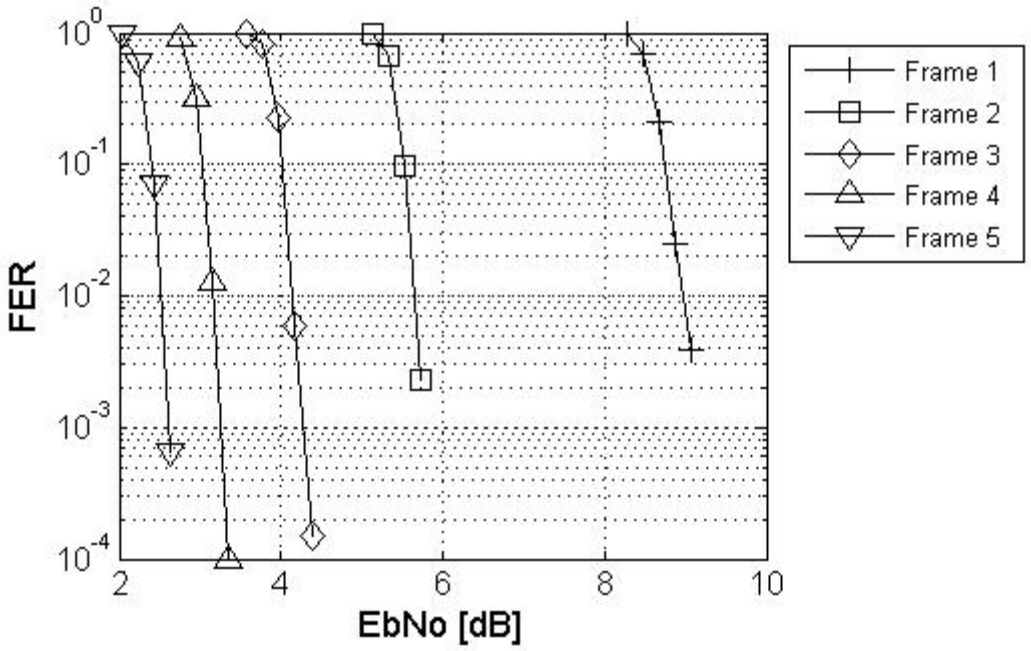


**Figure 5-30 RL FER vs. $E_b/N_0$ for packet format 14**

# Appendix E Location Calibration Table

| g.sc.id | l.ms.id | bs.loc.x | bs.loc.y | ms.loc.x | ms.loc.y | C/I | Path Loss | Chandiff |
|---|---|---|---|---|---|---|---|---|
| | | (m) | (m) | (m) | (m) | (dB) | (dB) | (dB) |
| 0 | 0 | 0 | 0 | 923.1855 | -821.784 | -8.35971 | 154.18 | 1.22076 |
| 0 | 1 | 0 | 0 | 1110.356 | -66.758 | 8.76876 | 125.031 | 13.2174 |
| 0 | 2 | 0 | 0 | 362.1842 | 359.5489 | 4.77396 | 127.683 | 8.8168 |
| 0 | 3 | 0 | 0 | 129.4834 | 201.0195 | 0.767965 | 134.083 | 1.7633 |
| 0 | 4 | 0 | 0 | 319.7925 | -92.287 | 7.45047 | 127.121 | 12.8739 |
| 0 | 5 | 0 | 0 | 1054.627 | 533.2838 | -0.12349 | 126.29 | 0.656323 |
| 0 | 6 | 0 | 0 | 997.3494 | -473.953 | -2.78099 | 143.36 | 5.05722 |
| 0 | 7 | 0 | 0 | 922.0448 | -449.127 | 1.96235 | 119.722 | 5.8613 |
| 0 | 8 | 0 | 0 | 367.9087 | 135.2231 | 15.1784 | 112.771 | 19.0204 |
| 0 | 9 | 0 | 0 | 641.6122 | 524.2848 | 8.35487 | 127.928 | 12.3431 |
| 1 | 0 | 0 | 0 | -62.6639 | 518.8976 | 6.44211 | 118.776 | 8.96731 |
| 1 | 1 | 0 | 0 | 254.3962 | 447.7367 | -1.65286 | 134.455 | 2.7543 |
| 1 | 2 | 0 | 0 | -432.835 | 36.29939 | -1.67037 | 141.616 | 2.9388 |
| 1 | 3 | 0 | 0 | -786.331 | 350.0729 | -0.60861 | 135.091 | 7.24162 |
| 1 | 4 | 0 | 0 | -15.6605 | 108.6677 | 15.7723 | 101.039 | 18.8147 |
| 1 | 5 | 0 | 0 | -916.291 | 781.3853 | -3.11849 | 135.44 | 0.547633 |
| 1 | 6 | 0 | 0 | -51.0684 | 280.9349 | 14.6912 | 103.792 | 19.0204 |
| 1 | 7 | 0 | 0 | -668.559 | 587.4711 | 10.5346 | 133.341 | 19.1159 |
| 1 | 8 | 0 | 0 | -746.416 | 125.9838 | -2.58887 | 141.197 | 5.66178 |
| 1 | 9 | 0 | 0 | -574.016 | 68.56649 | -1.8725 | 133.283 | 2.49885 |
| 2 | 0 | 0 | 0 | -555.214 | -1092.14 | -6.83238 | 150.806 | 4.62117 |
| 2 | 1 | 0 | 0 | -124.703 | -125.46 | 11.7518 | 124.741 | 17.6129 |
| 2 | 2 | 0 | 0 | -76.5442 | -499.441 | 9.22151 | 120.526 | 12.5985 |
| 2 | 3 | 0 | 0 | -440.678 | -646.422 | 7.2362 | 135.081 | 15.9262 |
| 2 | 4 | 0 | 0 | 231.2735 | -490.612 | 2.19259 | 126.326 | 2.9388 |
| 2 | 5 | 0 | 0 | -544.939 | -991.515 | 8.35803 | 120.465 | 13.6179 |
| 2 | 6 | 0 | 0 | -529.258 | -912.051 | -3.43493 | 144.18 | 4.29039 |
| 2 | 7 | 0 | 0 | -873.75 | -378.997 | 1.68117 | 123.629 | 6.95358 |
| 2 | 8 | 0 | 0 | -701.09 | -1032.67 | -3.73433 | 134.746 | 0.398971 |
| 2 | 9 | 0 | 0 | -319.491 | -345.003 | -1.48732 | 143.424 | 2.8273 |
| 3 | 0 | 2165.064 | 0 | 2813.238 | 198.6431 | 0.511935 | 120.491 | 3.42123 |
| 3 | 1 | 2165.064 | 0 | 3113.951 | -19.502 | -0.99228 | 134.948 | 5.12137 |
| 3 | 2 | 2165.064 | 0 | 2849.724 | 107.6759 | 3.08155 | 132.341 | 6.59297 |

| g.sc.id | l.ms.id | bs.loc.x | bs.loc.y | ms.loc.x | ms.loc.y | C/I | Path Loss | Chandiff |
|---|---|---|---|---|---|---|---|---|
| 3 | 3 | 2165.064 | 0 | 2430.914 | 459.1096 | -4.92334 | 129.249 | 0 |
| 3 | 4 | 2165.064 | 0 | 3151.596 | -341.482 | -6.91609 | 153.366 | 3.07286 |
