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Interference Analysis between 5G Network and LoRa Technology in Wireless Communication System

Analisis Interferensi antara Jaringan 5G dan Teknologi LoRa dalam Sistem Komunikasi Nirkabel

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Abstract – 5G and LoRa technologies have their own advantages in wireless communication. However, when used together, they can experience signal interference, especially at the 925 MHz frequency. This study aims to analyze interference between 5G and LoRa networks using the SEAMCAT simulation tool with a Monte Carlo approach. There are two scenarios used in this study, namely device spacing and transmit power settings. The simulation results show that the transmit power and device distance settings affect the Interference Received Signal Strength (iRSS) value and interference probability. At a distance of 35 km and a transmit power of 40 dBm, the interference probability is up to 0%. Thus the two technologies perform without interfering with each other. This research provides a simple solution to reduce interference and to maximize the use of 5G and LoRa technologies in wireless communications.
Keywords: interference, 5G, longe range (LoRa), SEAMCAT, wireless communication

Abstrak *– Teknologi 5G dan LoRa memiliki keunggulan masing-masing dalam komunikasi nirkabel. Namun, jika digunakan bersamaan, keduanya dapat mengalami gangguan sinyal (interferensi), terutama pada frekuensi 925 MHz. Penelitian ini bertujuan untuk menganalisis interferensi antara jaringan 5G dan LoRa menggunakan alat simulasi SEAMCAT dengan pendekatan Monte Carlo. Terdapat dua skenario yang digunakan pada penelitian ini yaitu pengaturan jarak perangkat dan pengaturan daya transmit. Hasil simulasi menunjukkan bahwa pengaturan daya transmit dan jarak perangkat memengaruhi nilai Interference Received Signal Strength (iRSS) dan probabilitas interferensi. Pada jarak 35 km dan daya transmit 40 dBm, probabilitas interferensi hingga 0%. Dengan demikian kinerja kedua teknologi tanpa saling mengganggu. Penelitian ini memberikan solusi sederhana untuk mengurangi gangguan dan memaksimalkan penggunaan teknologi 5G dan LoRa dalam komunikasi nirkabel.*
Kata Kunci: *interferensi, 5G, longe range (LoRa), SEAMCAT, komunikasi nirkabel*

INTRODUCTION

The development of telecommunications continues to make significant progress. Initially, the first generation (1G) technology came with an analog system. In 1991, second generation (2G) technology began to be developed using digital systems, which allowed not only voice services but also data transmission. This progress was then continued with the arrival of 3G and 4G technology (Karo Karo et al., 2020). Nowadays, the development of technology is moving at a very fast pace, almost in all fields, sophisticated devices have emerged that are designed to help make human work easier. One of the latest innovations that has an important role is 5G technology. 5G technology is the latest generation of wireless communication, which offers significant improvements over previous technologies (Muhamad Rizky et al., 2024). With wider bandwidth, higher data rates, and lower latency (Putra et al., 2023). On the other hand, Long range technology (LoRa) is also a wireless connectivity technology module that has the advantage of being a wide area network solution, with a wide range, very low power consumption, and a high level of security (Daffa Pebrian et al., 2024).

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However, as more communication technologies are used simultaneously, new challenges arise regarding interference between the various systems. This interference can degrade the quality of communication, such as a decrease in Signal to-Interference Noise Ratio (SINR), throughput, and reliability of data transmission (Raharjo et al., 2019). Therefore, it is important to conduct an in-depth analysis of the potential interference between 5G networks and LoRa technology.

Current research into the performance of 5G and LoRa networks is generally conducted separately, focusing on the advantages of each technology in various scenarios. However, specific analysis of the interference that may occur between these two technologies is limited.

In this study, researchers will explore the technical characteristics of both technologies, as well as analyze how interference between 5G and LoRa signals can affect their respective performance through a simulation approach using the Spectrum Engineering Advanced Monte Carlo Analysis Tool (SEAMCAT). This analysis will involve measuring the interfering Received Signal Strength (iRSS), which is the signal strength of the interference received by the receiving device from the interference source, as well as the desired Received Signal Strength (dRSS), which is the desired signal strength received by the receiving device from the relevant transmitter. A comparison between iRSS and dRSS will be used to evaluate the impact of interference on network performance. By analyzing the interference between these two technologies, it is expected that an effective solution can be found to overcome the interference and optimize the use of both technologies in wireless communication systems so that both technologies can be used optimally. This research aims to contribute to the development of interference mitigation strategies that can be applied in the implementation of wireless communication networks.

