Proceedings
NASM'2005

The First International Workshop on Network Architecture and Service Models

Editors

Chai Keong Toh
Xiangyang Xue
Xin Wang

November 22-24, 2005
Fudan University
Shanghai, China

Sponsored by

British Computer Society (BCS)
Chinese Institute of Electronics (CIE)
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Chai Keong Toh Xiangyang Xue Xin Wang

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FOREWORD

The proceedings contain the revised manuscripts of the contributed presentations at the first International Workshop on Network Architecture and Service Models (NASM'2005) held in Shanghai, China, on November 22-24, 2005.

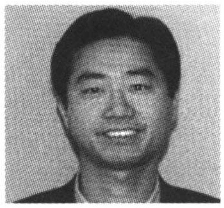
The workshop provided an international forum for scientists, engineers, and students to exchange and share their experiences, new ideas, and research results about next generation networks (NGN), ad hoc mobile networks, wireless sensor networks, and P2P networks.

In 2005, we just printed a temporary proceedings edition for exchange purpose at the workshop because of insufficient prophase preparation. According to the requirement of Fudan University Press, the workshop committee asked the authors to revise the manuscripts again. We also edited the papers which have not been revised by their authors. During the course, one author withdrew his submission in the formal proceedings. Finally, the formal proceedings include 37 high-quality papers.

The organizers would like to acknowledge all the authors for their contributions to the workshop and are thankful to all the members of the Technical Program Committee for their hard and competent work.

NASM'2005

November 2006



General Chair 's Message

As General Chair, it is my pleasure to welcome you to NASM'2005 - The first International Workshop on Network Architectures and Services. This workshop was founded as a result of close collaboration between Fudan University and Queen Mary College London. It is our intention to make this an international event and we warmly welcome you here in Shanghai.

It is our honor to have Professor Wu and Professor Fan to serve as our honorary chairs. We are also delighted and thankful to our keynote speakers, who have gracefully agreed to present and support our workshop.

With advances in communications, wireless, and networking technologies, the world is shrinking and globalization is happening. A workshop on next generation architectures and service models is absolutely necessary to reflect, address, and discuss the evolution, research advances, challenges, and the current state-of-the-art. We have lined up a comprehensive technical program for which I am sure you will enjoy and benefit from it. Thanks to Professor Xue, our technical program chair, for preparing an excellent technical program.

This workshop is jointly hosted by Fudan University and Queen Mary College London. I am grateful to Fudan University and the Department of Computer Science for agreeing to host this event within the university campus and for providing logistical support. Without their hard work and support on local arrangements, this workshop would not have been possible. In particular, Dr. Xin Wang deserves special mention on his contributions to local arrangements.

I am also thankful to IEEE Beijing Section, the Chinese Institute of Electronics, the IEE and the British Computer Society for agreeing to technically co-sponsor this workshop. With the support from all these professional societies, this workshop has really received its recognition and attention.

Finally, I would like to thank all authors and attendees for participating in this workshop. I hope you will have an enjoyable learning experience at the workshop and an enjoyable and memorable stay here in Shanghai.

Yours Sincerely,

C K Toh

Professor C K Toh, FIEE, FBCS, FNZCS, FHKIE
General Chair, NASM'2005

Technical Program Chair's Message

The first International Workshop on Network Architecture and Service Models (NASM'2005) provides an international forum for scientists, engineers, and students to exchange and share their experiences, new ideas, and research results about next generation networks, ad hoc mobile networks, wireless sensor networks, and P2P networks, etc.

There were a total of 92 paper submissions not only from Asia Pacific countries but also the European and the North American countries. The papers were submitted from the countries and regions as following: Australia—4, Canada—1, France—1, Germany—1, India—1, Iran—1, Japan—2, Korea—14, Netherlands—1, UK—1, USA—1, China Hongkong—6, China Mainland—58 (23 universities or institutes). All of the submitted papers were distributed to both the Technical Program Committee members, domestic and international reviewers for the purpose of obtaining at least three reviewers' comments.

According to TPC and reviewers' hard work, we decided to accept 42 papers. In these papers, well-conceived new ideas, concepts, and results were offered and well presented. Finally, the workshop acknowledged 38 paper registrations.

In addition to a top-notch paper program, we are also fortunate to have three keynote sessions by Prof. Jiangxing Wu (Academician of Chinese Academy of Engineering, NDSC, China), Prof. Teruo Higashino (PhD, FIPSJ, Professor in Computer Science, University of Osaka, Japan) and Prof. Victor O.K. Li (PhD MIT, FIEEE, Chair Professor in Information Engineering, The University of Hong Kong, China), respectively. We believe that you will find these keynote speeches of special interest in addition to paper sessions.