| 3 | 5 | 2165.064 | 0 | 2382.451 | 123.5847 | 11.2794 | 121.738 | 17.6329 |
| 3 | 6 | 2165.064 | 0 | 2755.978 | -32.9127 | 8.45873 | 118.922 | 12.0404 |
| 3 | 7 | 2165.064 | 0 | 2891.392 | -138.144 | 0.188327 | 145.548 | 12.4502 |
| 3 | 8 | 2165.064 | 0 | 2433.837 | -352.504 | 2.28733 | 128.062 | 4.1138 |
| 3 | 9 | 2165.064 | 0 | 2852.353 | 294.3411 | 0.744479 | 131.789 | 4.28438 |
| 4 | 0 | 2165.064 | 0 | 1580.508 | 754.0377 | 0.70714 | 139.221 | 6.98976 |
| 4 | 1 | 2165.064 | 0 | 1683.133 | 86.92938 | -0.69939 | 133.418 | 2.8129 |
| 4 | 2 | 2165.064 | 0 | 1920.734 | 890.1078 | 5.882 | 126.174 | 8.43115 |
| 4 | 3 | 2165.064 | 0 | 2071.205 | 948.422 | 1.38261 | 138.78 | 5.63941 |
| 4 | 4 | 2165.064 | 0 | 1846.079 | 274.9923 | 13.9143 | 101.721 | 19.1159 |
| 4 | 5 | 2165.064 | 0 | 1384.902 | 492.8636 | -3.84991 | 136.126 | 1.36755 |
| 4 | 6 | 2165.064 | 0 | 1897.183 | 510.4331 | 13.7532 | 125.496 | 19.9902 |
| 4 | 7 | 2165.064 | 0 | 2126.786 | 354.3951 | 7.88163 | 118.431 | 13.2751 |
| 4 | 8 | 2165.064 | 0 | 1701.31 | 210.56 | 9.54946 | 118.574 | 14.1061 |
| 4 | 9 | 2165.064 | 0 | 2031.886 | 601.995 | -2.76625 | 141.295 | 1.10516 |
| 5 | 0 | 2165.064 | 0 | 1366.635 | -584.462 | 6.38504 | 118.527 | 11.113 |
| 5 | 1 | 2165.064 | 0 | 2030.457 | -139.734 | 7.41256 | 121.499 | 8.95773 |
| 5 | 2 | 2165.064 | 0 | 1357.25 | -251.724 | 7.2822 | 128.529 | 9.9918 |
| 5 | 3 | 2165.064 | 0 | 2335.386 | -638.119 | -0.36846 | 132.608 | 5.87377 |
| 5 | 4 | 2165.064 | 0 | 1994.359 | -290.479 | 16.7299 | 114.225 | 20 |
| 5 | 5 | 2165.064 | 0 | 1878.936 | -1143.72 | -1.40757 | 140.605 | 4.86754 |
| 5 | 6 | 2165.064 | 0 | 1888.376 | -879.947 | 1.18369 | 129.982 | 6.42977 |
| 5 | 7 | 2165.064 | 0 | 2570.726 | -976.892 | -2.61743 | 146.234 | 6.09922 |
| 5 | 8 | 2165.064 | 0 | 1630.826 | -675.119 | -0.50069 | 135.912 | 3.18694 |
| 5 | 9 | 2165.064 | 0 | 1530.563 | -18.9858 | -0.55367 | 131.104 | 1.1755 |
| 6 | 0 | 4330.127 | 0 | 5094.74 | -720.449 | -4.49159 | 147.234 | 1.24598 |
| 6 | 1 | 4330.127 | 0 | 5500.737 | 313.3131 | 1.76951 | 134.775 | 5.45832 |
| 6 | 2 | 4330.127 | 0 | 4900.546 | -733.138 | 3.65355 | 123.815 | 8.47124 |
| 6 | 3 | 4330.127 | 0 | 4829.239 | -826.475 | -1.35598 | 140.344 | 1.9354 |
| 6 | 4 | 4330.127 | 0 | 5051.454 | -128.66 | 3.12511 | 121.837 | 7.2657 |
| 6 | 5 | 4330.127 | 0 | 4923.893 | -61.4923 | 13.0327 | 116.27 | 16.9657 |
| 6 | 6 | 4330.127 | 0 | 4482.365 | 35.87273 | 16.4219 | 110.562 | 19.5861 |
| 6 | 7 | 4330.127 | 0 | 4640.798 | 82.49157 | 7.54564 | 116.181 | 12.0085 |
| 6 | 8 | 4330.127 | 0 | 4631.296 | 119.1396 | 12.5626 | 119.37 | 18.5389 |
| 6 | 9 | 4330.127 | 0 | 4743.273 | -101.487 | 15.1654 | 121.796 | 19.52 |
| 7 | 0 | 4330.127 | 0 | 4082.053 | 263.3563 | 3.1585 | 127.189 | 10.3323 |

| g.sc.id | l.ms.id | bs.loc.x | bs.loc.y | ms.loc.x | ms.loc.y | C/I | Path Loss | Chandiff |
|---|---|---|---|---|---|---|---|---|