RESEARCH METHOD

Research Technique

This research was analyzed using the SEAMCAT simulation. This simulation is a statistical simulation model that uses an analysis method called Monte Carlo (MC) to assess potential interference between radio communication systems. This simulation was conducted to determine interference to cellular systems caused by other systems using frequency channels in the same or adjacent bands (Rahayu & Muttaqin, 2019).

Research Technical Data

Technical data is used to assist calculations and analysis to obtain appropriate results. The data is obtained from literature studies such as journals, articles, websites and related regulations. The data is used for SEAMCAT simulation parameters (Faqih et al., 2020).

Analysis Technique

This research used the SEAMCAT analysis technique. This simulation was used to analyze interference between systems. This analysis results in the possibility of interference between 5G networks and LoRa technology operating at frequencies of 923-925 MHz. This can be determined based on the dRSS and iRSS values and these values will be compared with the C/I values.

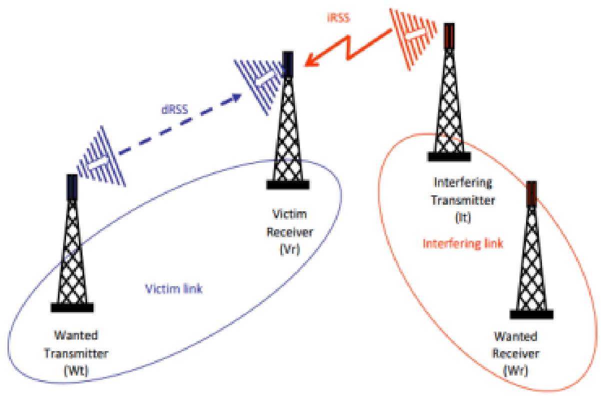

Figure 1 Victim and Interferer Scenarios for Monte Carlo (MC) Simulation Experiment

SEAMCAT models a Victim Receiver (Vr) connected to a Wanted Transmitter (WT) operating among a population of transmitters that have the opportunity to interfere with the victim receiver's Interferer Transmitters (IT). As described in Figure 1 (Ariansyah, 2014).

All this interference can be the same system as Vr, a different system or a combination of both. The carrier to interference ratio is the ratio of desired Received Signal Strength (dRSS) and interfering Received Signal Strength (iRSS). Meanwhile, the probability of interference (PI) is obtained from the formula PI = I - PNI, where PNI is the probability of non-interference obtained from equation (1) and equation (2) (Ariansyah, 2014).

$$P_{NI} = \frac{P(\frac{dRSS}{iRSS} > \frac{C}{I} dRSS > sens)}{P(dRSS > sens)} \quad (1)$$

Where:

$$iRSS_{comp} = \sum_{i=1}^{p} iRRS_j \quad (2)$$

The equation Probability of Non Interference (P_{NI}) is the probability of no interference, P is the transmit power at the transmitting antenna, Desired Received Signal Strength (dRss) is the received signal strength (dBm), Interference Received Signal Strength (iRSS) is the received interference signal strength (dBm), Carrier to Interference Threshold (C/I) is the ratio between the carrier signal and interference (dB), Receiver Sensitivity (sens) is the sensitivity at the minimum signal level (dBm).

This simulation model uses the frequency separation method with distance, setting the closest and farthest distance to determine the interference. dRSS is the received and desired signal strength by the Victim Link Transmitter (VLT) sent by the Access Point (AP) to the Mobile Station (MS). The dRSS value is generated from the calculation of the signal strength received by the Victim Link Receiver (VLR) which becomes the sensitivity value of the receiver. iRSS is the interference signal received by the victim receiver from several interfering transmitters. The iRSS value is generated from the value of the unwanted signal received by the VLR from the 5G network transmitter.

Research Flowcharts

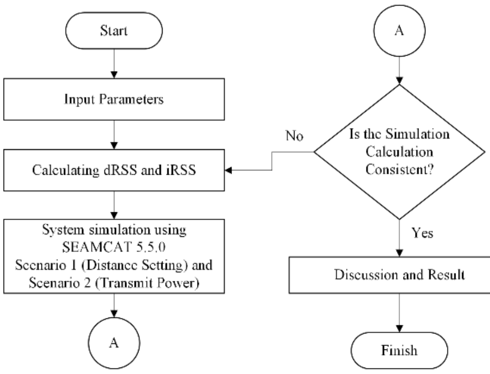

Figure 2 Research Flow

Based on Figure 2, the research begins by inputting the parameter values of the 5G Network and LoRa technology. After inputting both parameters, the next step is to calculate the dRSS and iRSS values. After all values are obtained from the predetermined formula, then proceed to the Interference Calculation Engine (ICE) process.

