財團法人台灣網路資訊中心因公出國人員報告書

103 年 11 月 10 日

報告人 姓　名	蔡更達	服務單位及職稱	IP 組工程師
出國期間	103 年 10 月 22 日 至 103 年 10 月 26 日	出國地點	泰國曼谷
出國事由	報告書內容應包含： 一、出國目的 二、考察、訪問過程 三、考察、訪問心得 四、建議意見 五、其他相關事項或資料 （內容超出一頁時，可由下頁寫起）		
授權聲明欄	本出國報告書同意貴中心有權重製發行供相關研發目的之公開利用。 授權人：　　（簽章）		

附一、請以「A4」大小紙張，橫式編排。出國人員有數人者，依會議類別或考察項目，彙整提出報告。

註二、請於授權聲明欄簽章，授權本中心重製發行公開利用。

一、出國目的

TENCON 是 IEEE Region 10(也被稱為亞太地區，IEEE 的最大的區域組織之一)的頂級國際技術會議。自 1980 年以來每年舉行一次，TENCON 做為一個全球性的重要論壇會議，讓研究人員和來自各行業的工程師，教授和研究生，從學術界到網路，並在電氣和電子工程，計算機科學及相關領域的新興領域，討論新的思路和發展。

2014 年度 IEEE 亞太區會議(TENCON 2014)於 2014 年 10 月 22 日至 25 日在泰國曼谷舉辦。會議匯集來自世界各地的專家學者及工程師共同研討信號處理、通訊網路和計算領域的新理論、技術和應用，並進行大會報告、專題學術報告及各種新技術討論與交流。

二、考察、訪問過程

此次研討會安排了許多論文發表的場次以及大會所規劃特別主題的專題演講， 大會海報照片請見圖一：

10 月 22 日至 25 日論文發表議程中，大會特地於 23-24 日上午場次邀請國際專家學者做專題演講，其餘為投稿論文發表的場次，所有報告都以英文進行簡報， 會議議程內容如下：

TENCON2014 Technical Program (22-25 October 2014)

22 October 2014 (Wed)

Registration, Tutorials, R10 Events

Oral sessions (parallel sessions)

Welcome Reception (at the hotel)

23 October 2014 (Thurs)

Opening Ceremony

Keynote Speakers (1,2)

Oral sessions (parallel sessions)

Banquet (at the hotel)

24 October 2014 (Fri)

Keynote speakers (3,4)

Oral sessions (parallel sessions)

Free, individual

25 October 2014 (Sat)

Oral sessions, Poster sessions

三、考察、訪問心得

本次會議中，由本中心蔡更達工程師出席於 IPv6 Networks and Services Session 代表報告一篇 IPv6 論文，題目為 Building an IPv6 Upgrade Model Based Upon Cost-Effective Strategies，內容詳如附件一，時間安排在 10 月 23 日下午的時段，此 Session 由 Prof. Sinchai Kamolphiwong Prince of Songkla University President, IPv6 Forum Thailand 擔任主席，並由暨南大學吳坤熹副教授擔任 co-chair，該 Session 之全部發表論文如下：

Technical Program IEEE TENCON-2014 (22-25 October 2014, Bangkok, Thailand)

Thursday, 23 October 2014

Session	PID	IPv6 Networks and Services	Presenter
15:00-15:20	PID356	DYNAMIC ASSIGNMENT OF IPV6 ADDRESS WITH EMBEDDED SERVER ROLE INFORMATION FOR UNIFIED SERVICES AND DEVICES DISCOVERY	Aun,Yichiet, USM Malaysia
15:20-15:40	PID452	On-line Evalution System for Examining Website Content Consistency between IPv4 and IPv6	Fan-Hsun Tseng, National IlanU. Taiwan
15:40-16:00	PID459	Design and Deployment of IPv6 Address management System on Research networks	Sunyoung Han, Konkuk U. South Korea
16:00-16:20	PID460	OpenFlow-based IPv6 Rapid Deployment Mechanism	Quincy Wu,

			National Chi-Nan U. Taiwan
16:20-16:40	PID464	Building an IPv6 Upgrade Model Based Upon Cost-Effective_Strategies	Geng-Da Tsai, TWNIC Taiwan
16:40-17:00	PID482	Performance of Intra and Inter communications of IPv4-in-IPv6 Tunneling Mechanisms	Napat Chuangchunsong, PSU Thailand
17:00-17:20	PID484	An IPv6 Network Congestion Measurement Based on Network Time Protocol	Itarun Pitimon RMUT, Thanyaburi Thailand

