AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
ELECTRONICS AND COMMUNICATIONS ENGINEERING DEPARTMENT

DESIGN AND ANALYSIS OF IP MULTIMEDIA SUBSYSTEM (IMS)

A Thesis
Submitted for Partial Fulfillment of the Requirements of the Degree of Doctor of Philosophy
in Electrical Engineering
(Electronics and Communications Engineering)

Submitted by

Eng. Wagdy Anis Aziz
B.Sc. of Electrical Engineering Ain Shams University, 1996
M.Sc. of Electrical Engineering Ain Shams University, 2006

Supervised by

Prof . Dr. Salwa Hussein El-Ramly
Professor of Communication Engineering
Electronics and Communication Engineering Dept.
Faculty of Engineering
Ain Shams Univeristy

Prof . Dr. Magdy Mahmoud Ibrahim
Professor of Communication Engineering
Electronics and Communication Engineering Dept.
Faculty of Engineering
Ain Shams Univeristy

Dr. Mohsen Tantawy
Associate Professor, Network Department ,
National Telecommunication Institute (NTI),
Cairo, Egypt

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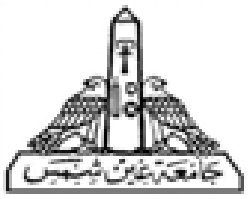

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ELECTRONICS AND COMMUNICATIONS ENGINEERING
DEPARTMENT

Examiners Committee

Name : Wagdy Anis Aziz
Thesis : **Design and Analysis of IP Multimedia Subsystem IMS**
Degree : Ph.D. (Electronics and Communications Engineering)

Approved by:

Name & Title	Signature
1- Prof. Dr. David Al Dabass Emeritus Professor of Intelligent Systems Nottingham Trent University NG11 8NS, United Kingdom.	.....
2- Prof. Dr. Samir Ibrahim Shahin Professor of Computer Engineering, Cairo University	.....
3- Prof. Dr. Magdy Mahmoud Ibraheem Professor of Communication Engineering Faculty of Engineering, Ain Shams University	.....
4- Prof. Dr. Salwa Hussein El Ramly Professor of Communication Engineering Faculty of Engineering, Ain Shams Univeristy	.....

Cairo, 23 May 2011

STATEMENT

This thesis is submitted to Ain Shams University for the degree of Doctor of Philosophy in Electrical Engineering (Electronics and communication Engineering)

The work included in this thesis was carried out by the author in the Department of Electronics and Communication Engineering, Ain Shams University.

No Part of this thesis has been submitted for a degree or a qualification at any other university or institute.

Name : **Wagdy Anis Aziz**
Signature :
Date : / / 2011

C.V.

Name of Researcher	:	**Wagdy Anis Aziz**
Date of Birth	:	23 January 1973
Nationality	:	Egyptian
First University Degree	:	B.Sc. in Electronics and Communication Engineering. Faculty of Engineering. Ain Shams University.
Date of Degree	:	1996
Second University Degree	:	M.Sc. in Electronics and Communication Engineering. Faculty of Engineering. Ain Shams University.
Date of Degree	:	2006

جامعة عين شمس – كلية الهندسة
قسم هندسة الإلكترونيات والاتصالات الكهربية

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مقدمة من
المهندس / وجدى أنيس عزيز

بكالوريوس الهندسة الكهربية (هندسة الإلكترونيات والاتصالات الكهربية)
كلية الهندسة – جامعة عين شمس – ١٩٩٦
ماجيستير الهندسة الكهربية (هندسة الإلكترونيات والاتصالات الكهربية)
كلية الهندسة – جامعة عين شمس – ٢٠٠٦

تحت اشراف

الأستاذ الدكتور / سلوى حسين الرملى
استاذ بقسم هندسة الإلكترونيات والإتصالات
كلية الهندسة – جامعةعين شمس

الأستاذ الدكتور / مجدى محمود ابراهيم
استاذ بقسم هندسة الإلكترونيات والإتصالات
كلية الهندسة – جامعةعين شمس

الدكتور / محسن طنطاوى
استاذ مساعد بقسم الشبكات
المعهد القومى للاتصالات - القاهرة

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ABSTRACT

Wagdy Anis Aziz. **Design and Analysis of IP Multimedia Subsystem (IMS)**. Doctor of Philosophy, Ain Shams University, Faculty of Engineering, Electronics and Communication Engineering Department, 2010.

Over the last years the IP Multimedia Subsystem (IMS) has continuously gained in importance as the next generation communication network. The Session Initiation Protocol (SIP) was chosen the signaling protocol for session establishment and control in IMS.

The IP Multimedia Subsystem (IMS) is the technology that will merge the Internet (packet switching) with the cellular world (circuit switching). It will make Internet technologies, such as the web, email, instant messaging, presence, and videoconferencing available nearly everywhere.

IP Multimedia Subsystem (IMS) has resulted from the work of the Third Generation Partnership Project (3GPP) toward specifying an all-IP communication service infrastructure. Mainly looking at the needs and requirements of mobile operators, the 3GPP first specified IMS as a service architecture combining the Internet's IP technology and wireless and mobility services of current mobile telephony networks. After that the IMS architecture was extended to include fixed networks as well. By deciding to use session initiation protocol (SIP) as the signaling protocol for session establishment and control in IMS instead of developing its own set of protocols, 3GPP has opened the door toward a tight integration of the mobile, fixed and Internet worlds. Recent reports already indicate that there are more than 200 million subscribers using the IMS technology for telephony services.