The process in this ICE will calculate the desired dRSS, iRSS, and C/I values using Seamcat software using two scenarios. Where the first scenario is by adjusting the distance between the Longe Range (LoRa) system and the 5G system, in the second scenario using variations in the transmit power value. If the calculation value with the simulation value shows a consistent value, then the discussion analysis is carried out, if the calculation value with the simulation is inconsistent, the calculation of dRSS and iRSS is required again.

5G Network Parameters with LoRa

In the software, there are two parts, namely the system part and the scenario part. The system part consists of three parameters, namely transmitter, receiver, and transmitter-receiver path. In the receiver parameter, data from the LoRa transmitter is entered as a victim, in the transmitter parameter, data from the 5G network will be entered as an interferer, and the transmitter-receiver trajectory parameter is entered into the Victim Link Transmitter (VLT) to Victim Link Receiver (VLR) distance value which will be changed. The parameters used in conducting this simulation are shown in Table 1 and Table 2:

Table 1 5G Network Parameters (Adhikari & Baral, 2021)

Parameter	Tx	Rx
Frequency Band	880 MHz-915 MHz (UL) 925 MHz-960 (DL)	
Bandwidth	35 MHz	
Tx Power (dBm)	43	23
Tx antenna gain	15 dBi	0
Tx antenna high	30m	1.5m
Sensitivity (dBm)	-124.53	
Cell Radius (Km)	5	
Noise Figure	7	7
Antenna Patterns	3GPP tri-sector (60 deg)	
Propagation Model	Okumura-Hatta	

Table 2 LoRa Parameters (Raharjo et al., 2019)

Parameter	Tx	Rx
Frequency Band	925 MHz	
Bandwidth	125 KHz	
Tx Power (dBm)	20	15
Tx antenna gain (dBi)	9	0

Tx antenna high (m)	30	1.5
Sensitivity (dBm)	-124.53	
Cell Radius (Km)	1.4	0.74344727
Noise Figure	6	6
Antenna Patterns	GSM 900 MHz	
Propagation Model	Okumura-Hatta	

This research uses the LoRa transmitter as the Victim Link Transmitter (VLT) and the 5G transmitter as the interfering signal. To analyze the impact of interference, the Okumura-Hata propagation model is used, which requires path loss calculations to predict signal attenuation in various environmental conditions. for the path loss formula, can be seen in equation (3):

$$PL = A + B\log(d) + C \quad (3)$$

PL represents path loss while A, B, and C are factors that depend on the frequency and height of the antenna. The A, B, and C factors use equations (4), (5), and (6):

$$A = 69{,}55 + 26{,}16\log(f) - 13{,}82\ \log(h_{tx}) - a(h_{tx}) \quad (4)$$

htx and hrx are the height of the transmitting antenna and receiving antenna in meters, respectively, f is the frequency in MHz and d is the distance in km. The function $a(h\text{rx})$ and the coefficient C for sub-urban areas are:

$$a(h_{\text{rx}}) = (1{,}1\log(f) - 0{,}7) - (1{,}56\log(f) - 0{,}8) \quad (5)$$

$$C = 0 \quad (6)$$

5G Technology

5G is the fifth generation of mobile network technology, a development of the currently widely used 4G LTE technology. It is designed to offer much higher speeds, lower latency, and greater capacity than its predecessors. 5G delivers better connectivity, a more optimized user experience, and supports new applications that require high performance. 5G network speeds can reach some gigabits per second, enabling extremely fast data downloads and uploads. This allows users to enjoy large content, such as high-definition video or 4K streaming, without buffering. In addition, low latency on 5G provides fast response for real time applications, such as online gaming, autonomous vehicles, and telemedicine (Sugiyatno et al., 2024).

Large 5G capacity also enables reliable and stable connectivity, even in locations with heavy data traffic. It supports more devices to be connected simultaneously, which is crucial for the development of the Internet of Things (IoT) and the implementation of smart city concepts. The 5G network is becoming a key platform for future technological evolution. The core elements of this network include New Radio (NR), integration with 4G LTE networks, non-3GPP access technologies, Wi-Fi, as well as modern infrastructure such as NFV, SDN, IoT, and cloud computing (Harianja et al., 2024).