The technical program for NASM'2005 is the result of the hard and excellent work of many authors, reviewers, and TPC members. We are very grateful for everyone's effort.

The three-day conference is part of Fudan University's centenary celebrations. We thank you for your attendance at NASM'2005 and we hope that you will find these three days well spent in Shanghai.

Xiangyang Xue

Xiangyang Xue, Professor of Fudan University, China
Technical Program Chair, NASM'2005

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Architecture of Next Generation Wired Networks

Chairperson

Prof. Binqiang Wang

National Digital Switching Center (NDSC), China

A Secure Complicated Information System Architecture Model

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Abstract: This paper presents a secure complicated information system (CIS) architecture model to conduct the construction or reconstruction of CIS. Through layered method, the model divides CIS into modules and reduces system complexity. Web service is adopted to fulfill the interoperability and extensibility. It uses Encryption Support Layer, Security Protection and Reliability Support Layer to guarantee the system security and stability. It uses System Management Layer to make CIS administrable. This model is apt to highly security-critical environment such as government, military and bank.

Keywords: network security; system architecture model; e-government; interoperability; extensibility.

1 INTRODUCTION

In this paper, complicated information system (CIS) refers to system that contains many inhomogeneous applications. Different applications are not able to effectively share information, which results in the waste of information. So, various applications have to build their own database to store even the same information. This always induces inconsistent data. Since applications often need to be modified according to the changed demands, it is necessary for applications to be well designed to make them extensible. Security is another important problem in CIS. Although many researchers are studying information system, most of the researches are focused on relative simple information system [2], [5], [6], [7], [8], [9], [10], [11]. These information system architectures usually focus on a simple background. They often aim to solve some specific problems in a certain application environment, which often omits interoperability and lacks of extensibility. In addition, these architectures usually are not secure and stable enough to protect against hackers and hostile countries. But for CIS, we need a flexible and extensible general architecture to control the system designing, developing, utilizing and maintenance process.

For historical reasons, many applications in a certain e-government system were built by various enterprises, which results in an inhomogeneous system and the weakness of security, interoperability and extensibility. As a key project of the 10th Five Year High-Tech Research and Development Plan of China, it is urgent to reconstruct the system. In addition, it is expected that experience from this E-government Experimental and Demonstration Project (EEDP) can assist to work out the national e-government criterions and guide other e-government constructions. We presented a Secure CIS Architecture Model (SCISAM). Guided by the model, EEDP has achieved its construction. Based on this model, China has released two national criterions: the national e-government application support platform criterion, and the national e-government security support platform criterion.

2 ANALYSIS OF CIS

Usually CIS involves lots of business application systems (BAS). The essence of CIS is sharing of information. On the other hand, with the changing of business processes, it is necessary to modify BASs to fit the changed demands. In order to realize the interoperability and extensibility, a powerful general support platform is necessary. This includes many standards, e.g. communication protocols, data exchange standards, security protocols.

CIS usually contains sensitive information. To make CIS secure and stable, we mainly focus on the microcosmic analysis of security threats at various levels in the following:

- Physical level security threat. Here physical level refers to all involved buildings, communication links and devices. It is the precondition of system security.
- Network level security threat. Network is a main approach to information system. Too many security problems occur in this layer.
- Application level security threat. Diverse security threats at this level make security problems much complex, for example design faults of applications.
- System level security threat, which mainly refer to operating system security and its failed configuration.
- Management level security threat. Management level includes management over network devices, applications, users. Besides technologies, perfect management rules are also important [3], [4].

In the aspects of security, CIS involves people, technologies and operations. The target of the comprehensive defence strategy is to make all the three factors under control.

3 SECURE CIS ARCHITECTURE MODEL

We present a secure CIS architecture model. It contains many components, which are indicated in figure 1.