圖二、Chair Prof. Sinchai Kamolphiwong 主持論文發表場次

圖三、Co-chair 吳坤熹副教授協助 Malaysia 以錄影方式發表論文

圖四、蔡更達工程師出席代表報告 Building an IPv6 Upgrade Model Based Upon Cost-Effective Strategies

論文發表的每一篇論文報告時間為 20 分鐘，並由主持主持，接受大家的提問。

第一位馬來西亞 Aun,Yichiet 之報告 DYNAMIC ASSIGNMENT OF IPV6 ADDRESS WITH EMBEDDED SERVER ROLE INFORMATION FOR UNIFIED SERVICES AND DEVICES DISCOVERY 因為有要事無法前來，所以用錄影方式替代報告，內容主要是提出 IPv6 動態位址配發時，可以嵌入 server 的角色及設備等相關資訊，以便進行管理。

第二位台灣宜蘭大學曾繁勛報告 On-line Evalution System for Examining Website Content Consistency between IPv4 and IPv6，主要是因為目前升級 IPv6 網站愈來愈多，如何在升級的過程中，檢查 IPv6 網站與 IPv4 內容的一致性，提出一套檢查與量測的方式，並進行實際測試與相關探討。

第三位暨南大學吳坤熹副教授報告 OpenFlow-based IPv6 Rapid Deployment Mechanism，提出以 OpenFlow-based 之技術可以協助 ISP 快速導入 IPv6 並可加強相關之安全性。

第四位 TWNIC 蔡更達工程師報告 Building an IPv6 Upgrade Model Based Upon Cost-Effective_Strategies，政府為跨越百年，迎接新世代，實現民眾享有運用網際網路之福祉，行政院於 2011/12/30 日核定通過「網際網路通訊協定升級推動方案」，以「網路服務無縫隙，智慧

創新樂生活」為願景，推動政府優先進行 IPv6 網路升級，並政策性推動 IPv6 產業的發展，以帶動民營業界的發展動能，訂定了 4 年完成政府對外服務升級 IPv6 之時程，TWNIC 做為執行作業組，擔任實際協助各政府機關升級對外服務之角色，並提出相關升級策略，分為 2 個階段，並提出相關步驟(詳見附件一)，如組織 16 路顧問群，就近協助全國政府機關實際升級作業，於 2013 年底就超前預計進度，協助全國 67%(原預訂 50%)之政府機關對外服務升級 IPv6，並將過程記錄整理進行報告。

第五位講者泰國 Napat Chuangchunsong,
PSU 報告 Performance of Intra and Inter communications of IPv4-in-IPv6 Tunneling Mechanisms，內容主要是分析比較各種不同的 IPv6 Tunnel 技術，並以實驗方式，認為 Lightweight 4over6(lw4over6)在 http 協定運作效能頗佳。

第六位講者泰國 Itarun Pitimon RMUT, Thanyaburi 報告 An IPv6 Network Congestion Measurement Based on Network Time Protocol，內容主要提出一般以 ICMP 做為量測網路擁擠(Network Congestion)程度之缺點，並提出以 NTP(Network Time Protocol)做為量測網路擁擠之方法。

本次會議有許多國際專家學者都出席參加，藉此機會互相觀摩討論與學習。

四、建議事項
(一) 藉由參加此國際研討會議與來自各國的教授及專家互相面對面的交流，建立彼此相互合作的機會，也了解各國對於 IPv6 的研究與應用狀況，對於未來 IPv6 的推動有很大的幫助。
(二) IPv6 已由早期的小量互連測試進入實際使用及應用的階段，產、官、學、研各領域也都開始佈署與使用 IPv6，除了國內應多舉辦 IPv6 相關研討會，也建議多多參加國外各種相關研討會，以即時了解國際之 IPv6 之應用與發展。