Network Infrastructure

5G technology requires a more complex and sophisticated infrastructure. Service providers need to build extensive fiber optic networks, transmitter towers with wide coverage, and base stations that support 5G technology. This process requires large investments, strategic layout planning, and coordination with various related parties. 5G implementation requires significant network infrastructure adjustments. 5G network infrastructure consists of key components such as small cells, edge computing, and an updated core network to support 5G requirements. Small cells are a vital component in the 5G architecture as they enable high-frequency transmissions with shorter range, as well as support higher device density. In addition, edge computing is becoming increasingly important in 5G networks as it allows data processing to be performed closer to the end user, reducing latency and improving applicant responsiveness (Mulyono et al., 2024).

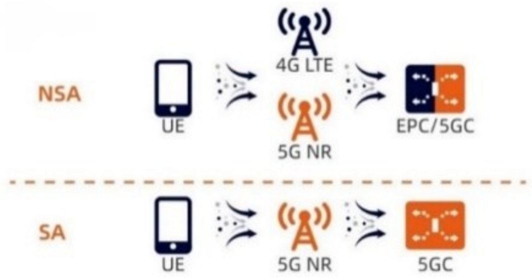

Figure 3 5G Network Architecture

In addition to infrastructure adjustments, 5G network architecture can be built with two main approaches: Non-Standalone (NSA) and Standalone (SA). In the NSA approach, the 5G network still relies on the existing 4G network infrastructure so that the adoption of the 5G network is faster. Conversely, in the SA approach, the 5G network stands alone without dependence on the 4G network which can fully optimize the capabilities of 5G technology. Figure 3 shows the 5G network architecture.

Frequency Spectrum

The presence of high speed and large capacity in 5G requires a wide frequency spectrum. However, the availability of this spectrum is limited, making it a frequent source of competition among operators and other spectrum users. This challenge requires optimal spectrum management, efficient frequency allocation, and good coordination among regulators, operators and governments. 5G networks use higher millimeter wave frequencies than previous networks. This frequency spectrum is limited and must be allocated wisely to avoid interference and maximize efficiency. The use of this spectrum requires good regulation and spectrum management from the authorities to ensure fair and optimal use (Mesya Nandawani Manik and Rayyan Firdaus 2024). Figure 4 shows the 5G frequency spectrum.

NR operating band	Uplink (UL) *operating band* BS receive / UE transmit F_{UL_low} – F_{UL_high}	Downlink (DL) *operating band* BS transmit / UE receive F_{DL_low} – F_{DL_high}	Duplex Mode
n1	1920 MHz – 1980 MHz	2110 MHz – 2170 MHz	FDD
n2	1850 MHz – 1910 MHz	1930 MHz – 1990 MHz	FDD
n3	1710 MHz – 1785 MHz	1805 MHz – 1880 MHz	FDD
n5	824 MHz – 849 MHz	869 MHz – 894 MHz	FDD
n7	2500 MHz – 2570 MHz	2620 MHz – 2690 MHz	FDD
n8	880 MHz – 915 MHz	925 MHz – 960 MHz	FDD
n12	699 MHz – 716 MHz	729 MHz – 746 MHz	FDD
n14	788 MHz – 798 MHz	758 MHz – 768 MHz	FDD
n18	815 MHz – 830 MHz	860 MHz – 875 MHz	FDD
n20	832 MHz – 862 MHz	791 MHz – 821 MHz	FDD
n25	1850 MHz – 1915 MHz	1930 MHz – 1995 MHz	FDD
n26	814 MHz – 849 MHz	859 MHz – 894 MHz	FDD
n28	703 MHz – 748 MHz	758 MHz – 803 MHz	FDD
n29	N/A	717 MHz – 728 MHz	SDL
n30[3]	2305 Mhz – 2315 MHz	2350 MHz – 2360 MHz	FDD
n34	2010 MHz – 2025 MHz	2010 MHz – 2025 MHz	TDD
n38[10]	2570 MHz – 2620 MHz	2570 MHz – 2620 MHz	TDD
n39	1880 MHz – 1920 MHz	1880 MHz – 1920 MHz	TDD
n40	2300 MHz – 2400 MHz	2300 MHz – 2400 MHz	TDD
n41	2496 MHz – 2690 MHz	2496 MHz – 2690 MHz	TDD
n46	5150 MHz – 5925 MHz	5150 MHz – 5925 MHz	TDD[13]
n47[11]	5855 MHz – 5925 MHz	5855 MHz – 5925 MHz	TDD
n48	3550 MHz – 3700 MHz	3550 MHz – 3700 MHz	TDD
n50	1432 MHz – 1517 MHz	1432 MHz – 1517 MHz	TDD[1]
n51	1427 MHz – 1432 MHz	1427 MHz – 1432 MHz	TDD
n53	2483.5 MHz – 2495 MHz	2483.5 MHz – 2495 MHz	TDD
n65	1920 MHz – 2010 MHz	2110 MHz – 2200 MHz	FDD[4]

Figure 4 5G Frequency Spectrum

Interoperability

5G could be operated alongside previous network technologies, such as 4G, Wi-Fi, and other telecommunication systems. This challenge includes the development of interoperability standards that are compatible with existing technologies, as well as the integration of hardware and software from various systems (Haidar Hari et al., 2023). 5G networks must be compatible with previous technologies and a wide array of existing devices and applications. Interoperability challenges can arise when connecting 5G networks with legacy networks or different systems. These challenges require standardization and industry collaboration to ensure smooth interoperability (Mesya Nandawani Manik & Rayyan Firdaus, 2024).