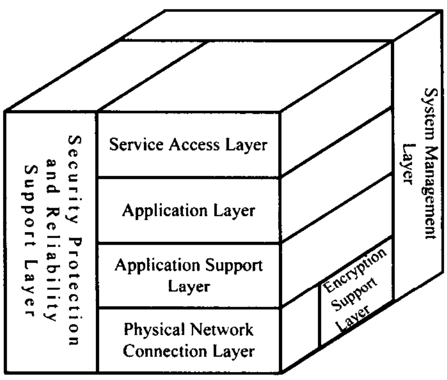

Figure 1 *Secure CIS architecture model.*

3.1 Physical Network Connection Layer

PNCL is the transform and exchange hardware platform of CIS. According to the analysis of security threats in physical and network levels, relative national security standards should be fulfilled to protect system environment and devices [1]. PNCL contains unauthentic network, trusted network and secret-related network. Unauthentic network refers to Internet or other public information network. It should be isolated from trusted network through logical isolation devices such as firewall or authentication gateway. Trusted and secret-related networks run applications of CIS. PKI and PMI can be adopted to build trust domain in trusted network to protect the network. According to Chinese national rules, national secret-related network must be physically isolated from Internet or other public information networks. While for the sake of exchanging information between trusted network and secret-related network, we can use physical isolation devices such as physical isolation adaptor or switch. When using physical isolation, the secret level of information must be identified accurately. Loose secret level results in low security. Whereas, strict secret level leads to bad interoperability [12].

3.2 Encryption Support Layer

Only depending on technologies such as firewall, IDS, antivirus system are far from enough to meet the system security demands. ESL provides essential encryption services to realize confidentiality, integrality, non-repudiation, access control, etc. ESL comprises encryption service, directory service, key management, timestamp service, authentication service, privilege management.

ESL is the security core of CIS. Any other layers in the model could use services provided by this layer directly. Furthermore, through ASL and AL, these services also can be utilized indirectly, which is a recommended method.

3.3 Application Support Layer

ASL locates upon ESL. Based on ESL and web service, ASL securely provides common business application services to AL, SML and SPRSL. This efficiently speeds up the design, development and deploy of BASs. Different CIS differs greatly in ASL. In EEDP, ASL contains information exchange service, secure email service, secure message service, GIS support service, secure audit service, etc.

3.4 Application Layer

AL is located at the top of ASL. It uses services provided by ASL or ESL. Diverse BASs run in this layer and provide services through SAL. In EEDP, there are BASs such as archive management system, decision support system, etc.

3.5 Service Access Layer

SAL is the only passage for information exchange between outside and CIS. Through SAL, outside users use services provided by BASs in AL. Usually SAL authenticates and assigns relative privilege to users in the first place.

3.6 Security Protection and Reliability Support Layer

Different from ESL, SPRSL focuses on basic protection and reliability support. While ESL focuses on encryption services. SPRSL includes firewall, IDS, system scanning, audit system, antivirus system, etc. They fight against network, application and system level security threats. Reliability support provides fault and disaster recovery. Fault recovery is performed using redundancy hot standby clusters at critical points. When fatal fault or disaster happens, BASs can be quickly switched to local or remote backup center to assure that the system will function all the time. SPRSL needs to function in every involved layer in SCISAM. For low security level systems, this layer may be properly simplified according to their actual requirements.

3.7 System Management Layer

SML manages not only buildings, networks and BASs, but also personnel. It permeates into all layers in the model. SML involves the management of network configuration, security, accounting, etc.

4 MODEL ANALYSIS

SCISAM provides a general framework for the construction or reconstruction of CIS. To make system secure enough, we must emphasize that proper security policies should be worked out at every layer during project implementation. E.g. in PNCL, factors such as network topology, proper redundancy are quite crucial. In ESL, we should select proper encryption, devices and protocols. In SML, perfect policies and rules for system and personnel management are important too. System such as firewall, IDS, system scanner, audit system, antivirus system should also be properly deployed and configured. BASs may possess different security level. Using various security level encryption technologies, incorporating with SPRSL, SCISAM makes CIS under relative secure condition.

Using web service technology in layers of SCISAM, the model makes BASs extensible and interoperable. Web service contains simple object access protocol (SOAP), web services description language (WSDL), universal description, discovery and integration (UDDI). Helped by these protocols, developers are able to divide applications into modules, and select their preferred programming language and suited platform to develop and deploy web based, distributed applications. Furthermore, all these applications meet the demand of interoperability. Based on the web service technology, developers are capable of designing compatible applications more conveniently. When the system demands changes, it is also very easy to modify and redeploy the applications according to the changed demands, which makes the system extensible.

Through layered method and web service technology, we can divide CIS and business application systems into smaller function modules. Due to the sharing of common application components, we can efficiently reduce the investment of system development and maintenance. This method is also beneficial to limit the occurrence area of potential faults and to locate and solve the faults. In a word, SCISAM can decrease the implementation complexity of CIS and help to analyze, design, develop and deploy CIS more conveniently, which makes the model feasible.

