A Tri-Band Frequency Reconfigurable Slot Antenna for Wireless Applications

Karam M. Younus and Khalil H. Sayidmarie

Department of Communication Engineering
College of Electronic Engineering, Ninevah University, Mosul, Iraq
karam.younus@uoninevah.edu.iq, kh.sayidmarie@gmail.com

Abstract **─** With the increase in wireless services, the demand for antennas that can operate at more than one frequency has increased. This work proposes a slot antenna whose frequency of operation can be configured into three bands of 2.4 GHz, 5 GHz, and 3.5 GHz for the Wireless-Area-Network (WLAN) and Worldwide Interoperability for Microwave Access (WiMAX) applications. The switching between the three bands is achieved by two PIN diodes properly placed between the two sides of the slot. The antenna consists of a rectangular slot etched on the ground plane, while on the other side of the substrate, there is a microstrip line to feed the slot with an open stub for matching. The tri-band frequency reconfigurable slot antenna has been studied, and its parameters optimized using computer simulation Technology (CST-MWS). Parametric study on the slot dimensions and the microstrip feeding is presented. For verification of the simulation results, the antenna is fabricated and measured. The simulated and measured parameters such as return loss, radiation pattern, and gain show excellent agreement for the three operation bands.

Index Terms **─** PIN diode, reconfigurable antenna, slot antenna, WLAN, WiMAX.

I. INTRODUCTION

The increasing development of wireless communications has led to diverse applications working at various bands for lower spectrum congestion. Thus, antennas that can operate at more than one frequency are desired. A single wide-band antenna may fulfill the requirement but on account of receiving more than one frequency band at the same time and consequently is prone to interference. A frequency reconfigurable antenna that can be switched from one band to another will be a better choice. Such antennas have received attention due to their selectivity for operation and attractive feature of using the spectrum. They can be easily integrated with switching and control circuits alongside providing a better reconfiguration. In addition to covering more than one application, frequency reconfigurable antennas are also governed by several factors such as; size, cost, and high data rate features. It is attractive to integrate more than one standard into a single wireless device, such as Worldwide Interoperability for Microwave Access (WiMAX) and Wireless-Area Network (WLAN) standards. Consequently, different multi-band antennas have been proposed, such as the dual-band monopole antenna for the WiMAX systems in [1], the multi-band planar inverted-F antenna (PIFA) for the wireless-wide-area-network (WWAN) system in [2], the multi-band patch antenna having varied polarization states in [3], and the dual-loop antenna for the 2.4/5.2/5.8 GHz bands in [4].

Various types of slot antennas have been designed for the WLAN, WiMAX, and ISM applications in the 2.4 GHz (802.11 b/g/h), 5 GHz (802.11 a/n), and 3.5 GHz (IEEE 802.16) operating bands. To achieve the above goals, slots of various shapes were used, leading to different bandwidth and gain characteristics [5-6]. The slot antenna, with the advantages of compact size, wide bandwidth, and easy integration with other devices, is a good candidate for the design of multi-band antennas.

In the past years, different designs of multi-band slot antennas have been proposed [7-16]. The dual-band characteristics of the slot antennas were generated by etching several narrow slots on the ground planes [7-8], or several stubs on the large slot as in [9-10]. The tri-band antennas in [11-12] and [13-14] were achieved using three folded slots etched on the ground planes or several stubs on the slots, respectively. In [15], a compact tri-band split-ring resonator (SRR) loaded slot antenna was proposed, which offers independent frequency tunability for operation at WLAN and WiMAX bands. In [16] the antenna is capable of being switched between single-band, dual-band or triple-band operation by incorporating three pairs of PIN diodes that are located within the dipole arms etched on the ground plane.

This work proposes a slot antenna whose frequency of operation can be configured into three bands for the WLAN and WiMAX applications. The switching between the three bands is achieved by two PIN diodes properly placed between the two sides of the slot. Section

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II describes the proposed idea, while Section III presents the results of the parametric analysis and optimization. The obtained performance is compared with those of other published works in Section IV. Finally, the conclusions are listed in Section V.