Long Range (LoRa)

LoRa is a low-power wireless communication technology capable of covering a wide area. It uses Chirp Spread Spectrum (CSS) modulation, which is known to increase communication range while keeping power consumption low (Enriko et al., 2024). CSS has previously been utilized by the military and space agencies due to its resistance to interference. LoRa operates at sub-GHz frequencies, such as 433 MHz, 868 MHz, and 915 MHz, thus offering advantages over other communication technologies such as cellular, Bluetooth, or Wi-Fi. It combines the advantages of long-distance communication like cellular with the low-power efficiency of Bluetooth. This makes LoRa ideal for battery-powered sensor devices with a lifespan of up to many years and designed to cover large areas (Putra et al. n.d.). Figure 5 shows the LoRa network architecture.

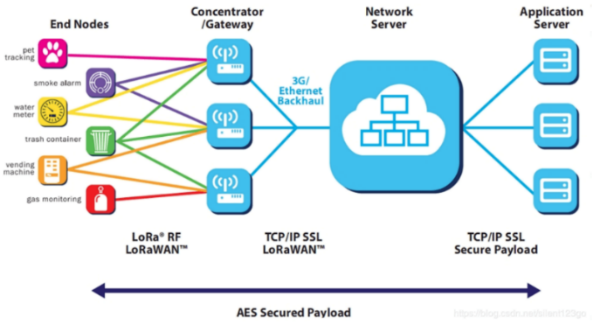

Figure 5 Longe Range (LoRa) Network Architecture

SEAMCAT

Spectrum Engineering Advanced Monte Carlo Analysis Tool (SEAMCAT) is a statistical simulation model that uses Monte Carlo methods to evaluate the probability of interference between various radio communication systems, including broadcast, point-to-point, point-to-multipoint, radar, cellular networks, aviation, and satellite. In SEAMCAT simulations, there is one Victim Link Receiver (VLR) connected to a Victim Link Transmitter (VLT) among one or more populations of Interference Link Transmitters (ILTs) connected to Interference Link Receivers (ILRs). SEAMCAT tracks the strength of the interference signal and the desired signal for each event separately in the array data. By comparing the desired signal and interference signal at the victim link receiver for each event against certain interference criteria, such as Carrier-to-Interference ratio (C/I), SEAMCAT can calculate the probability of interference occurring. (Bakare et al., 2021).

Interference

Interference is the presence of unwanted radio signals that interfere with the reception of the intended signal. This interference can suppress the intended signal, cause signal loss, or affect sound or picture quality. The main causes of interference are usually transmitters and electrical devices. This interference can be continuous or intermittent, due to refraction or diffraction at the Earth's surface or atmospheric layers (troposphere). Interference can result in decreased signal quality, increased delay (latency), and reduced data transmission speed (throughput). In more serious cases, interference can even cause communication failures (Park et al., 2020).

Interference is noise that arises due to the operation of other communication systems. Interference will affect the amount of signal power received at a receiver. The amount of interference will depend on the distance between the receiving system and the sending system compared to other factors, such as weather and environmental conditions. The interference scheme discussed in this research will be grouped into 4 characteristics, such as, Interfering Link Transmitter (ILT), Interfering Link Receiver (ILR), Victim Link Receiver (VLR), and Victim Link Transmitter (VLT).

In wireless communication, interference is divided into two types including Co Channel Interference (CCI) and Adjacent Channel Interference (ACI). CCI is interference caused by the carrier frequency signal being the same as the information signal, while ACI is interference caused by the influence of adjacent channel frequencies (Nofriando et al., 2016).