附件一：

Building an IPv6 Upgrade Model Based Upon Cost-Effective Strategies

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***Abstract*—While confronting the global IPv4 address exhaustion, it is important and crucial for the entire Internet environment to smoothly upgrade to the next generation Internet Protocol, IPv6. Due to the budget constraints, different organizations should decide the priority of the IPv6 upgrade among all the provided services according to the degree of the necessity and the difficulty of the upgrade. Our idea is firstly to upgrade external network services of governmental agencies as the driving force of the upgrade in the country and secondly to use cost-effective and adaptive strategies to have a seamless transition. Therefore, in this study, we proposed a two-stage IPv6 upgrade model to progressively execute the IPv6 upgrade according to the defined priorities of the services of the governmental organization. The first one, service-based survey stage, is to find the difficulty and problems of the IPv6 deployment using a small-scale trial survey to a full-scale survey strategy. The second one, the adaptive upgrade stage, is to provide the adaptive upgrade support or solution for different services according to the corresponding survey results. Besides, 16 IPv6 supporting teams consisting of 40 university professors and experts have been formed to help nearby organizations in the IPv6 upgrade. In this study, the proposed IPv6 upgrade model is successfully implemented on Taiwan Government Network Services. Using this model, we can cost-effectively handle the large number of network services in the IPv6 upgrade. Up to now, the upgrading rate is much higher than the original expected one to show the feasibility and effectiveness of this study.**

Keywords— IPv6 Upgrade Model, Service-Based Survey, Adaptive Upgrade, Cost-Effective Strategies

Introduction

While confronting the global IPv4 address exhaustion, it is important and crucial for the entire Internet environment to smoothly migrate to the next generation Internet Protocol, IPv6. [1] The last unassigned top-level address blocks of 16 million IPv4 addresses were allocated in February 2011 by the Internet Assigned Numbers Authority (IANA) to the five regional Internet registries (RIRs). Each RIR is expected to continue with standard address allocation policies until one /8 Classless Inter-Domain Routing (CIDR) block remains. After that, only blocks of 1024 addresses (/22) will be provided from the RIRs to a local Internet registry (LIR).

As of September 2012, both the Asia-Pacific Network Information Centre (APNIC) and the Réseaux IP Européens Network Coordination Centre (RIPE NCC) had applied the above policy.[2][3] IPv6 is intended to replace IPv4, which still carries the vast majority of Internet traffic as of 2013.[4] As of February 2014, the percentage of users reaching Google services over IPv6 surpassed 3% for the first time.[5] Many countries have been actively made the preparation for the IPv6 network. [6-12]

In Taiwan, the Executive Yuan approved the "IPv6 Upgrade Promotion Program" (IPv6 UP) on December 30th, 2011 to cope with the problem of the IPv4 exhaustion and to upgrade the Internet to IPv6. The "IPv6 UP Program Office" has been convening by the National Information and Communications Initiative (NICI) to promote this upgrade program in every government agency since January 30th, 2012. According to the schedule of <IPv6 UP> program, half of the main external services such as Governmental Service Network (GSN) infrastructure, DNS, Email, and critical international services will be upgraded to IPv6 by 2013, and the rest of the secondary external services will be upgraded by the end of 2015. How to efficiently promote the IPv6 upgrade to foster the development of IP network and relevant industries becomes an important issue.

When organizations plan to execute the IPv6 upgrade, different organizations should decide the priority of the IPv6 upgrade among all the provided services according to the degree of the upgrade necessity, the difficulty, and the annual budget of the software/hardware procurements.

Our idea is firstly to upgrade external network services of governmental agencies as the driving force of the upgrade in the country and secondly to use cost-effective strategies to have a seamless transition. Therefore, in this study, we proposed a two-stage IPv6 upgrade model to progressively

execute the IPv6 upgrade according to the defined priority of the governmental organization. The first one is service-based survey stage, which includes six steps. The second one is the adaptive upgrade stage, which includes four steps.

In the service-based survey stage, we proposed the strategy in the survey using a small-scale trial survey to a full-scale survey strategy to find the difficulty and problems of the IPv6 deployment. In the adaptive upgrade stage, providing the adaptive upgrade support or solution for different services according to the survey result is an important part. Hence, 16 IPv6 supporting teams consisting of 40 university professors and experts have been formed to help nearby organizations in the IPv6 upgrade.

