بسم الله الرحمن الرحيم

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بقسم التوثيق الإلكتروني بمركز الشبكات وتكنولوجيا المعلومات دون أدنى مسئولية عن محتوى هذه الرسالة.

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Design, Fabrication and Characterization of Novel 5G Microstrip Antennas

Submitted to Faculty of science- Ain Shams University in partial fulfillment for Degree of Master of Science (M.Sc.) in Physics

By

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ABSTRACT

Present wireless communication technology is expanding due to the increase of the number of users in terms of internet usage. Currently, there is a great interest in higher data rates using wireless communication. Mobile wireless technology has been developed through four generations from 1G to 4G technology. Due to the poor coverage, poor quality, dropped connection and flexibility, the current generation of wireless communication (4G) is unable to fulfill the consumer's requirements. Currently, some mobile technologies use 900, 1800, 2100, 2300 MHz, etc. Therefore, the coverage is wide and has a relatively low attenuation due to the low frequencies. To increase quality and coverage, research has been deployed in 5G-wireless communication. The major advantage of the new release (5G) is to provide data rates of at least one gigabit per second for tens of thousands of users, large bandwidth, cell higher resolution and the energy efficiency enhancement. The frequency range used for the 5G research is mostly below 6 GHz, around 28GHz, 38 GHz and 60 GHz. One of the goals of 5G technology is to connect millions of devices together.

Methodologies for meeting the requirements of the 5G by a structured and simplified design of two antennas are proposed in this thesis for frequencies centred at first design17 GHz,26 GHz, 28 GHz at second design 4 GHz, 7 GHz, 25GHz and 35 GHz. The reported first design has narrow band and high gain. The reported second design has multi-band, high gain and high efficiency. The whole configuration is optimized using particle swarm optimization algorithm to achieve the optimal bandwidth and gain. The proposed

antennas are simulated using Finite Integration Technique (FIT), Finite Element Method (FEM) and fabricated using photolithograph technique. The performance of the antennas is analyzed in terms of S_{11} parameter, gain, Efficiency and Radiation Pattern. The measured results are in a good agreement with the simulated results. The first antenna offers -10 dB return loss bandwidth of 672 MHz, 596 MHz and 600MHz over the frequency range with three bands frequencies (16.426 – 17.098 GHz), (26.33 – 26.926 GHz) and (28.39 – 28.99 GHz), respectively. Furthermore, the maximum gains over the microstrip antenna are 7.64, 5.24, and 7.19 dB at operating frequencies 16.449 GHz, 26.1 GHz and 28.7 GHz, respectively. The second antenna offers -10 dB return loss bandwidth of 4.11 GHz, 1.3 GHz, 7.1 GHz and 4.49 GHz over the frequency range (3.8 – 7.91 GHz), (12.59 – 13.92GHz), (19.9 – 27 GHz) and (34 – 38.49 GHz), respectively. Furthermore, the maximum gain over the microstrip antenna is 4.8, 4.28, 4.99, 5.17, 6.72, 7.64 and 5.73 dB at operating frequencies 4 GHz, 7 GHz, 13 GHz, 21 GHz and 23.28 GHz, 25.88 GHz and 35.2 GHz, respectively.

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