II. DESIGN OF THE SLOT ANTENNA

The geometry of the proposed tri-band frequency-reconfigurable antenna is shown in Fig.1. The design consists of a rectangular slot of length L and width W etched on the ground plane, while on the other side of the substrate, there is a microstrip line to feed the slot. The feed length is L_4 while the microstrip line extends beyond the slot by S. This extension works as an open stub that can be used to match the microstrip line to the slot. The chosen substrate is FR-4 with thickness h=1.6 mm, relative permittivity $\varepsilon_r = 4.3$, and dielectric loss tangent of 0.025. The reconfigurability is achieved by properly inserting two PIN diodes along the slot. By switching these diodes between ON and OFF states, the antenna operation can be switched between the three bands (2.4 GHz, 3.5 GHz, and 5.3 GHz).

The radiating slot resonates at frequency f when its length L is equal to an integer (N) multiple of half the effective wavelength:

$$L = N \times \frac{\lambda_e}{2} = N \times \left(\frac{C}{2f \times \sqrt{\varepsilon_e}}\right). \quad (1)$$

Where C is the speed of light and ϵ_e is the effective permittivity inside the slot that is given by:

$$\varepsilon_e = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left(\sqrt{1 + \frac{12h}{w}}\right)^{-0.5}. \quad (2)$$

The performance of the proposed antenna was investigated using the Computer Simulation Technology (CST-MWS) software, which uses the Finite Integration Technique (FIT). This is a numerical simulation method for approximation-free solutions of Maxwell's equations in their integral form. The Time-Domain solver was used to obtain the results. Parametric studies and optimization using the built-in Trust Region Framework Algorithm which is a numerical optimization for solving nonlinear programming problems. The optimized parameters were the length and width of the microstrip feed line and the slot to obtain the dimensions that result in the best performance.

A. The effect of slot length

Slot antennas relay on Babinet's principle, which relates the radiated field and impedance of an aperture, of slot antenna to that of the field of a dipole antenna [17]. The slot length plays a significant role in the proposed design, as shown by (1) and (2). The length of the slot L for the operation at 2.4 GHz frequency was found to be 30.12 mm, and this initial value was then optimized. Figure 2 shows the variation of the reflection coefficient parameter (S_{11}) with frequency for various slot lengths, where it is seen that the resonance frequency increases when the slot length is decreased. The best value of the slot length for the 2.4 GHz WLAN operation is 34.55 mm.

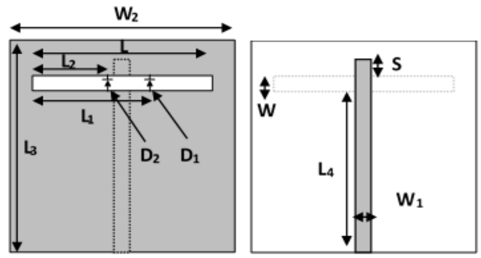

Fig. 1. Configuration of the proposed antenna: (a) front view and (b) back view.

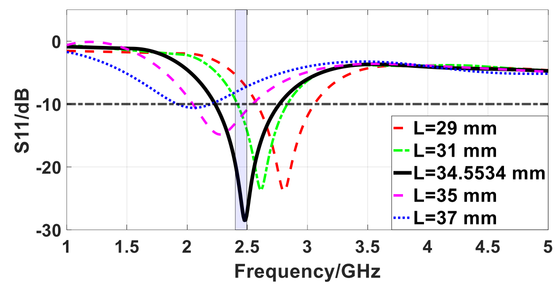

Fig. 2. S_{11}variation with frequency for various slot lengths L.

B. The effect of slot width

As regards the suitable width of the slot, there is no established design rule; thus, the parametric study is very beneficial in this respect. Figure 3 shows the effect of various slot widths, where it is clear that the resonant frequency decreases slightly by increasing the slot width. Larger bandwidth is also noticed for increasing the slot width. Therefore, if the slot width is to be increased, the slot length should be slightly decreased in order to keep the resonance frequency at 2.4 GHz.

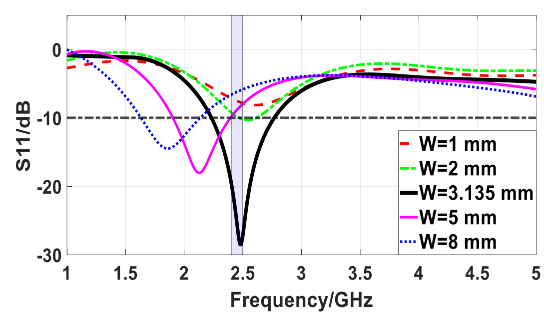

Fig. 3. S_{11} variation with frequency for various slot widths W, at L= 34.55 mm.