| 7 | 1 | 4330.127 | 0 | 4476.015 | 727.1476 | -3.05621 | 137.862 | 0.631701 |
| 7 | 2 | 4330.127 | 0 | 4523.355 | 450.0568 | 3.31426 | 125.056 | 4.1138 |
| 7 | 3 | 4330.127 | 0 | 4210.85 | 687.8458 | 1.41385 | 122.76 | 3.59851 |
| 7 | 4 | 4330.127 | 0 | 4183.234 | 363.777 | 5.75839 | 140.271 | 16.2062 |
| 7 | 5 | 4330.127 | 0 | 3753.109 | 51.99575 | -3.18381 | 137.269 | 0.057367 |
| 7 | 6 | 4330.127 | 0 | 4529.848 | 1202.126 | -0.79829 | 126.945 | 3.7307 |
| 7 | 7 | 4330.127 | 0 | 4271.968 | 103.8453 | 14.2151 | 126.279 | 19.9976 |
| 7 | 8 | 4330.127 | 0 | 4134.173 | 5.926098 | 0.604758 | 123.374 | 1.1755 |
| 7 | 9 | 4330.127 | 0 | 4392.764 | 450.006 | 10.6986 | 114.122 | 12.9307 |
| 8 | 0 | 4330.127 | 0 | 3431.87 | -64.9339 | -1.67123 | 142.069 | 4.58333 |
| 8 | 1 | 4330.127 | 0 | 4258.635 | -49.6718 | 15.1451 | 86.9318 | 18.4694 |
| 8 | 2 | 4330.127 | 0 | 3887.333 | -170.29 | 7.04395 | 126.048 | 12.3431 |
| 8 | 3 | 4330.127 | 0 | 4421.684 | -158.886 | -0.33939 | 119.386 | 0 |
| 8 | 4 | 4330.127 | 0 | 4230.507 | -94.3659 | 12.7833 | 108.462 | 17.4302 |
| 8 | 5 | 4330.127 | 0 | 3703.769 | -385.744 | 2.86566 | 134.541 | 7.05726 |
| 8 | 6 | 4330.127 | 0 | 3736.384 | -746.191 | 9.56095 | 130.453 | 17.2672 |
| 8 | 7 | 4330.127 | 0 | 4054.884 | -55.6294 | 5.45672 | 111.267 | 6.465 |
| 8 | 8 | 4330.127 | 0 | 3967.102 | -30.6317 | -1.61463 | 133.575 | 2.9388 |
| 8 | 9 | 4330.127 | 0 | 3429.084 | -862.527 | -5.09633 | 143.749 | 1.84402 |
| 9 | 0 | 3247.595 | 1875 | 3645.094 | 1405.343 | 0.789066 | 127.581 | 5.8776 |
| 9 | 1 | 3247.595 | 1875 | 4336.808 | 2149.508 | -4.43369 | 151.395 | 11.8638 |
| 9 | 2 | 3247.595 | 1875 | 4019.379 | 1542.779 | -2.01654 | 139.849 | 0.869649 |
| 9 | 3 | 3247.595 | 1875 | 3404.079 | 2093.873 | 2.69256 | 110.634 | 3.5268 |
| 9 | 4 | 3247.595 | 1875 | 3427.725 | 1848.156 | 12.5242 | 130.38 | 19.8433 |
| 9 | 5 | 3247.595 | 1875 | 3565.054 | 1866.12 | 15.5135 | 119.925 | 19.9902 |
| 9 | 6 | 3247.595 | 1875 | 4432.714 | 2114.643 | 1.36913 | 128.043 | 4.07428 |
| 9 | 7 | 3247.595 | 1875 | 3478.522 | 1841.445 | 13.1605 | 126.048 | 19.8433 |
| 9 | 8 | 3247.595 | 1875 | 4209.648 | 1570.112 | 0.754508 | 130.437 | 1.56328 |
| 9 | 9 | 3247.595 | 1875 | 3459.693 | 1798.212 | 10.0409 | 120.623 | 13.8329 |
| 10 | 0 | 3247.595 | 1875 | 3469.451 | 2290.191 | -2.12451 | 139.391 | 1.1755 |
| 10 | 1 | 3247.595 | 1875 | 2964.365 | 2387.695 | 13.8667 | 111.011 | 19.9976 |
| 10 | 2 | 3247.595 | 1875 | 2968.016 | 2135.161 | 7.42242 | 123.513 | 10.5505 |
| 10 | 3 | 3247.595 | 1875 | 3481.187 | 2475.652 | 2.812 | 133.93 | 5.2902 |
| 10 | 4 | 3247.595 | 1875 | 2810.534 | 2891.634 | 0.887629 | 121.388 | 4.1138 |
| 10 | 5 | 3247.595 | 1875 | 2078.927 | 1875.896 | -2.77499 | 136.778 | 3.44333 |
| 10 | 6 | 3247.595 | 1875 | 2549.238 | 2050.552 | 2.45722 | 131.677 | 5.89963 |
| 10 | 7 | 3247.595 | 1875 | 3379.656 | 2245.959 | 3.04665 | 123.721 | 5.8776 |