In this study, the proposed IPv6 upgrade model is successfully implemented on Taiwan Government Network Services. Using this model, we can cost-effectively handle large numbers of network services in the IPv6 upgrade. Up to now, the upgrading rate is much higher than the original expected one to show the feasibility and effectiveness of this study.

IPv6 upgrade model

In this study, we proposed a two-stage IPv6 upgrade model to make the organization be able to progressively execute the IPv6 upgrade, as shown in Figure 1.

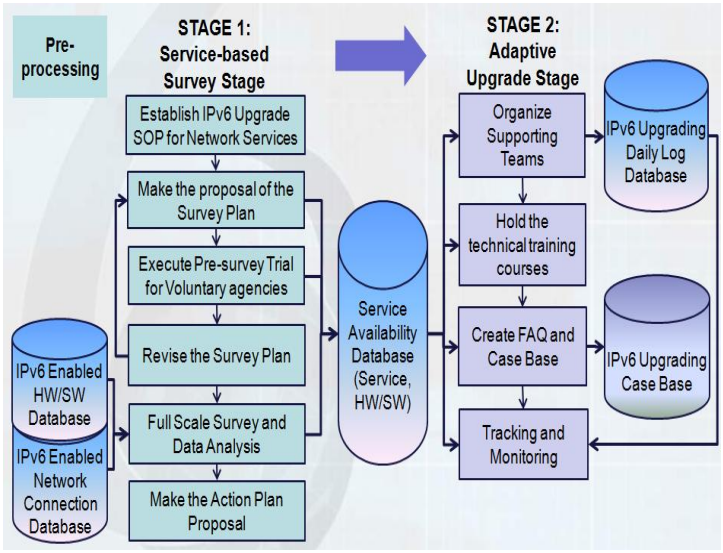

Fig. 1. IPv6 Upgrade Model

Firstly, two databases, IPv6 Enabled HW/SW and IPv6 Enabled Network Connection, are prepared in the pre-processing of the survey. The former contains the information of the name of the IPv6-enabled hardware/ software and their corresponding manufacturer and version. The latter contains the information of the network connection type and the supported ISP. These information will be used in the data analysis and diagnosis system to check the correctness of the surveyed data.

In the survey stage, we define and establish the Service Availability database, as shown in Figure 2, which will be used in the upgrade stage. In the upgrade stage, the IPv6 Upgrading Daily Log Database and IPv6 Upgrading Case base will be established to accumulate the upgrade experience.

Besides, we build the survey system with the Service Availability Database for data collection, data diagnosis, and service detection. The survey system collects the information of external services and their corresponding hardware and software in the Service Availability database. The data diagnosis system will analyze the correctness and consistency of the input data by the data comparison method between the property of the service type and the corresponding hardware/software using the above database.

In this study, we proposed a small-scale trial survey to a full-scale survey strategy in the survey stage. Using this strategy, we will easily find questions in filling out the surveyed data of the organization. The data fields of the Service Availability database can be appropriately modified for the full-scale survey.

Attribute	Data Type
Serial No	Integer
Service Type	{WEB, DNS, EMAIL, FTP, Other}
Service Name	String
Service URL	String
Manufacturer	String
Version	String
Expected Year for Upgrade	Integer
Administrator	String

(a) Service

Attribute	Data Type
Service Number	Integer
Device Number	Integer
Device Type	String
Manufacturer	String
Version	String
IPv6 Enabled	True or False
IPv6 Launched	True or False
Expected Year for Upgrade	Integer
Hardware Upgrade Solution	String
Software Upgrade Solution	String
Administrator	String

(b) Hardware and Software

Fig. 2. Attributes in the Service Availability database.

The six steps in the survey stage are preparation, launch, pre-survey trial, checking, survey, and summarization. These six steps provide the required preparation for the IPv6 upgrade. At the end of this stage, the organization can make the action plan proposal for the IPv6 upgrade based on the established service availability database.

In the adaptive upgrade stage, providing the adaptive upgrade support or solution for different services according to the corresponding survey results is an important part. 16 IPv6 supporting teams consisting 40 university professors and experts have been formed to help nearby organizations in the IPv6 upgrade. The four steps in upgrade stage are to organize supporting teams, to make technical training courses for IPv6 professional cultivation, to create FAQ and case base, and to execute progress tracking and monitoring. In this stage, the experience of the IPv6 upgrade in different organizations will be collected to be the IPv6 Upgrading Case base. The IPv6 Upgrading Daily Log Database is

reported by supporting teams and can be the reference of the IPv6 upgrade for different governmental organizations.