C. Effect of the Open Stub

In order to match the antenna feedline to the slot, a stub of length S has been added to the feed line. This open-ended stub adds a reactive impedance Z_s given by:

$$Z_s = -j \times Z_0 \times \cot(\beta S). \quad (3)$$

Where Z_o is the impedance of the feedline and $\beta = 2\pi/\lambda_e$. Figure 4 shows the effect of varying the stub length. Without the stub (S=0), proper matching ($S_{11} < -10$dB) cannot be achieved. Moreover, the resonance frequency decreases by increasing the stub length.

The parametric study shows that the slot length, width, and the stub length influence the design parameters, and the simulation with the CST is a useful tool to optimize the antenna dimensions. Table 1 shows the parameters of the designed antenna after the optimization.

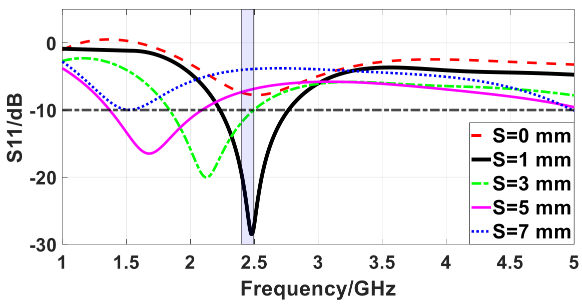

Fig. 4. S_{11} variation with frequency for various stub lengths S, at L= 34.55 mm.

Table 1: Parameters of the designed antennas, all dimensions are in millimeters

Parameter	Value
L	34.55
L_1	22.27
L_2	14.77
L_3	44
L_4	34
S	1
W	3.14
W_1	3.14
W_2	45

III. DESIGN OF THE FREQUENCY RECONFIGURABLE ANTENNA

The proposed antenna is wanted to operate at three bands by switching the two diodes D_1 and D_2 shown in Fig. 1. As mentioned in Section II, the slot was designed to resonate at 2.4 GHz by choosing its length according to (1) and (2). Then, by inserting a PIN diode across the slot edges, the slot can be divided into two adjacent slots when the diode is switched ON and thus short-circuiting the two sides of the slot. The positions of the two diodes can be chosen to change the length of the slot and thus excite resonance at the required frequency, as it is explained in the next section. Prototypes of the designed antenna were fabricated, as shown in Fig. 5. In the testing of the fabricated prototypes, the ON state of the PIN diode was realized by placing a shorting copper strip of width about 1.5 mm between the two sides of the slot.

(a) (b) (c)

Fig. 5. Photograph of the fabricated antennas: (a) resonate at 2.4GHz, (b) resonate at 3.5GHz, and (c) resonate at 5.3GHz.

A. Case-1, operation at 2.4 GHz

When the diodes D_1 and D_2 are in OFF state, the antenna resonates at 2.4 GHz, since the full length of the slot is radiating as shown in the previous section. Figure 6 shows the variation of the S_{11} with frequency for this case for both simulated and practical results, which indicate good agreement. It is clear that the antenna covers a bandwidth of about 290 MHz and has an S_{11} value of better than -23.87 dB along the 2.45 GHz WLAN band. Figure 7 shows the E-field distribution across the slot of the antenna at 2.4 GHz, where a peak is noticed at the center characterizing the ½ λ_e resonance. The radiation pattern of the fabricated prototype of the antenna was measured at 2.4 GHz and compared to that obtained from the simulation, as shown in Fig. 8. Figure 9 shows the variations of the calculated radiation efficiency and the total gain with frequency. The gain is about 4.5 dB, and the efficiency is better than 90% across the WLAN band.

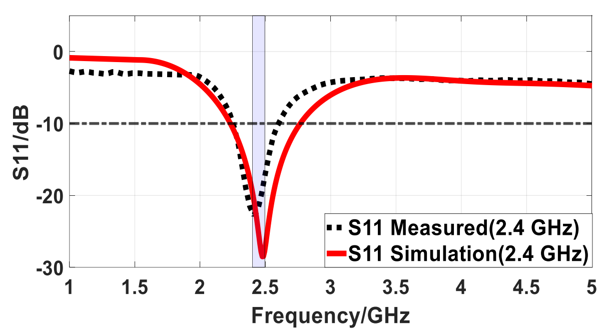

Fig. 6. Simulated and measured S_{11} variation with frequency when the diodes D_1 and D_2 are in the OFF state.