| 10 | 8 | 3247.595 | 1875 | 3250.777 | 2736.837 | 5.76885 | 128.42 | 9.31027 |

| g.sc.id | l.ms.id | bs.loc.x | bs.loc.y | ms.loc.x | ms.loc.y | C/I | Path Loss | Chandiff |
|---|---|---|---|---|---|---|---|---|
| 10 | 9 | 3247.595 | 1875 | 2866.963 | 2534.517 | -3.2729 | 144.769 | 3.9865 |
| 11 | 0 | 3247.595 | 1875 | 3341.305 | 1711.631 | -0.39675 | 113.021 | 0 |
| 11 | 1 | 3247.595 | 1875 | 2940.518 | 1844.576 | 2.33131 | 135.437 | 3.5268 |
| 11 | 2 | 3247.595 | 1875 | 3028.162 | 967.1231 | -3.95644 | 141.492 | 0.17462 |
| 11 | 3 | 3247.595 | 1875 | 2659.492 | 1367.545 | 8.00134 | 120.702 | 14.3599 |
| 11 | 4 | 3247.595 | 1875 | 2623.098 | 1142.329 | -9.88154 | 155.273 | 1.8273 |
| 11 | 5 | 3247.595 | 1875 | 3145.265 | 1780.967 | 15.9333 | 107.877 | 19.2922 |
| 11 | 6 | 3247.595 | 1875 | 3105.91 | 1325.244 | 12.9524 | 121.202 | 19.3731 |
| 11 | 7 | 3247.595 | 1875 | 3020.459 | 1592.114 | 8.89267 | 132.321 | 17.8299 |
| 11 | 8 | 3247.595 | 1875 | 3273.296 | 1723.775 | 10.3566 | 104.278 | 11.7546 |
| 11 | 9 | 3247.595 | 1875 | 2697.506 | 1621.712 | -0.8454 | 136.121 | 2.45703 |
| 12 | 0 | 1082.532 | 1875 | 1608.488 | 2053.788 | 4.37308 | 134.137 | 7.38909 |
| 12 | 1 | 1082.532 | 1875 | 1484.761 | 1966.286 | 0.135327 | 117.242 | 1.28387 |
| 12 | 2 | 1082.532 | 1875 | 1923.943 | 2146.101 | 6.58502 | 122.245 | 7.73611 |
| 12 | 3 | 1082.532 | 1875 | 1632.569 | 1607.426 | 10.2836 | 123.231 | 14.1323 |
| 12 | 4 | 1082.532 | 1875 | 1620.075 | 2231.833 | 5.88775 | 119.823 | 7.41143 |
| 12 | 5 | 1082.532 | 1875 | 1297.07 | 1952.78 | 13.8149 | 112.098 | 19.0204 |
| 12 | 6 | 1082.532 | 1875 | 1606.352 | 2758.131 | 5.69041 | 129.264 | 11.249 |
| 12 | 7 | 1082.532 | 1875 | 1623.971 | 1205.545 | -4.8745 | 132.207 | 0.055342 |
| 12 | 8 | 1082.532 | 1875 | 1932.491 | 1949.975 | -11.9532 | 159.14 | 7.28931 |
| 12 | 9 | 1082.532 | 1875 | 1417.159 | 2364.95 | -3.21064 | 131.844 | 0.744962 |
| 13 | 0 | 1082.532 | 1875 | 853.0143 | 2687.499 | -4.16806 | 128.955 | 0.151931 |
| 13 | 1 | 1082.532 | 1875 | 960.3293 | 1926.381 | 10.3696 | 128.04 | 13.5183 |
| 13 | 2 | 1082.532 | 1875 | 915.5712 | 2276.232 | 12.8129 | 121.146 | 17.6385 |
| 13 | 3 | 1082.532 | 1875 | 492.0917 | 2336.593 | 14.7135 | 109.193 | 18.8147 |
| 13 | 4 | 1082.532 | 1875 | 295.3142 | 1878.422 | -3.04926 | 146.934 | 4.78473 |
| 13 | 5 | 1082.532 | 1875 | 1285.964 | 2288.921 | -0.3693 | 130.275 | 2.351 |
| 13 | 6 | 1082.532 | 1875 | 1442.19 | 2542.938 | -1.49988 | 126.504 | 1.1755 |
| 13 | 7 | 1082.532 | 1875 | 646.264 | 2176.875 | 10.0932 | 125.401 | 13.0661 |
| 13 | 8 | 1082.532 | 1875 | 598.7756 | 2378.857 | 6.60387 | 113.87 | 10.7379 |
| 13 | 9 | 1082.532 | 1875 | -20.3609 | 2406.516 | 2.90679 | 132.28 | 8.75519 |
| 14 | 0 | 1082.532 | 1875 | 803.1839 | 1081.412 | -3.7792 | 141.16 | 0.119668 |
| 14 | 1 | 1082.532 | 1875 | 936.5059 | 1830.325 | 7.97177 | 111.409 | 9.9918 |
