AIN SHAMS UNIVERSITY

FACULTY OF ENGINEERING

Electronics Engineering and Electrical Communications

Development of mobile network planning for 4G systems

A Thesis submitted in partial fulfillment of the requirements of the degree of

Master of Science In Electrical Engineering

(Electronics Engineering and Electrical Communications)

By

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Bachelor of Science In Electrical Engineering

(Electronics Engineering and Electrical Communications)

Faculty of Engineering, Akhbar El Youm Academy, 2009

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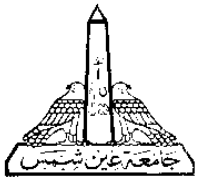

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Statement

This thesis is submitted as a partial fulfilment of Master of Science in Electrical Engineering, Faculty of Engineering, Ain shams University.

The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

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Abstract

Microwave Line-of-sight radio is one of the most important and common transmission methods in telecommunications networks. As the microwave radio signals are propagated through the lower atmosphere, they are sensitive to terrain, atmospheric, and climatic conditions. The planning and design of a reliable microwave links are very difficult and require a lot of complex computations. Therefore, not only software implementation is required, but studying the effect of all the different design aspects is very crucial for the telecommunication systems. The software then estimates the path profile, link budget, fade margin, and all other parameters at any place.

This thesis presents the design and implementation of new microwave planning tool with study of all of design parameters. This software is an engineering tool to aid in the design and planning of the microwave transmission links considering the geography, distance, antenna height, transmit power, frequency, temperature, atmospheric effect, pressure, losses, and other factors which affect the microwave line-of-sight radio link.

This tool can design microwave radio links for both TDM and 4G networks. And it is known that the fourth generation of mobile networks needs special capacity requirements in the transmission paths between access and core parts. Therefore, microwave line-of-sight radio links have to be developed to satisfy this increasing capacity demand.

The challenge for microwave transmission in 4G is meeting the capacity and reliability required of this generation of mobile

networks. Hence, this work presents some techniques to achieve the required capacity for 4G networks such as: Wider Co-channels, Millimeter Waves, and Ethernet Frame Suppression and Compression.

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$A_{0.01}$	Required fade margin due to rain exceeded 0.01% of time
A_a	Atmospheric absorption
b	Earth bulge
C_{Lat}	Latitude coefficient in multipath fading
C_{Lon}	Longitude coefficient in multipath fading
C_o	Terrain altitude coefficient in multipath fading
c	Speed of light
d	Distance between two endpoints
d_o	Rain cell length
d_{eff}	Effective path length
F	Fresnel zone radius
f	Frequency
GTX	Transmitter antenna gain
GRX	Receiver antenna gain
h_r	Height of the receiving antenna
h_t	Height of the transmitting antenna
k	Effective Earth radius factor
K	Geoclimatic factor

LTX	Transmitter losses
LRX	Receiver losses
M	Fade margin
P	Atmospheric pressure
P_o	Multipath fading occurrence factor
P_w	The average worst month multipath fading probability
PTX	Transmitter output power
r	Radius of the first Fresnel zone
R	Rain rate
T	Atmospheric temperature
γ_o	Atmospheric absorption due to oxygen
γ_w	Atmospheric absorption due to water vapor
θ_1	Longitude of site A
θ_2	Longitude of site B
ρ_w	Water vapor density
$\emptyset_1$	Latitude of site A
$\emptyset_2$	Latitude of site B
$\in p$	Path inclination
γ_R	Specific rain attenuation
λ	Wavelength