Survey Stage

In this study, we proposed the service-based survey as the first stage in the IPv6 upgrade model. When a network service is planned to be upgraded to IPv6, the network connection, the operating system of the device, and the application server all should be upgraded to IPv6. These works are generally undertaken by different people. To find out the related hardware/software in supporting a network service is an important issue. Hence, the principle of our strategy in this stage is to make the survey of external network service systems and the corresponding hardware/ software.

There are six steps in this service-based survey stage. These six steps can provide the required preparation for the IPv6 upgrade. The detail of the action plan in this stage is described in the following.

Step1. Preparation: We establish 5 standard operating procedures (SOPs) of IPv6 upgrade for DNS, WEB, Email, FTP, Network services. An example of SOP in the upgrade is shown in Figure 3. Besides, we establish survey data management system including the data acquisition authoring and on-line help tools. In this step, the technical trial is used to verify these SOPs.

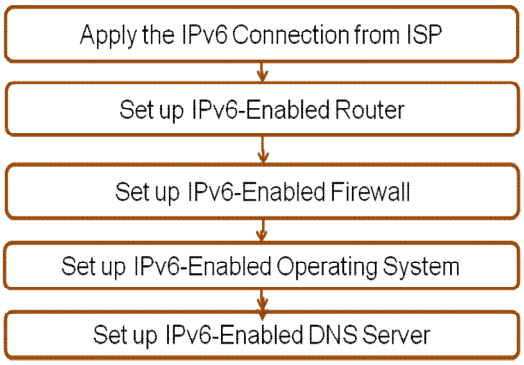

Fig. 3. A SOP in the upgrade of the DNS service

Step2. Launch: We make a proposal of IPv6 deployment survey plan for government agencies.

Step3. Pre-survey trial: A small scale trial survey is applied for 6 voluntary government agencies.

There are about 20% data of survey are faulty due to the lack of IPv6 knowledge or mistyping, so starting the survey from small scale trial is a good approach to find out the algorithm to solve the ill-conditioned data problems in advance. The workflow of the data analysis and diagnosis system is shown in Figure 4. This is used to find out the noisy data in the service availability database.

Step4. Checking: Revise the plan according to the feedback. This step is a technical training to test the upgrade proposal.

Step5. Survey: The full scale survey and the data analysis is applied in this step. There will be a large number of survey data in network services and their corresponding hardware/software.

Step6. Summarization: The summarized action plan proposal will be made in this step. Although the security and the budget allocation are the most concerned issues in the organization, all external services of the action plan proposal still are suggested to be upgraded in four years.

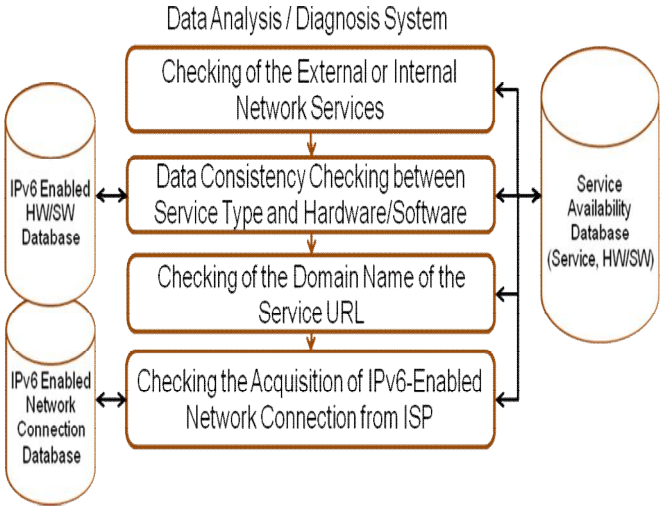

Fig. 4. Workflow of the Data Analysis and Diagnosis System.