Carrier to Interference (C/I) is a characteristic value of a technology that utilizes a carrier signal in the data exchange process. To find out the interference that occurs between the 5G network and LoRa, data will be collected on the relationship between the distance of the coverage area of the 5G network and the C/I value of LoRa. To get the C/I value, it can be done with equation (7) (Cahyasiwi et al., 2017):

$$\frac{C}{I}(dB) = 10\log\left(\frac{10^{dRSS/10}}{10^{iRSS_{compossite/10}}}\right) \qquad (7)$$

C/I (Carrier-to-Interference Threshold) is the ratio between carrier and interference signals (dB), Desired Received Signal Strength (dRSS) is the received signal strength (dBm), composite Interference Received Signal Strength (iRSS composite) is the received combined interference signal strength (dBm).

In this research, the C/I characteristic used is 19 dB. The characteristic value will later be compared with the C/I from the simulation results that have been run.

The Interference Calculation Engine (ICE) will perform the interference calculation based on the dRSS and iRSS data obtained (Cahyasiwi et al., 2017). The probability of interference can be calculated using equation (8):

$$P_D = P\left(\frac{dRSS}{iRSS_{compossite}} > \frac{C}{I}\middle| dRSS > sens_{vr}\right) \qquad (8)$$

$iRSS_{compossite}$ is the sum of all signals interfering with the 5G network receiver and $sens_{vr}$ is the sensitivity value of the LoRa technology receiver.

RESULTS AND DISCUSSION

Simulations are carried out using SEAMCAT software using 2 simulation scenarios, scenario 1 using distance settings between the victim system and interference and scenario 2 using settings on transmit power. The simulation results will be in the form of tables and graphs that can be analyzed to get conclusions.

Table 3 Comparison of dRSS and iRSS Values From Calculation and Simulation

Tx Power (dBm)	dRSS (dBm)		iRSS (dBm)	
	Calculation	Simulation	Calculation	Simulation
40	-130,13	-133,52	-156,13	-120,37
41	-129,13	-133,78	-156,13	-119,33
42	-128,13	-133,55	-156,13	-118,45
43	-127,13	-133,43	-156,13	-117,38

Table 3 shows the comparison between the calculation of dRSS and iRSS values and simulation results when transmitting power 5G 40 dBm, 41 dBm, 42 dBm, 43 dBm with the same distance of 1 km. When transmit power 40 dBm shows that there is a difference between the calculation and simulation results of iRSS by 2.60% and dRSS by 22.89%. Then when transmitting power 41 dBm there is a difference in iRSS of 3.60% and dRSS of 23.57%. At the time of transmit power 41 dBm there is a difference in iRSS of 4.23% and dRSS of 24.12% while transmit power 43 dBm there is a difference in the calculation and simulation value of iRSS of 4.95% and dRSS of 24.81%. The increase in the difference in value is due to the strengthening of the 5G transmit power.

Table 4 Simulation Results of 5G and LoRa Interference Probability with 40 dBm Transmit Power

Distance between 5G gNB and LoRa End Device (Km)	dRSS (dBm)	iRSS (dBm)	Interference Probability (%)
1	-133,52	-120,37	97,82
5	-133,44	-146,36	65,63
10	-133,63	-157,21	39,97
15	-133,53	-163,76	25,02
20	-133,51	-169,32	14,70
25	-133,46	-174,13	8,8
30	-133,52	-178,34	5
35	-133,42	-181,75	0

Based on the simulation results in Table 4, using a transmitting power of 40 dBm. Shows that setting the distance between the 5G gNodeB and the LoRa End Device will affect the resulting probability. The largest interference probability is at a distance of 1km by 97.82% with an iRSS value of -120.37 dBm and the smallest interference probability value of 0% is at a distance of 35 km.

Table 5 Simulation Results of 5G and LoRa Interference Probability with 41 dBm Transmit Power

Distance between 5G gNB and LoRa End Device (Km)	dRSS (dBm)	iRSS (dBm)	Interference Probability (%)
1	-133,78	-119,33	98,11
5	-133,51	-145,34	67,81
10	-133,47	-156,18	41,47
15	-133,5	-162,68	26,65
20	-133,65	-168,32	16,62
25	-133,54	-173,1	10
30	-133,54	-177,23	6
35	-133,43	-180,91	3

The simulation results in Table 5 show that increasing the transmit power by 1 dBm will affect the resulting interference probability. The smallest interference probability is 3% at a distance of 35 km, while the largest interference probability is 98% at a distance of 1km.