| 14 | 2 | 1082.532 | 1875 | 673.0974 | 1766.382 | 7.01068 | 121.316 | 8.8168 |
| 14 | 3 | 1082.532 | 1875 | 539.8342 | 1175.88 | -0.00533 | 139.034 | 6.04226 |
| 14 | 4 | 1082.532 | 1875 | 917.9504 | 1367.278 | 1.64282 | 125.23 | 5.16211 |
| 14 | 5 | 1082.532 | 1875 | 976.7574 | 1754.148 | 16.3839 | 104.596 | 19.7037 |
| 14 | 6 | 1082.532 | 1875 | 1013.383 | 1301.784 | 14.7745 | 119.353 | 18.7045 |

| g.sc.id | l.ms.id | bs.loc.x | bs.loc.y | ms.loc.x | ms.loc.y | C/I | Path Loss | Chandiff |
|---|---|---|---|---|---|---|---|---|
| 14 | 7 | 1082.532 | 1875 | 943.8625 | 1844.306 | 6.17501 | 109.843 | 7.0536 |
| 14 | 8 | 1082.532 | 1875 | 1042.447 | 1765.284 | 16.5411 | 116.244 | 19.7551 |
| 14 | 9 | 1082.532 | 1875 | 803.0607 | 1858.959 | 1.34327 | 118.259 | 1.7633 |
| 15 | 0 | 2165.064 | 3750 | 3125.097 | 3861.472 | 9.07032 | 122.866 | 15.2545 |
| 15 | 1 | 2165.064 | 3750 | 2369.754 | 3864.882 | 12.603 | 128.407 | 17.9404 |
| 15 | 2 | 2165.064 | 3750 | 2209.864 | 3777.062 | 14.2352 | 106.561 | 17.0445 |
| 15 | 3 | 2165.064 | 3750 | 2636.921 | 4547.035 | -1.91249 | 129.389 | 4.03781 |
| 15 | 4 | 2165.064 | 3750 | 2577.893 | 3679.14 | 9.65678 | 132.06 | 14.2689 |
| 15 | 5 | 2165.064 | 3750 | 2285.947 | 3847.739 | 10.2838 | 120.174 | 12.3431 |
| 15 | 6 | 2165.064 | 3750 | 2952.167 | 3334.269 | 0.062856 | 128.671 | 2.42629 |
| 15 | 7 | 2165.064 | 3750 | 3106.942 | 4356.078 | -3.82458 | 146.701 | 0.322477 |
| 15 | 8 | 2165.064 | 3750 | 2684.069 | 3750.581 | 4.66899 | 119.134 | 10.634 |
| 15 | 9 | 2165.064 | 3750 | 2419.564 | 3832.233 | 15.3161 | 111.519 | 19.2065 |
| 16 | 0 | 2165.064 | 3750 | 2569.846 | 4476.295 | -2.53069 | 134.315 | 0.5878 |
| 16 | 1 | 2165.064 | 3750 | 1860.692 | 3795.926 | 2.49462 | 119.398 | 5.2902 |
| 16 | 2 | 2165.064 | 3750 | 2263.961 | 4492.828 | 4.45853 | 132.061 | 11.0933 |
| 16 | 3 | 2165.064 | 3750 | 2057.172 | 4824.111 | 6.90633 | 133.294 | 12.6964 |
| 16 | 4 | 2165.064 | 3750 | 2439.299 | 4658.445 | -4.32787 | 134.268 | 0.337372 |
| 16 | 5 | 2165.064 | 3750 | 2071.096 | 4076.812 | 11.3197 | 119.069 | 14.4399 |
| 16 | 6 | 2165.064 | 3750 | 2159.548 | 3788.017 | 15.8041 | 83.3422 | 18.8147 |
| 16 | 7 | 2165.064 | 3750 | 2276.033 | 4669.642 | 0.466889 | 129.645 | 4.41156 |
| 16 | 8 | 2165.064 | 3750 | 2403.462 | 4259.266 | -0.47548 | 146.632 | 11.724 |
| 16 | 9 | 2165.064 | 3750 | 2154.996 | 3854.04 | 15.5523 | 99.3807 | 18.5894 |
| 17 | 0 | 2165.064 | 3750 | 1222.487 | 3544.272 | -3.88191 | 135.319 | 1.76262 |
| 17 | 1 | 2165.064 | 3750 | 2119.324 | 3718.22 | 15.3634 | 111.139 | 18.4694 |
| 17 | 2 | 2165.064 | 3750 | 1952.457 | 3582.317 | 15.3017 | 114.027 | 18.8147 |
| 17 | 3 | 2165.064 | 3750 | 2043.535 | 3457.58 | 15.0907 | 114.632 | 19.88 |
| 17 | 4 | 2165.064 | 3750 | 2084.438 | 3391.746 | 7.85217 | 135.074 | 13.509 |
| 17 | 5 | 2165.064 | 3750 | 2502.44 | 2680.271 | -4.23776 | 140.381 | 4.05082 |
| 17 | 6 | 2165.064 | 3750 | 2198.714 | 3612.49 | 8.38073 | 96.0009 | 9.4038 |