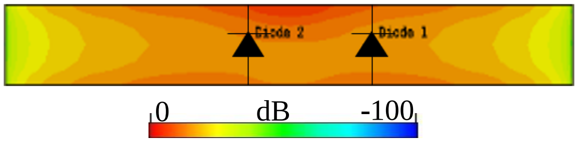

Fig. 7. Simulated E-field at 2.4 GHz (zooming on the slot), the diodes D_1 and D_2 are in the OFF state.

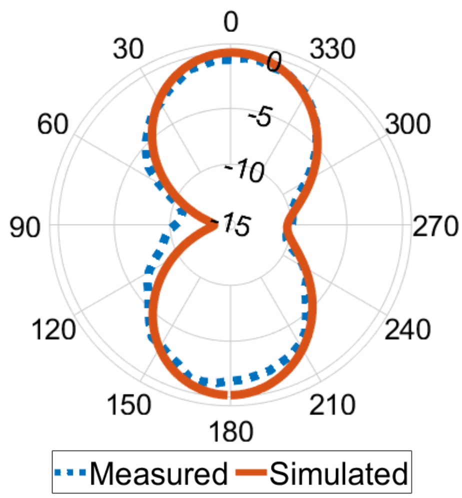

Fig. 8. Normalized simulated and measured radiation patterns of the antenna at 2.4GHz, both diodes D1 and D2 are in the OFF state.

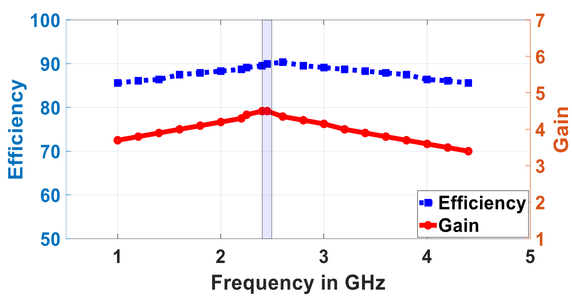

Fig. 9. Antenna gain and efficiency when the diodes D_1 and D_2 are in the OFF state.

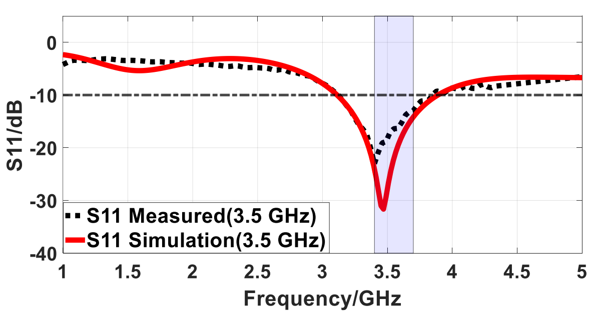

Fig. 10. Simulated and measured S_{11} variation with frequency, when the diode D_1 is ON, and D_2 is OFF state.

B. Case-2, operation at 3.5 GHz

To achieve operation at the frequency of 3.5 GHz, the slot length is reduced by switching the diode D_1 to ON state while keeping the diode D_2 in the OFF state. Thus, the position of the diode D_1 is found, such that the left part of the slot has a length $L_1 = 0.5\lambda_{e2}$ at the frequency of 3.5 GHz. According to (1) and (2), the length L_1 is found to be 22.275 mm. In this case, the right part of the slot will have a length of 12.275 mm, and it may resonate at 6.3 GHz. Figure 10 shows the variation of the simulated and measured S_{11} with frequency. It is clear that the antenna operates at the WiMAX band of 3.5 GHz with a bandwidth of about 310 MHz and an S_{11} value of better than -15 dB. Figure 11 shows the E-field distribution in the slot of the antenna at 3.5 GHz, where it is seen the ½ λ_e distribution is across the left part of the slot. The field at the right side of the slot exhibits small values indicating no resonance. Figure 12 illustrates the normalized simulated and measured radiation patterns of the antenna at 3.5 GHz, where good agreement between the two results is evident. Figure 13 shows the variation of the radiation efficiency and the total gain with frequency. The gain is better than 4.5 dB, and the efficiency is about to 86% across the WiMAX band. The maximum value of the gain is almost equal to that obtained at 2.45 GHz since in the two cases the slot length is 0.5 λ_e, while the efficiency is slightly smaller probably due to the loss in the shorting strip and the increased loss in the substrate at the higher frequency of 3.5 GHz.