Table 6 Simulation Results of 5G and LoRa Interference Probability with 42 dBm Transmit Power

Distance between 5G gNB and LoRa End Device (Km)	dRSS (dBm)	iRSS (dBm)	Interference Probability (%)
1	-133,55	-118,45	98,4
5	-133,47	-144,28	69,71
10	-133,52	-155,09	44,63
15	-133,46	-159,27	33,72
20	-133,52	-167,46	17,79
25	-133,48	-172,05	11,26
30	-133,54	-176,31	6,6
35	-133,42	-179,95	4

Table 6 shows the simulation results when the transmit power is amplified by 1 dBm. The data results show that with a distance setting of 1-35 km it can be seen that the further the distance of the device the iRSS value will decrease while the dRSS value tends to stabilize and the probability of interference decreases. The largest probability value is 98.4% at a distance of 1km and the lowest probability value is 4% at a distance of 35km.

Table 7 Simulation Results of 5G and LoRa Interference Probability with 43 dBm Transmit Power

Distance between 5G gNB and LoRa End Device (Km)	dRSS (dBm)	iRSS (dBm)	Interference Probability (%)
1	-133,43	-117,38	98,5
5	-133,65	-143,2	72,57
10	-133,62	-154,18	47
15	-133,62	-160,59	31,52
20	-133,6	-166,46	19
25	-133,61	-171,06	12,94
30	-133,63	-175,39	7,72
35	-133,45	-178,71	4,59

Table 7 shows the simulation results when the transmit power is 43 dBm. The results show that the smallest interference probability is 4.59% at a distance of 35 km and the largest interference probability is 98.5%. The resulting IRSS value tends to decrease as the distance used increases while the dRSS value tends to stabilize.

Tables 4, 5, 6 and 7 show that increasing transmit power affects the IRSS value and interference probability. The greater the transmit power value, the higher the probability of interference. A probability of 0% is achieved when the transmit power is 40 dBm with a device distance of 35 km. And the largest probability of interference is 98.5% at a distance of

35km with a transmit power of 43 dBm. This shows that 5G and LoRa devices can operate together without interfering with each other at a distance of 35 km with a transmit power of 40 dBm.

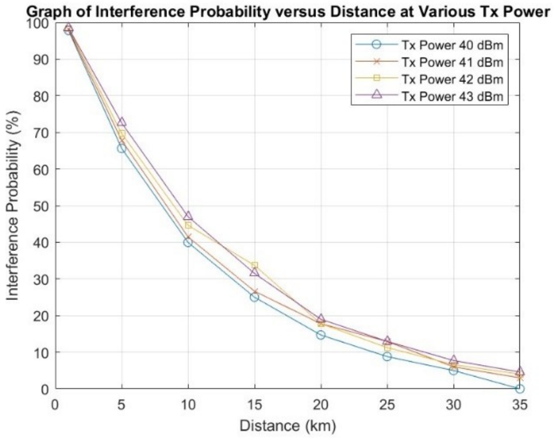

Figure 6 Effect of Distance and Trasmit Power on Interference Probability

The probability of interference will decrease as the distance between the 5G GNodeB and the LoRa End Device increases with transmit power of 40 dBm, 41 dBm, 42 dBm and 43 dBm. The probability of interference will reach 90% when the device distance is 1km while the probability of interference will reach 0% when the device distance is 35 km. The greater the distance used, the lower the probability of interference, but higher transmit power tends to result in a greater probability of interference.

CONCLUSIONS

The potential interference between 5G and LoRa at 925 MHz frequency has been investigated using SEAMCAT software. Simulation results using SEAMCAT show that setting the transmit power and device distance will affect the iRSS value and the resulting interference probability. The iRSS value tends to decrease as the device distance increases. A decrease in the probability of interference between the two systems can be achieved by lowering the transmit power of the 5G transmitter and adjusting the distance between the victim and interference devices. The probability of interference will reach 0% when the device is 35 km away with a transmit power of 40 dBm.

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REFERENCE

Adhikari, M., & Baral, D. S. (2021). Interference Analysis of 5G in Coexistence Scenario with Short Range Devices (SRD). *Proceedings of 10th IOE Graduate Conference*, *10*, 1277–1286.

Ariansyah, K. (2014). Analisis interferensi T-DAB dan TV Analog pada pita Very High Frequency (VHF) Interference Analysis of T-DAB and Analog Television on VHF Band. *Buletin Pos dan Telekomunikasi*, *12*(3), 217–230.

Bakare, B. I., Idigo, V. E., & Nnebe, S. U. (2021). Interference Management for the Coexistence of DTTV and LTE Systems within the Proposed Digital Dividend Band in Nigeria. *European Journal of Electrical Engineering and Computer Science*, *5*(6), 1–9. https://doi.org/10.24018/ejece.2021.5.6.366

Cahyasiwi, D. A., Roza, E., & Fayakun, K. (2017). Analisis Interferensi TV Digital Terhadap Long Term Evolution (LTE) Pada Frekuensi 700 MHZ. *Seminar Nasional TEKNOKA*, *2*(2502).