| 17 | 7 | 2165.064 | 3750 | 2549.385 | 2864.089 | 0.682236 | 136.446 | 2.22736 |
| 17 | 8 | 2165.064 | 3750 | 2056.211 | 3724.442 | 6.82352 | 94.701 | 7.6412 |
| 17 | 9 | 2165.064 | 3750 | 1109.183 | 3506.143 | 4.42409 | 131.748 | 7.6412 |
| 18 | 0 | 0 | 3750 | 303.3748 | 4214.174 | -3.61049 | 144.361 | 1.7633 |
| 18 | 1 | 0 | 3750 | 128.2674 | 3857.199 | 10.2432 | 104.913 | 11.7546 |
| 18 | 2 | 0 | 3750 | 514.2349 | 3762.608 | 15.5082 | 115.219 | 19.9976 |
| 18 | 3 | 0 | 3750 | 529.4765 | 4298.697 | -1.96903 | 135.853 | 0.106174 |
| 18 | 4 | 0 | 3750 | 455.2791 | 4285.7 | 1.52158 | 128.316 | 5.8776 |

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| 18 | 7 | 0 | 3750 | 713.4089 | 4116.545 | 4.09948 | 128.376 | 7.65155 |
| 18 | 8 | 0 | 3750 | 740.6094 | 3075.999 | -1.23169 | 142.354 | 1.71351 |
| 18 | 9 | 0 | 3750 | 263.8398 | 3846.246 | 14.6897 | 116.062 | 19.0204 |
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| 19 | 1 | 0 | 3750 | 139.073 | 4001.65 | -0.82098 | 139.209 | 0.5878 |
| 19 | 2 | 0 | 3750 | 94.20352 | 4391.331 | -0.19343 | 134.976 | 5.90207 |
| 19 | 3 | 0 | 3750 | 518.5811 | 4794.841 | -2.59524 | 131.038 | 0.837775 |
| 19 | 4 | 0 | 3750 | 161.6448 | 4307.421 | 4.50026 | 134.518 | 8.229 |
| 19 | 5 | 0 | 3750 | -510.48 | 3848.427 | 2.9051 | 115.526 | 6.465 |
| 19 | 6 | 0 | 3750 | 152.0415 | 4061.063 | -0.83483 | 133.253 | 2.351 |
| 19 | 7 | 0 | 3750 | -410.912 | 4187.514 | 5.88303 | 137.44 | 16.3993 |
| 19 | 8 | 0 | 3750 | -500.93 | 4021.272 | 4.96316 | 119.588 | 12.5125 |
| 19 | 9 | 0 | 3750 | -196.312 | 3758.613 | 1.36805 | 110.128 | 1.7633 |
| 20 | 0 | 0 | 3750 | -135.214 | 3633.945 | 15.9569 | 111.377 | 19.1159 |
| 20 | 1 | 0 | 3750 | -577.153 | 3646.199 | -3.56361 | 132.715 | 4.48233 |
| 20 | 2 | 0 | 3750 | -222.067 | 3577.693 | 12.7747 | 123.079 | 18.8147 |
| 20 | 3 | 0 | 3750 | -570.181 | 3265.84 | 1.84364 | 137.509 | 5.69094 |
| 20 | 4 | 0 | 3750 | -137.701 | 3730.678 | 4.14816 | 94.2428 | 4.702 |
| 20 | 5 | 0 | 3750 | -101.17 | 3636.226 | 16.4656 | 115.522 | 19.6473 |
| 20 | 6 | 0 | 3750 | -82.3875 | 3677.894 | 16.0425 | 103.389 | 19.1159 |
| 20 | 7 | 0 | 3750 | -312.556 | 3259.652 | 0.599244 | 131.376 | 4.76819 |
| 20 | 8 | 0 | 3750 | 203.3534 | 2950.936 | -0.42304 | 142.303 | 5.75281 |
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| 21 | 0 | -1082.53 | 1875 | -218.731 | 1402.461 | 5.92572 | 129.503 | 12.0824 |
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| 21 | 7 | -1082.53 | 1875 | -718.42 | 1327.271 | -4.59403 | 142.895 | 2.20094 |
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| 21 | 9 | -1082.53 | 1875 | -825.468 | 2272.91 | 1.67655 | 134.995 | 7.7816 |
| 22 | 0 | -1082.53 | 1875 | -1179.78 | 2900.513 | 1.00302 | 138.678 | 6.51111 |
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| 23 | 7 | -1082.53 | 1875 | -1030.5 | 1444.733 | 11.1916 | 119.361 | 13.5183 |