Upgrade Stage

In this study, we proposed the adaptive upgrade in this stage that includes four steps. These steps focus on the user-oriented strategy. When the organizations begin to upgrade the network service based on the action plan proposal, they are requested to have the IPv6 upgrading knowledge and resource accordingly. These knowledge can be obtained either from the interview with the supporting experts or from the access of the IPv6 upgrading database, such as the IPv6 Enabled Hardware/Software, IPv6 Enabled Network Connection, Service Availability, and the IPv6 Upgrading Daily Log. Besides, the IPv6 upgrading FAQ and the IPv6 upgrading case base can provide the important information in the experience of the IPv6 upgrading. The supporting resource of the IPv6 upgrade for different organizations is shown in Figure 5.

The detail of the adaptive upgrade stage is described in the following.

Step1. Organize 16 supporting teams:

The supporting teams can provide the technical support for the upgrade of services. They also can help organizations to correct the survey data of services. Besides, they can take in charge in cleansing the survey data, building up the IPv6 upgrading daily log database, and IPv6 upgrading case base.

Step2. Technical training courses for IPv6 professional cultivation:

The IPv6 technical training is conducted for IPv6 professional cultivation in governmental organizations. Most of government IT staffs are happy to be involved in the IPv6 UP Program and eager for the technical supports and training.

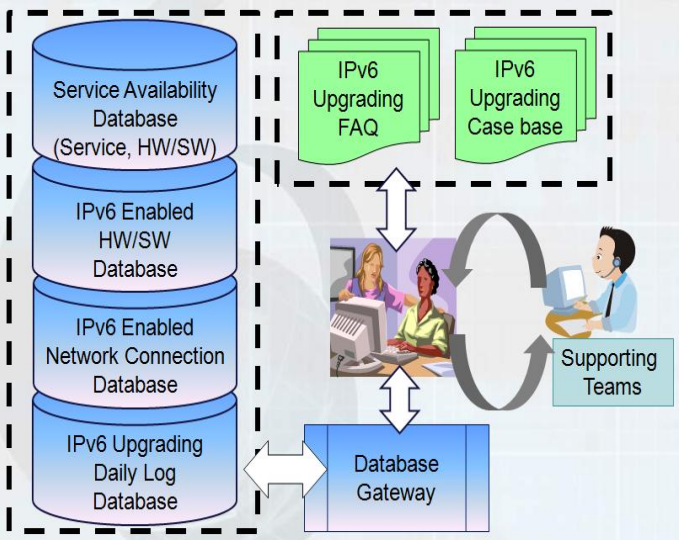

Fig. 5. Supporting resource of IPv6 upgrade for governmental organizations

Step3. Create FAQ and Case base:

The data standardization can be created in the IPv6 upgrade guide as a reference to the different organizations.

Step4. progress tracking and monitoring:

The upgrade progress will be tracked and monitored by the detecting system.

Experimental Results

In this study, the proposed IPv6 upgrade model has been implemented in Taiwan governmental agencies since 2012. The goal is expected to upgrade a half of the external network services such as Governmental Service Network (GSN) infrastructure, DNS, Email, and critical international services to IPv6 by 2013, and the rest of the external services by the end of 2015.

In the first stage, 5,212 services have been surveyed in the first half of 2012. Based on the proposed data analysis and diagnosis system, some noisy data of the surveyed services in the Service Availability database are updated. The total number of the surveyed services have been decreased from 5,212 to 4,969, where 501 services have been deleted, 412 services have been added, 120 services have been corrected, and 154 service types have been changed from the external to the internal.

Hence, the survey result of the expected IPv6 ready for service systems is shown in Figure 6. In the total 4,969 services in Taiwan governmental agencies, 67% services are planned to be upgraded by 2013, and 98% services to be upgraded by 2015.

In these surveyed services, the statistics of the distribution of surveyed WWW, Email, and DNS server systems are shown in Figure 7, 8, and 9, respectively. The more usage of the server system, the more training courses needed in the IPv6 upgrade for the technical staff of the governmental agencies. 23 training courses of IPv6 upgrading for government employees and technical workers were held in 2013. These courses were welcome by 1,142 participants who finished the training program. Besides, information of the IPv6 Enabled Hardware/Software database can be used to support the solution of the IPv6-enabled version of the server system.

In the upgrade stage, the tracking and monitoring of the upgraded service has been implemented. The number of upgraded services is dynamically updated every day to keep the latest upgrading information. 3,956 services had been upgraded till June 2014 in the upgrade stage. The upgrading rate, 79.6%, is much higher than the original expected one to show the feasibility and effectiveness of this study.