Faqih, M., Ardiansyah, N. M., & Usman, U. K. (2020). Analisis Interferensi Teknologi 5G Terhadap Sistem Komunikasi Satelit di Pita Frekuensi Extended-C (3.4 – 3.7 GHz). *e-Proceeding of Engineering*, *7*(3), 8850.

Haidar Hari, N., Eka Putra, F. P., Hasanah, U., Sutarsih, S. R., & Riyan. (2023). Transformasi Jaringan Telekomunikasi dengan Teknologi 5G: Tantangan, Potensi, dan Implikasi. *Jurnal Informasi dan Teknologi*, *5*(2), 146–150. https://doi.org/10.37034/jidt.v5i2.357

Harianja, A. P., Pakpahan, S., & Situmorang, C. A. (2024). Dampak Perkembangan Teknologi 5G Di Bidang Komunikasi Dan Internet Of Things (IoT) Pada SMK Skylandsea Deliserdang. *ULEAD: Jurnal e-Pengabdian*, *3*(2).

Karo Karo, F., Nugraha, E. S., & Gustiyana, F. N. (2020). Analisis Hasil Pengukuran Performansi Jaringan 4G LTE 1800 MHz di

Area Sokaraja Tengah Kota Purwokerto Menggunakan Genex Asistant Versi 3.18. *AITI*, *16*(2), 115–124. https://doi.org/10.24246/aiti.v16i2.115-124

Mesya Nandawani Manik & Rayyan Firdaus. (2024). Tantangan Dan Peluang Jaringan 5G Dalam Meningkatkan Operasional Perusahaan. *Jurnal Manuhara : Pusat Penelitian Ilmu Manajemen dan Bisnis*, *2*(3), 203–209. https://doi.org/10.61132/manuhara.v2i3.1026

Muhamad Rizky, Selpi Amanda Fadillah, Juniwan Juniwan, Muhamad Yusuf Habibi, & Didik Aribowo. (2024). Perkembangan Teknologi Jaringan 5G di Indonesia. *Jupiter: Publikasi Ilmu Keteknikan Industri, Teknik Elektro dan Informatika*, *2*(3), 58–68. https://doi.org/10.61132/jupiter.v2i3.279

Mulyono, B., Rachman, A., Rahayu, N., Eldo, H., & Nuryanto, U. W. (2024). Analisis Dampak Implementasi Teknologi 5G terhadap Infrastruktur Jaringan di Indonesia. *Jurnal Minfo Polgan*, *13*(2), 1462–1467. https://doi.org/10.33395/jmp.v13i2.14103

Nofriando, E., Cahyasiwi, D. A., & Alim, S. (2016). Analisa Interferensi Long Term Evolution terhadap Wifi pada Frekuensi Unlicensed. *Seminar Nasional TEKNOKA_FT UHAMKA*.

Park, Y.-G., Chang, E.-Y., Lee, I.-K., & Cheng, Y.-M. (2020). Analysis of Wi-Fi HaLow Device Interference to LTE User Equipment. *Journal of Communications*, *15*(1), 58–64. https://doi.org/10.12720/jcm.15.1.58-64

Putra, F. P. E., Riski, M., Yahya, M. S., & Ramadhan, M. H. (2023). Mengenal Teknologi Jaringan Nirkabel Terbaru Teknologi 5G. *Jurnal Sistim Informasi dan Teknologi*, *5*(2), 167–174.

Raharjo, A. H., Usman, U. K., & Jayad, Y. T. (2019). Analisis Dan Solusi Dampak Interferensi Dari Sinyal Lora Pada Komunikasi Seluler Band 8 Dan Usulan Untuk Penggelaran Jaringan Lora Di Indonesia. *E-Proceeding of Engineering*, *6*, 3208.

Rahayu, Y., & Muttaqin, A. (2019). Penanganan Kasus Interferensi Sistem Egsm dan Lte di Pita 800 Mhz Area Pekanbaru Menggunakan Pemisahan Kanal (Guard Band). *JTEV (Jurnal Teknik Elektro dan Vokasional)*, *5*(1.1), 159. https://doi.org/10.24036/jtev.v5i1.1.106755

Sugiyatno, Sidiq, P., & Edrisy, I. F. (2024). Pengaruh Teknologi 5G pada Evolusi Komunikasi: Sebuah Kajian Terhadap Perkembangan dan Implikasinya di Bidang Sains. *NUCLEUS*, *4*(2), 115–120. https://doi.org/10.37010/nuc.v4i2.1448