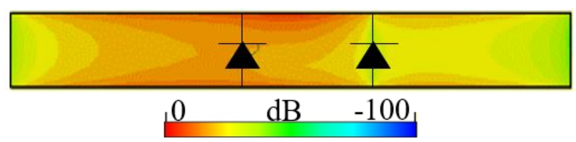

Fig. 11. Simulated normalized E-field at 3.5 GHz (zooming on the slot), the diode D_1 is ON, while D_2 is OFF state.

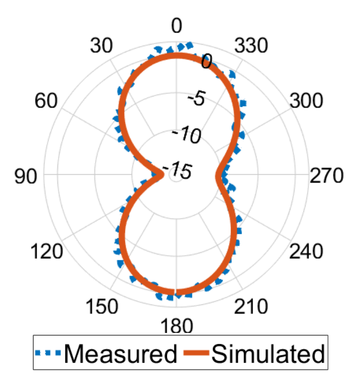

Fig. 12. Normalized simulated and measured radiation patterns of the antenna at 3.5GHz, the diode D_1 is ON, while D_2 is OFF state.

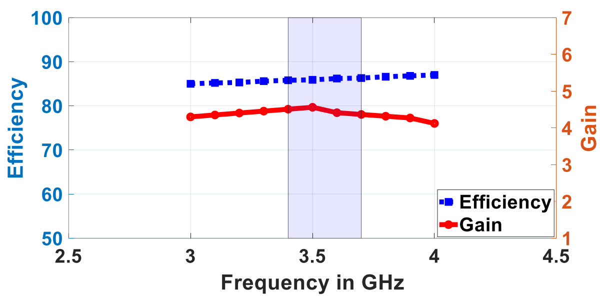

Fig. 13. Antenna gain and efficiency when the diode D_1 is ON and diode D_2 is OFF.

C. Case-3, operation at 5.3 GHz

To realize the operation at 5.3 GHz, there should be a slot of smaller length compared to the two former cases. When both of the diodes D_1 and D_2 are switched ON, then the slot will be divided into three parts. If the part at the left is to resonate, then it should have a length of $L_2 = ½\ \lambda_e$ at the frequency of 5.3 GHz. According to (1) and (2), L_2 was found to be 14.775 mm. Again, the ON states of the two diodes were realized by placing two strips between the two sides of the slot. Figure 14 shows the S_{11} parameter for this case for both simulated and practical results, where the condition of (S11 < -10dB) is insured across a bandwidth of more than 2000 MHz. The measured results are few dB's higher than the simulated ones, but still, it is lower than -10B across the wanted band. Figure 15 shows the E-field distributions in the slot of the antenna at 5.3 GHz. The field intensity at the left part is highest, and its distribution resembles a half-sinusoid variation. This confirms that the left part of the slot is resonating at 5.3 GHz. The field along the two copper strips is minimal, showing the short-circuit action of the strips. The normalized simulated and measured radiation patterns of the antenna at 5.3 GHz are compared in Fig. 16. Figure 17 shows the radiation efficiency and the total gain in the 5.3 GHz band.

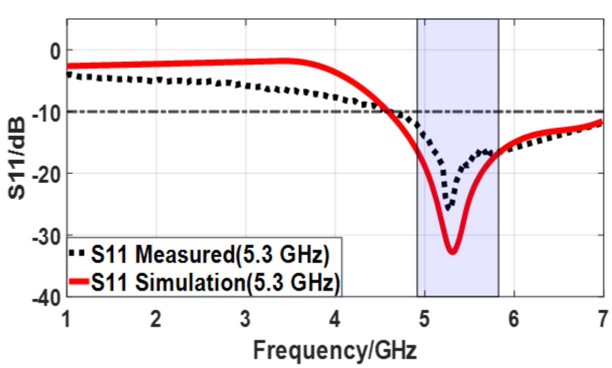

Fig. 14. Simulated and measured S_{11} variation with frequency when both diodes D1 and D2 are in ON state.

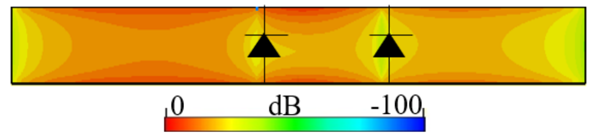

Fig. 15. Simulated E-field distribution in the slot (zooming on the slot), the diodes D_1 and D_2 are ON.