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| 28 | 0 | -3247.6 | 1875 | -4198.59 | 2282.96 | 2.66075 | 137.569 | 6.86464 |
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| 30 | 4 | -2165.06 | 0 | -1963.42 | 182.5436 | 8.52057 | 115.045 | 10.58 |
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| 30 | 6 | -2165.06 | 0 | -1637.76 | -481.603 | 0.172244 | 136.646 | 5.9436 |
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| 31 | 0 | -2165.06 | 0 | -2361.19 | 347.419 | 7.51364 | 122.69 | 10.1997 |
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| 31 | 3 | -2165.06 | 0 | -2638.06 | 259.9491 | -4.2033 | 136.231 | 1.40234 |
| 31 | 4 | -2165.06 | 0 | -2269.44 | 48.95822 | 12.0794 | 114.541 | 14.694 |
| 31 | 5 | -2165.06 | 0 | -2235.07 | 204.5774 | 13.9108 | 105.441 | 18.6246 |
| 31 | 6 | -2165.06 | 0 | -2650.04 | 599.9189 | 10.1411 | 125.633 | 16.2293 |
| 31 | 7 | -2165.06 | 0 | -2383.74 | 539.2605 | 7.11477 | 128.997 | 14.014 |
| 31 | 8 | -2165.06 | 0 | -2485.1 | 221.9309 | 4.58174 | 123.721 | 10.8576 |
| 31 | 9 | -2165.06 | 0 | -2084.58 | 968.0261 | -7.07497 | 152.077 | 2.5529 |
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| 32 | 4 | -2165.06 | 0 | -3128.06 | -105.302 | -0.78019 | 125.22 | 2.65705 |
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| 32 | 9 | -2165.06 | 0 | -2293.15 | -106.101 | 15.7781 | 91.3341 | 19.0204 |
| 33 | 0 | -4330.13 | 0 | -3413.82 | -771.091 | -0.21789 | 133.009 | 3.43229 |
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| 35 | 0 | -4330.13 | 0 | -4026.25 | -610.488 | -1.56983 | 131.76 | 0.918927 |
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| 35 | 4 | -4330.13 | 0 | -4287.74 | -889.788 | 4.38738 | 133.855 | 10.4403 |
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| 35 | 6 | -4330.13 | 0 | -4630.21 | -60.3906 | 2.22355 | 137.37 | 6.465 |
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| 36 | 2 | -3247.6 | -1875 | -2666.23 | -1832.1 | 7.99954 | 135.081 | 16.0692 |
| 36 | 3 | -3247.6 | -1875 | -2395.27 | -2034.85 | 0.273427 | 132.739 | 3.10883 |
| 36 | 4 | -3247.6 | -1875 | -3114.81 | -1708.97 | 4.46595 | 117.51 | 5.2902 |
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| 42 | 4 | -2165.06 | -3750 | -1360.65 | -3838.61 | 0.63141 | 133.169 | 3.55697 |
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| 42 | 6 | -2165.06 | -3750 | -2026.26 | -3965.3 | 1.24648 | 113.804 | 1.7633 |
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| 44 | 4 | -2165.06 | -3750 | -2154.38 | -3894.87 | 12.6591 | 113.157 | 15.282 |
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| 44 | 8 | -2165.06 | -3750 | -2191.32 | -3963.16 | 14.1645 | 113.319 | 18.7045 |
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| 47 | 6 | 0 | -3750 | -443.176 | -3772.34 | -1.81516 | 134.456 | 1.7633 |
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| 53 | 4 | 2165.064 | -3750 | 2657.269 | -4829.53 | -1.88684 | 121.842 | 3.94924 |