Type of Service	Web	Email	DNS	FTP	Other	Total	Upgrade percentage by year					
							Web	Email	DNS	FTP	Other	Total
Already Ready	108	3	11	0	2	124	2.8%	0.5%	2.1%		4.0%	2.5%
Year 2012	203	36	47	0	1	287	8%	7%	11%		6%	8%
Year 2013	2,143	385	374	16	22	2,940	65%	75%	82%	57%	50%	67%
Year 2014	385	57	35	2	3	482	75%	85%	89%	64%	56%	77%
Year 2015	894	73	51	10	19	1,047	98%	98%	99%	100%	94%	98%
Year 2016	69	10	7	0	3	89	100%	100%	100%	100%	100%	100%
小計	3,802	564	525	28	50	4,969						

Fig. 6. Expected IPv6 ready for service systems.

	Server System	Quantity	Percentage
1	IIS6	1463	42%
2	Apache	820	23%
3	IIS7	587	17%
4	IIS5	223	6.3%
5	Tomcat	128	3.6%
6	Oracle Web Server	92	2.6%
7	WebSphere	61	1.7%
8	JBoss	29	0.8%
9	Sunweb	27	0.8%
10	TrendMicro	17	0.5%

Fig. 7. Statistics of WWW Server systems distribution

	Server System	Quantity	Percentage
1	IIS6	1463	42%
2	Apache	820	23%
3	IIS7	587	17%
4	IIS5	223	6.3%
5	Tomcat	128	3.6%
6	Oracle Web Server	92	2.6%
7	WebSphere	61	1.7%
8	JBoss	29	0.8%
9	Sunweb	27	0.8%
10	TrendMicro	17	0.5%

Fig. 8. Statistics of Email Server systems distribution

	Server System	Quantity	Percentage
1	IIS6	1463	42%
2	Apache	820	23%
3	IIS7	587	17%
4	IIS5	223	6.3%
5	Tomcat	128	3.6%
6	Oracle Web Server	92	2.6%
7	WebSphere	61	1.7%
8	JBoss	29	0.8%
9	Sunweb	27	0.8%
10	TrendMicro	17	0.5%

Fig. 9. Statistics of DNS Server systems distribution

The upgraded external network services include Web, Email, DNS, and FTP. The categorization of IPv6 upgraded services in the end of June 2014 is shown in Figure 10.

Besides, in the achievement of the driving force of the IPv6 upgrade from governmental agencies, there were accumulated 256 Information and Communication Technology (ICT) products from Taiwan approved by IPv6 Ready Phase-2 Gold Logo, including 63 products approved in 2013, 6 product approved in 2014. Taiwan is ranked world No.2.

Upgraded Service	Web	Email	DNS	FTP	Other	Total
Year 2012	30	6	16	0	6	58
Year 2013	2,853	351	349	12	8	3,573
Year 2014	240	47	36	2	0	325
Total	3,123	404	401	14	14	3,956

Fig. 10. Categorization of Upgraded Sevices

Conclusions

In this study, we proposed a two-stage IPv6 upgrade model that includes the service-based survey stage and adaptive upgrade stage to progressively execute the IPv6 upgrade according to the defined priority of the governmental organization.

Our idea is firstly to upgrade external network services of governmental agencies as the driving force of the upgrade in the country and secondly to use cost-effective strategies to have a seamless transition. In the service-based survey stage, we proposed using a small-scale trial survey to a full-scale strategy to find the difficulty and problems of the IPv6 deployment. In the adaptive upgrade stage, providing the adaptive solution for different services is an important part. 16 IPv6 supporting teams have been formed to help nearby organizations in the IPv6 upgrade.

In this study, the achievement of the driving force of the IPv6 upgrade from governmental agencies is shown in the number of ICT products from Taiwan approved by IPv6 Ready Phase-2 Gold Logo. Taiwan is ranked world No.2.

Besides, the proposed IPv6 upgrade model is successfully implemented on Taiwan Government Network Services. 4,969 external services need to be upgraded to IPv6 in governmental agencies. Till June 2014, 3,956 services had been upgraded. Using this model, we handle the large number of network services in the IPv6 upgrade. The upgrading rate, 79.6%, is much higher than the original expected one to show the feasibility and effectiveness of this study.

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