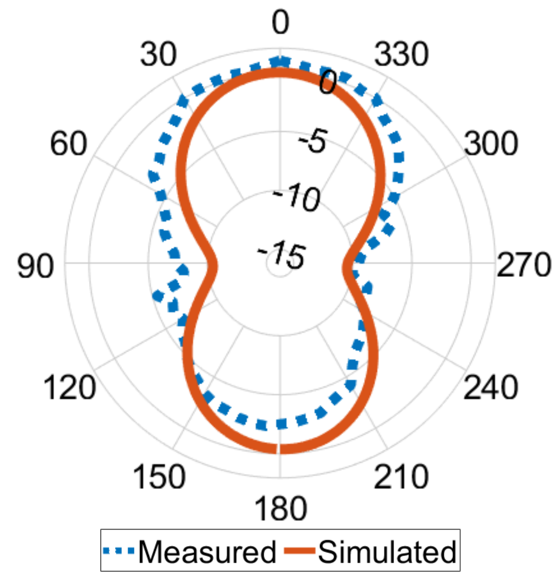

Fig. 16. Normalized simulated and measured radiation patterns of the antenna at 5.3 GHz and both diodes are in the ON state.

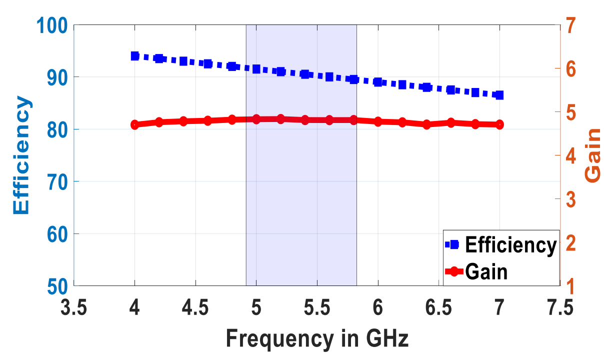

Fig. 17. Antenna gain and efficiency when the diodes D_1 and D_2=ON.

IV. COMPARISON OF OBTAINED RESULTS WITH THOSE OF PUBLISHED WORKS

The performance of the proposed antenna is compared with other tri-band antennas that were published for WiMAX and WLAN applications, as shown in Table 2. The comparison comprised antenna size, operation frequencies, and gain. The proposed antenna matches the frequency bands of those presented in [6], [18-21]. The table shows that, in general, the larger gain is related to the larger size of the antenna in terms of the effective wavelength. However, the proposed antenna has a higher gain than most of the shown antennas, while its size smaller than those of [6, 22, 25]. The size of the proposed antenna is basically occupied by the ground plane. The antennas in [24, 25] cover a frequency range extending to 0.9 GHz and 1.5 GHz, where it is easier to keep the characteristics of the antenna, yet they offer lower gain compared to the proposed antenna. One important characteristic of the proposed antenna is its capability to switch its operation among the three bands, where only those in [21-23] are reconfigurable.

V. CONCLUSION

A Tri-Band frequency reconfigurable slot antenna for wireless WLAN and WiMAX applications has been demonstrated. The design consists of a rectangular slot etched on the ground plane, while on the back of the substrate, a microstrip line feeds the slot. Two diodes are placed at proper positions along the slot to achieve reconfigurability by switching them into ON and OFF states. The antenna can be switched to operate at any one of three bands of 2.4, 3.5 and 5.3 GHz. The relation between the band frequency and the position of the diode is derived. A prototype of the proposed antenna was fabricated and measured. The S_{11}, radiation patterns, efficiency, and gain results are obtained for both simulation and the prototype. The simulated and measured parameters show excellent agreement for the three operation bands, thus verifying the design rules.

Table 2: Comparison of the performance of the proposed antenna with other designs