| 53 | 5 | 2165.064 | -3750 | 1586.435 | -4046.81 | 4.5446 | 125.085 | 8.90518 |
| 53 | 6 | 2165.064 | -3750 | 1736.919 | -4860.47 | 1.21858 | 138.166 | 4.14762 |
| 53 | 7 | 2165.064 | -3750 | 2182.03 | -4767.88 | 5.44486 | 119.84 | 9.98723 |
| 53 | 8 | 2165.064 | -3750 | 1853.401 | -4268.36 | 11.6519 | 115.754 | 17.063 |
| 53 | 9 | 2165.064 | -3750 | 1359.515 | -4438.02 | -1.83399 | 141.704 | 1.06294 |
| 54 | 0 | 3247.595 | -1875 | 3841.354 | -1398.43 | -1.28295 | 126.809 | 0.659541 |
| 54 | 1 | 3247.595 | -1875 | 3972.564 | -2626.77 | -4.67079 | 138.559 | 1.98597 |
| 54 | 2 | 3247.595 | -1875 | 4205.84 | -1120.37 | -1.90759 | 137.073 | 0.324371 |
| 54 | 3 | 3247.595 | -1875 | 4360.154 | -2278.84 | 3.78395 | 124.176 | 5.55015 |
| 54 | 4 | 3247.595 | -1875 | 3412.213 | -1862.83 | 16.0718 | 122.028 | 19.9608 |
| 54 | 5 | 3247.595 | -1875 | 3735.18 | -1736.08 | 6.75015 | 130.354 | 11.6845 |
| 54 | 6 | 3247.595 | -1875 | 3799.09 | -1187.83 | 4.90421 | 121.758 | 8.04268 |
| 54 | 7 | 3247.595 | -1875 | 3549.731 | -2185.35 | -2.52457 | 146.284 | 6.39439 |
| 54 | 8 | 3247.595 | -1875 | 3663.105 | -1756.96 | 10.7862 | 124.711 | 16.5282 |
| 54 | 9 | 3247.595 | -1875 | 3910.4 | -1586.22 | 3.95613 | 125.514 | 5.73797 |
| 55 | 0 | 3247.595 | -1875 | 3273.242 | -812.998 | -5.34364 | 147.533 | 1.61015 |
| 55 | 1 | 3247.595 | -1875 | 2312.462 | -1223.42 | 1.0181 | 131.024 | 4.42804 |
| 55 | 2 | 3247.595 | -1875 | 3191.983 | -1431.65 | 7.88395 | 121.39 | 14.3755 |
| 55 | 3 | 3247.595 | -1875 | 3156.073 | -1632.27 | 14.7594 | 123.926 | 19.8016 |
| 55 | 4 | 3247.595 | -1875 | 3199.669 | -1870.05 | 3.04662 | 78.7964 | 3.5268 |
| 55 | 5 | 3247.595 | -1875 | 3005.335 | -902.139 | -2.17296 | 138.425 | 3.28575 |
| 55 | 6 | 3247.595 | -1875 | 3270.718 | -1660.98 | 11.8302 | 120.526 | 14.1061 |
| 55 | 7 | 3247.595 | -1875 | 3436.8 | -1323.98 | 2.2239 | 121.197 | 6.465 |
| 55 | 8 | 3247.595 | -1875 | 3108.55 | -1198.24 | 1.23975 | 134.532 | 6.47527 |
| 55 | 9 | 3247.595 | -1875 | 3358.347 | -1350 | 6.57964 | 125.85 | 10.58 |
| 56 | 0 | 3247.595 | -1875 | 2697.951 | -2148.47 | 1.4069 | 123.153 | 4.80285 |
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| 56 | 3 | 3247.595 | -1875 | 3176.999 | -2199.92 | 8.42285 | 121.935 | 13.1704 |
| 56 | 4 | 3247.595 | -1875 | 3080.936 | -1969.49 | 13.819 | 124.751 | 17.6329 |

| g.sc.id | l.ms.id | bs.loc.x | bs.loc.y | ms.loc.x | ms.loc.y | C/I | Path Loss | Chandiff |
|---|---|---|---|---|---|---|---|---|
| 56 | 5 | 3247.595 | -1875 | 3689.527 | -2981.94 | 4.27154 | 129.795 | 9.25433 |
| 56 | 6 | 3247.595 | -1875 | 3060.947 | -2014.55 | 12.0668 | 114.833 | 16.7265 |
| 56 | 7 | 3247.595 | -1875 | 3675.766 | -2830.38 | -2.22264 | 143.943 | 2.75386 |
| 56 | 8 | 3247.595 | -1875 | 3492.249 | -2908.17 | -4.32119 | 141.002 | 0.635744 |
| 56 | 9 | 3247.595 | -1875 | 2163.849 | -2319.54 | -2.43515 | 132.211 | 2.82137 |