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المؤلف الرئيسي:	El Hayatmy, Gamal Nabil Fatehy
مؤلفين آخرين:	Mohamed, Ahmed Abd Allah Hassan، Soliman, Hassan Hussin Al Sayed(Super)
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الملخص العربى

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ملخص الرسالة

إن إدارة شبكات الحاسب أصبحت هذه الأيام من الأمور المهمة جدا نظرا لزيادة حجم الشبكات وتعدد مهام عناصرها المختلفة. وفى هذه الرسالة تمت دراسة الطرق المختلفة لإدارة شبكات الحاسب والبروتوكولات الشائعة الإستخدام مثل بروتوكول SNMP. كما تطرقت الرسالة للمشاكل التى تحدث فى إدارة الشبكات وقدمت دراسة لإستخدام تكنولوجيا Mobile Agent فى إدارة الشبكات, والتى يمكنها أن تلعب دوراً هاما فى اللامركزية فى إدارة الشبكات والتى تعد بمعالجة مشاكل المركزية فى إدارة الشبكات والمتعلقة بعدم كفاءتها عند زيادة حجم الشبكات التى تديرها. وكذلك قدمت دراسة لأحدث بروتوكول إدارة شبكات تم اعتماده من قبل فريق المهام الهندسى (IETF) ويدعى بروتوكول NETCONF, ونظرا لشيوع إستخدام بروتوكول SNMP فى إدارة الشبكات فقد استخدم فى هذه الرسالة كنقطة مرجعية لمقارنة أداءه بالنسبة لأداء كل من بروتوكولNETCONF و تكنولوجيا Mobile Agent وذلك فى حالة مراقبة أداء الشبكات.

أولا: لمقارنة أداء كل من بروتوكولى NETCONF وSNMP فقد تم اختيار التطبيق المناسب لكل بروتوكول وتشغيله وذلك فى بيئة نظام تشغيل Linux حيث تم مردود كل منهما بقياس استخدامهما للشبكة Network usage وكذلك الزمن الإجمالى المطلوب لكلٍ منهما لجلب البيانات من أجهزة الشبكات تحت المراقبة.

وقد أظهرت النتائج التى تم الحصول عليها أن بروتوكول NETCONF أكثر فاعلية من بروتوكول SNMP وذلك من حيث سرعة جلب البيانات من الأجهزة الموجودة بالشبكة (عملية واحدة لاسترداد كميات كبيرة من البيانات). ولكن بروتوكول SNMP أكثر فاعلية من بروتوكول NETCONF من حيث إستخدام الشبكة Network usage. ولتحسين أداء بروتوكول NETCONF تم إقتراح دمج استخدام تطبيق Cluster Secure Shell (CSSH) إلى جانب تطبيق NETCONF. وأظهرت النتائج تحسن أداء بروتوكول NETCONF ليصبح أكثر فعالية من بروتوكول SNMP.

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ثانياً: لتقييم أداء Mobile Agent فى مراقبة أداء الشبكات, فقد تم تنفيذ وتشغيل ثلاثة سيناريوهات بالإستعانه بى SNMP4J library وذلك نظرا لعدم وجود التطبيق المناسب لاستخدام Mobile Agent لمراقبة أداء الشبكات حتى وقتنا هذا, وتم التشغيل فى بيئة نظام تشغيل الويندوز xp, حيث تم مردود كل من الثلاثه سيناريوهات الخاصة بى Mobile Agent و بروتوكول SNMP بقياس استخدامهما للشبكة Network usage وكذلك الزمن الإجمالى المطلوب لكلٍ منهما لجلب البيانات من أجهزة الشبكات تحت المراقبة.

وقد أظهرت النتائج التى تم الحصول عليها أن مراقبة أداء الشبكات باستخدام عدد من Mobile Agents يتم تنفيذهم على التوازى, كل Mobile Agent يحمل state data فقط ويتوقف عددها على عدد الأجهزة بالشبكة تحت المراقبة, علاوة على استخدام Java gzip utility لضغط البيانات انها اكثر فاعلية من استخدام بروتوكول SNMP التقليدى.

هذه الرسالة تم تنظيمها على النحو التالى:-

الفصل الأول:- مقدمة

مقدمة عامة عن الرسالة, وعرض عام لأهداف ومحتوى الرسالة.

الفصل الثانى:- طرق إدارة شبكات الحاسب

يتم فيه وصف ثلاث طرق رئيسية لإدارة شبكات الحاسب, ويناقش بروتوكولات إدارة الشبكات مثل: CLI, SNMP, and NETCONF

الفصل الثالث:- اللامركزية في إدارة شبكات الحاسب

يتم فيه تقديم دراسة عن استخدام تكنولوجيا Mobile Agent فى إدارة شبكات الحاسب, ووصف لتصميم Mobile Agent وكيفية تطبيقه لإدارة شبكات الحاسب بالتفصيل.

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الفصل الرابع:- تصميم نظام إدارة الشبكات NETCONFوتنفيذه

يتم فيه وصف التصميم العام لنظام إدارة شبكات الحاسب NETCONF والتطبيق المستخدم لتنفيذ وتشغيل هذا النظام.

الفصل الخامس:- مقارنة الأداء بين بروتوكولى SNMP and NETCONF

يتم فيه عرض و شرح التجارب المستخدمة لمقارنة الأداء بين بروتكول إدارة الشبكات SNMP و NETCONF وذلك فى حالة مراقبة أداء الشبكات, واستخلاص النتائج.

الفصل السادس:- تقييم أداء Mobile Agent فى مراقبة أداء الشبكات

يتم فيه عرض وتنفيذ ثلاثة سيناريوهات لأستخدام تكنولوجيا Mobile Agent فى مراقبة أداء الشبكات وتقييم أدائهم بالمقارنه بأداء بروتوكول SNMP, واستخلاص النتائج.