Reference	Dimensions in (mm)	Dimensions in (λ_o) at the Lower Band	Substrate (ε_r)	Operation Frequencies (GHz)	Gain (dB)
6	40×45×0.8	0.46x0.52×0.001	2.55	3.5/4.1/5/6.4/6.8	4.3/4.3/4.4/5.5/5.3
18	26×20×1.6	0.2×0.16×0.012	4.4	2.4/3.5/5.8	2.24/2.8/2.6
19	35×30×1.6	0.29×0.25×0.013	4.4	2.5/3.5/5.5	3.86/3.52/4.32
20	25×22×1.6	0.2×0.183×0.013	4.4	2.5/3.5/5.8	1.98/3.15/2.68
21	40×40×1.6	0.32×0.32×0.012	4.4	2.4/3.5/5.3	2.4/3.3/3.2
22	80×80×1	0.64×0.64×0.008	4.4	2.4/3.5/5.8	2.33/3.14/2.89
23	58×40×1.2	0.42×0.29×0.001	4.4	2.2/ 2.4/3.8	4.2/3.7/4.7
24	100×65×1.6	0.3×0.195×0.004	4.4	0.9/1.8/2.6	0.25/0.6/3.28
25	120×60×1.6	0.6×0.3×0.008	4.4	1.5/2.4/5.8	0.16/2.62/2.04
This work	45×44×1.6	0.36×0.35×0.013	4.3	2.4/3.5/5.3	4.5/4.4/4.7

REFERENCES

[1] X. L. Sun, S. W. Cheung, and T. I. Yuk, "Dual-band monopole antenna with frequency tunable feature for WiMAX applications," *IEEE Antennas Wireless Propag. Lett.*, vol. 12, pp. 100-103, 2013.

[2] C. H. Chang and K. L. Wong, "Printed λ/8-PIFA for penta-band WWAN operation in the mobile phone," *IEEE Trans. Antennas Propag.*, vol. 57, no. 5, pp. 1373-1381, May 2009.

[3] Y. D. Dong, H. Toyao, and T. Itoh, "Design and characterization of miniaturized patch antennas loaded with complementary split-ring resonators," *IEEE Trans. Antennas Propag.*, vol. 60, no. 2, pp. 772-785, Feb. 2012.

[4] S. W. Su, "High-gain dual-loop antennas for MIMO access points in the 2.4/5.2/5.8 GHz bands," *IEEE Trans. Antennas Propag.*, vol. 58, no. 7, pp. 2412-2419, July 2010.

[5] A. A. Eldek, A. Z. Elsherbeni, C. E. Smith, and K. Lee, "Wideband planar slot antennas," *ACES Journal*, vol. 9, no. 1, 2004.

[6] N. H. Gad and M. Vidmar, "Design of a microstrip-fed printed-slot antenna using defected ground structures for multiband applications," *ACES Journal*, vol. 33, no. 8, pp. 854-860, Aug. 2018.

[7] K. L. Wong and L. C. Lee, "Multiband printed monopole slot antenna for WWAN operation in the laptop computer," *IEEE Trans. Antennas Propag.*, vol. 57, no. 2, pp. 324-330, Feb. 2009.

[8] Y. Cao, B. Yuan, and G. F. Wang, "A compact multiband open-ended slot antenna for mobile handsets," *IEEE Antennas Wireless Propag. Lett.*, vol. 10, pp. 911-914, 2011.

[9] Y. C. Lu and Y. C. Lin, "A mode-based design method for dual-band and self-duplexing antennas using double T-stubs loaded aperture," *IEEE Trans. Antennas Propag.*, vol. 60, no. 12, pp. 5596-5603, Dec. 2012.

[10] M. J. Chiang, S. Wang, and C. C. Hsu, "Compact multifrequency slot antenna design incorporating embedded arc-strip," *IEEE Antennas Wireless Propag. Lett.*, vol. 11, pp. 834-837, 2012.

[11] A. P. Spaghetti, M. Azarmanesh, and R. Zaker, "A novel switchable single and multifrequency triple-slot antenna for 2.4-GHz Bluetooth, 3.5-GHz WiMax, and 5.8-GHz WLAN," *IEEE Antennas*

Wireless Propag. Lett., vol. 9, pp. 534-537, 2010.

[12] J. H. Lu and B. J. Huang, "Planar compact slot antenna with multi-band operation for IEEE 802.16m application," *IEEE Trans. Antennas Propag.*, vol. 61, no. 3, pp. 1411-1414, Mar. 2013.

[13] L. Dang, Z. Y. Lei, Y. J. Xie, G. L. Ning, and J. Fan, "A compact microstrip slot triple-band antenna for WLAN/WiMAX applications," *IEEE Antennas Wireless Propag. Lett.*, vol. 9, pp. 1178-1181, 2010.

[14] W. Hu, Y. Z. Yin, P. Fei, and X. Yang, "Compact triband square-slot antenna with symmetrical L-strips for WLAN/WiMAX applications," *IEEE Antennas Wireless Propag. Lett.*, vol. 10, pp. 462-465, 2011.