Measuring the capacity of the (IMS) controllers is very important due to the critical role it plays in the Next Generation Network (NGN) of the Fixed and Mobile Networks. This thesis proposes a robust and scalable method that can be used to measure the capacity of the IMS controllers,

Call Session Control Function (CSCF) and benchmark their different vendors. The purpose of this method is to measure the capacity of the server in terms of how many calls are routable into a defined time interval and what the consequences of overloading the system are.

Evaluating the IP Multimedia Subsystem (IMS) Performance is very important due to the critical role it plays in the Next Generation Network (NGN) of the Fixed and Mobile Networks. This Thesis proposes robust and scalable methods that can be used to test the performance of the IP Multimedia Subsystem (IMS) controllers, Call Session Control Function (CSCF) and benchmark their vendors.

In this thesis we provide also a theoretical model that can be used by operators and network designers to determine the effects of introducing IMS to their networks in terms of bandwidth usage for example and the effects of losses and delays on the service quality. This model uses as the input various traffic characteristics such as the number of calls per second and mean holding time and network characteristics, such as losses and propagation delays. The output of the model provides details on the bandwidth and delay needed for successfully establishing a session when using SIP over UDP in IMS networks.

Voice traffic in IP Multimedia Subsystem (IMS) will be served using Internet Protocol (IP) which is called Voice over IP (VoIP). This chapter uses the "E-Model", (ITU-T G.107), as an optimization tool to select network and voice parameters like coding scheme, packet loss limitations, and link utilization level in IMS Network. The goal is to deliver guaranteed Quality of Service for voice while maximizing the number of users served. This optimization can be used to determine the optimal configuration for a Voice over IP in IMS network.

Key words:

IMS, SIP, VoIP, CSCF, SIPp, OpenSER, OPNET, MOS, E-Model.

Thesis supervisor:

- Prof. Dr. Salwa Hussein El-Ramly
  Prof. Emeritus, Electronics & Communications Engineering. Department
  Electronics and Communications Engineering Department,
  Faculty of Engineering,
  Ain Shams University,
  Cairo, Egypt.

- Prof. Dr. Magdy Mahmoud Ibrahim
  Prof. Emeritus, Electronics & Communications Engineering. Department
  Electronics and Communications Engineering Department,
  Faculty of Engineering,
  Ain Shams University,
  Cairo, Egypt.

- Dr. Mohsen Tantawy
  Associate Professor,
  Network Department National Telecommunication Institute (NTI),
  Cairo, Egypt.

PUBLICATION ARISING FROM THIS THESIS

JOURNAL PAPERS

1. W. A. Aziz, S. H. EL-Ramly , M. M. Ibrahim , M. M. Tantawy "IP–Multimedia Subsystem (IMS) Performance Evaluation and Benchmarking" *Ain Shams Journal of Electrical Engineering (A S J E E)*, 2010. Paper ID: #440231, Vol (1), pp: 11-20, June 2010.

2. W. A. Aziz, S. H. EL-Ramly , M. M. Ibrahim , M. M. Tantawy "Capacity Measurement for IP–Multimedia Subsystem (IMS) Controllers " *Ain Shams Journal of Electrical Engineering (A S J E E)* , 2010. Paper ID: #450044, , Vol (1), pp: 83-89, June 2010.

3. W. A. Aziz, S. H. EL-Ramly , M. M. Ibrahim, M. M. Tantawy "Voice over IP (VoIP) Quality Optimization in IP–Multimedia Subsystem (IMS) " *Ain Shams Journal of Electrical Engineering (A S J E E)* , 2010. Paper ID: #450043, Vol (1), pp: 31-42, June 2010.

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1. W. A. Aziz, S. H. EL-Ramly, M. M. Ibrahim "IP–Multimedia Subsystem (IMS) Performance Evaluation and Benchmarking ", *SIBIRCON-2010, the IEEE Region 8 International Conference on Computational Technologies in Electrical and Electronics Engineering*. Irkutsk (Listvyanka), Russia, from 11st to 15th of July 2010.PaperID:#67.http://ieeexplore.ieee.org/search/freesearchresult.jsp?reload=true&newsearch=true&queryText=10.1109%2FSIBIRCON.2010.5555343

2. W. A. Aziz, S. H. EL-Ramly, M. M. Ibrahim "Capacity Measurement for IP–Multimedia Subsystem (IMS) Controllers ", *CIMSIM 2010.Second International Conference on Computational Intelligent, Modeling and Simulation*, Bali 28-30 September 2010. Paper ID: #1569346511

3. W. A. Aziz, S. H. EL-Ramly , M. M. Ibrahim "Voice over IP (VoIP) Quality Optimization in IP–Multimedia Subsystem (IMS) ", *CIMSIM 2010.Second International Conference on Computational Intelligent, Modeling and Simulation*, Bali 28-30 September 2010. Paper ID: #1569351243

4. W. A. Aziz, S. H. EL-Ramly , M. M. Ibrahim "A Theoretical Model to Calculate the Bandwidth of IMS Session Establishment ", *ISMS2011. 2nd International Conference on Intelligent Systems, Modeling and Simulation*, Kuala Lumpur, Malaysia, Monday 24 January 2011 and Phnom Penh, Cambodia, Thursday and Friday 27 and 28 January 2011.Paper ID: #1569376849

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