5 INSTANCE OF EEDP

A certain government has five classes of e-government sub systems: duty and conference management system, document management system, government information management system, decision support system, public service system. Each class of sub system includes some e-government affair applications. There are more than forty applications in the CIS need to be reconstructed or constructed all together. These applications will be distributed in more than twenty buildings. Through 1000Mbps Ethernet, about 1500 computers are connected and form the network environment. EEDP is reconstructed under the guidance of SCISAM to make the system secure, extensible and interoperable.

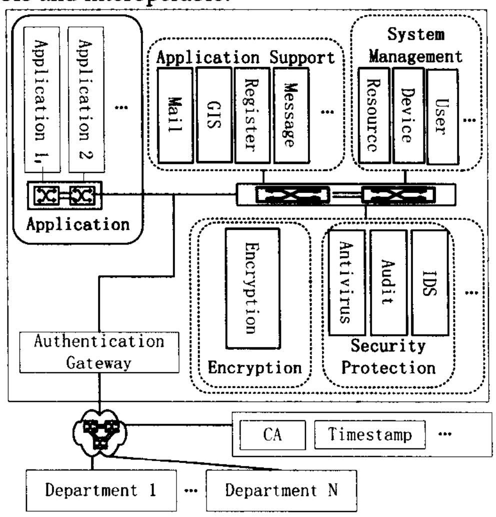

Figure 2 *A simplified part of inner network layout in EEDP.*

Figure 2 shows the simplified part of EEDP. Through the request of PNCL, this CIS enforce relative national information system rules to keep physical security. And most part of the network is physically isolated from Internet. This CIS uses ESL to provide common encryption services to other layers, for example ASL. According to different department, using authentication gateways, the e-government system is divided into many sub networks. Through SPRSL, security systems such as IDS, antivirus system and audit system are widely deployed to protect against security risks at higher level. Redundancy hot standby clusters are deployed at critical points to protect against local fault, e.g. redundant main router and database server. Remote disaster recovery backup center is established to make the system possess the feature of continuous service even when disaster happens. Although there are many applications in the system, these applications usually contain some common components. They can be shared as common services, e.g. GIS service, secure mail service and so on. E-government affair applications are located in the AL layer. Encryption technologies are employed in almost all important applications. Together with technology measures, necessary rules and regulations make the system controllable. All layers cooperate to achieve diverse e-government applications. EEDP meets the demands of security, interoperability and extensibility.

For the particularity of this system, security and stable are the top important things. So we have to take measures to achieve this target. On the other hand, we hope the security measures will not interfere with the application performance. Therefore further performance study is necessary. Nearly all these applications need database support. Although there are more than forty applications in the system, most of them are based on browser/server architecture. This means most of the applications use HTTP protocol. Email is another important application in the network. Still there are some file transfer traffics in the system. That is, database application, HTTP, Email and FTP are the main network traffics in this system. We need assure that applications that use these network traffics will not response too slowly. We put some probes at the source and destination of network connections and capture network traffic at 9:00-11:00 AM (the busiest time). Figure 3 shows the statistics. The average database query response time is about 0.0003s. When send and receive Email, the average response time is about 0.0016s and 0.0024s, respectively. The average HTTP page response time is about 0.0027s. And the average FTP download and upload time are the same: about 0.0018s. Form the above statistics, we know that the CIS is able to satisfy the performance request of applications.

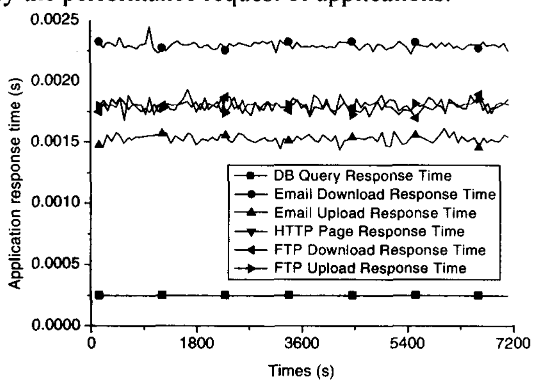

Figure 3 *Application response time.*

6 CONCLUSION

According to the requests of an E-government Experimental and Demonstration Project of China, this paper presented a secure CIS architecture model. Conducted by the model, EEDP has been successfully constructed over one year. SCISAM meets the features of security, interoperability and extensibility and can be used as a framework to guide the construction or reconstruction of CIS. Based on the model, China has approved the national e-government application support platform criterion and e-government security support platform criterion. The model can be adapted to highly security-critical CIS such as government, military and bank. Been properly simplified, SCISAM suits relative simple information system too.

ACKNOWLEDGEMENT

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