[15] P. M. Paul, K. Kandasamy, and M. S. Sharawi, "A tri-band SRR loaded half slot antenna with wideband properties," *2018 IEEE Radio and Antenna Days of the Indian Ocean* (*RADIO*), Grand Port, pp. 1-2, 2018.

[16] I. H. Idris, M. R. Hamid, M. H. Jamaluddin, M. K. A. Rahim, J. R. Kelly, and H. A. Majid, "Single-, dual- and triple-band frequency reconfigurable Antenna," *Radioengineering*, vol. 23, no. 3, pp. 805-811, 2014.

[17] C. Chulvanich, J. Nakasuwan, N. Songthanapitak, N. Anantrasirichai, and T. Wakabayashi, "Design narrow slot antenna for dual frequency," *PIERS Online*, vol. 3, no. 7, pp. 1024-1028, 2007.

[18] L. Li, X. Zhang, X. Yin, and L. Zhou, "A compact triple-band printed monopole antenna for WLAN/ WiMAX applications," in *IEEE Antennas and Wireless Propagation Letters*, vol. 15, pp. 1853-1855, 2016.

[19] L. Dang, Z. Y. Lei, Y. J. Xie, G. L. Ning, and J. Fan, "A compact microstrip slot triple-band antenna for WLAN/WiMAX applications," in *IEEE Antennas and Wireless Propagation Letters*, vol. 9, pp. 1178-1181, 2010.

[20] T. Ali and R. C. Biradar, "A compact multiband antenna using λ/4 rectangular stub loaded with metamaterial for IEEE 802.11N and IEEE 802.16E," *Microwave and Optical Technology Letters*, vol. 59, pp.1000-1006, 2017.

[21] A. P. Saghati, M. Azarmanesh, and R. Zaker, "A novel switchable single- and multifrequency triple-slot antenna for 2.4-GHz Bluetooth, 3.5-GHz WiMax, and 5.8-GHz WLAN," in *IEEE Antennas and Wireless Propagation Letters*, vol. 9, pp. 534-537, 2010.

[22] H. Boudaghi, M. Azarmanesh, and M. Mehranpour, "A frequency-reconfigurable monopole antenna using switchable slotted ground structure," in *IEEE Antennas and Wireless Propagation Letters*, vol. 11, pp. 655-658, 2012.

[23] Y. Pan, Y. Ma, Z. Hou, and Y. Zeng, "A compact antenna with frequency and pattern reconfigurable characteristics," *Microwave and Optical Technology Letters*, vol. 57, no. 11, pp. 2467-71, Aug. 2015.

[24] J.-S. Sun, H.-S. Fang, P.-Y. Lin, and C.-S. Chuang, "Triple-band MIMO antenna for mobile wireless applications," *IEEE Antennas Wirel. Propag Lett.*, vol. 15, pp. 500-503, 2015.

[25] R. Zhang, H.-H. Kim, and H. Kim, "Triple-band ground radiation antenna for GPS, WiFi 2.4 and 5 GHz band application," *Electron Lett.*, vol. 51, no. 25, pp. 2082-4, 2015.

Karam M. Younus was born in Mosul, Iraq, in 1986. He received the B.Sc. degree in Communication Engineering from the University of Mosul, Iraq, in 2010, and an M.Sc. degree in Communication Engineering, University of Bradford, U.K., in 2015. He is currently an Assistant-Lecturer at the Communication Engineering Department, College of Electronics Engineering, Ninevah University. His research interest includes beam steering, reconfigurable antennas, and antenna design.

Khalil H. Sayidmarie received a B.Sc. degree in Electronic & Communication Eng. from Mosul University, Iraq, in 1976, and Ph.D. degree in Antennas & Propagation from Sheffield University/U.K. in 1981. Then he joined the College of Engineering at Mosul University in 1983 and was promoted to full professor in 1992. He worked as the head of the Electrical Engineering department for 9 years. Sayidmarie served as Prof. of Communication Engineering at the College of Engineering/University of Amman/Jordan from Oct. 2006 to Sept. 2009, and as the Dean of that college from Sept. 2008 to Sept. 2009. He is Prof of Communication Engineering at the college of Electronic Engineering/ Ninevah University since July 2002. His research interests cover antennas, propagation, and microwaves, and he has published more than 120 papers in international journals and conferences.