الفصل السابع:- النتائج والعمل المستقبلي

يتم فيه عرض الأستنتاجات النهائيه من البحث وما يمكن تقديمه لاحقاً من أفكار تكميلية.

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Abstract

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In this thesis, a test-lab setup using open source implementations of SNMP and NETCONF on machines running Linux environment has been installed. The following aspects are examined: Network usage, Round Trip Delay Time. The results showed that NETCONF is more effective than SNMP in terms of speed to retrieve data from the existing managed objects of the network (a single process to retrieve large amounts of data). But SNMP is more effective than NETCONF in terms of Network usage.

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Finally, a methodology to improve the performance of the NETCONF protocol, by including Cluster Secure Shell (CSSH) to the implementation, is proposed and implemented. Moreover, a large reduction of network usage is achievable through using a data compression technique to reduce the size of the XML-encoded data. The results showed that the performance of NETCONF becomes more effective than SNMP.

Also, a test-lab setup using SNMP4J library that is fully implemented in java language on machines running windows xp environment has been installed. As there is no standard implementation of Mobile Agent-based network monitoring at the moment, in this thesis, three variations of Mobile Agent-based network monitoring scenarios have been performed and several measurements have been taken and evaluated. The following aspects are examined: Network usage, Round Trip Delay Time. The results showed that Monitoring based on the parallel execution of multiple MAs, each Mobile Agent carries its state only. where the MA's state information is compressed (using the Java gzip utility) before being transferred to the next destination host, presents better scalability as monitored devices are separated in 'virtual' managed domains, each managed by separate MA objects collecting management data in parallel.

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In this chapter, several tests (SNMP-based network monitoring and three variations of Mobile Agent-based network monitoring scenarios) have been performed and several measurements have been taken and evaluated.

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This chapter contains a summary of what has been achieved in this thesis with the presentation of the results derived from them and the most important proposal for future work.

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Mansoura University
Faculty of Engineering
Electronics & Communications
Engineering Department

Computer Network Management Systems

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By

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Dr. Ahmed Abdullah Hassan Mohamed

Lecturer at the – Dept. of Electronics and Communications Engineering- Faculty of Engineering, Mansoura University

2012

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Research Title: Computer Network Management Systems

Researcher Name: Gamal Nabil Fatehy El-Hayatmy

Scientific Degree: M.Sc.

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Gamal El-Hayatmy

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This chapter contains a summary of what has been achieved in this thesis with the presentation of the results derived from them and the most important proposal for future work.

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List of Abbreviations

Abbreviation	Details
AES	Advanced Encryption Standard
API	Application Programming Interface
ASN.1	Abstract Syntax Notation version .1
ATM	Asynchronous Transfer Mode
BEEP	Blocks Extensible Exchange Protocol
BER	Basic Encoding Rules
BGP	Border Gateway Protocol
CLI	Command Line Interface
CSSH	Cluster Secure Shell
DES	Data Encryption Standard
EIGRP	Enhanced Interior Gateway Routing Protocol
FCAPS	Fault, Configuration, Accounting, Performance, Security
GUI	Graphical User Interface
IAB	Internet Architecture Board
IETF	Internet Engineering Task Force
IP	Internet Protocol
IRTF	Internet Research Task Force
ISDN	Integrated Services Digital Network
ISM	Itinerary Scheduler Module
ISO	International Standardization Organization
ITU-T	International Telecommunications Unions-Telecommunications Standardization Sector
JVM	Java Virtual Machine
KBytes	KiloBytes
MA	Mobile Agent
MAP	Mobile Agent Platform

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Abbreviation	Details
MbD	Management by Delegation
MD5	Message-Digest algorithm 5
MIB	Management Information Base
mSec	milliSecond
NETCONF	NETWORK CONFIGURATION
NMS	Network Management Station
NOC	Network Operations Center
ntop	network traffic probe
OID	Object Identifier
OMG	Object Management Group
OSI	Open Systems Interconnection
OSPF	Open Shortest Path First
PDU	Protocol Data Unit
RFC	Request For Comments
RMON	Remote Monitoring
RPC	Remote Procedure Calling
RTT	Round Trip Time
SHA	Secure Hash Algorithm
SMI	Structure of Management Information
SNMP	Simple Network Management Protocol
SOAP	Simple Object Access Protocol
SSH	Secure Shell
TCP	Transmission Control Protocol
tunctl	tunnel control
VLAN	Virtual Local Area Network
VPN	Virtual private network
UDP	User Datagram Protocol
URI	Uniform Resource Identifier

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Abbreviation	Details
W3C	World Wide Web Consortium
XCMS	XML-Based Configuration Management System
XML	Extensible Markup Language
Xpath	XML path Language
YANG	Yet Another Next Generation
YUMA	YANG-Based Unified Modular Automation

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Chapter One

Introduction

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1 Introduction

1.1. Background

Ever since the introduction of computer networks, there has been an interest in management functionality. In the early days of computer networks simple applications such as ping and trace route were sufficient to find congestions in the network for instance. But as the complexity of networks rises and networks become more and more interconnected, the need for more complex management functionality is also growing. Operating a large communication network requires, tools to assist in the configuration, monitoring, and troubleshooting of network elements such as switches, routers, or firewalls. In addition, it is necessary to collect event reports to identify and track failures or to provide a log of network activities. Finally, it is necessary to collect measurement data for network planning and billing purposes.

1.1.1. What Is Network Management?

The International Standardization Organization (ISO), the organization that gave us the well-known 7-layer ISO reference model, has also created a network management model, specifies five functional areas for managing networks, known as FCAPS model [1]:

- **Performance Management.** The goal of performance management is to quantify, measure, report, analyze and control the performance (for

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