



# Taiwan IPv6 Readiness Measurement

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**IPv6 Readiness Measurement BoF**



# Outline

- Introduction
  - Background & Motivation
- Measurement
  - ISP IPv6 Service Availability
  - IPv6 Service availability
- Conclusions



# Introduction

- **Motivation**

- We want to find out the root cause of the low user availability.
- We use three measurement criteria to investigate the user availabilities of the Governmental domain, Academic domain, and commercial domain of a ccTLD.

# Internet Operation Diagram

## Services

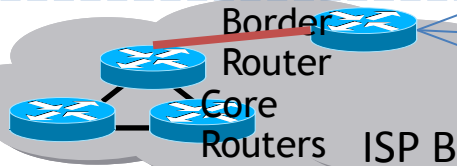


DNS

Email



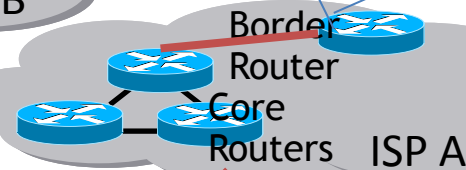
## Core Network



Border Router

Core Routers

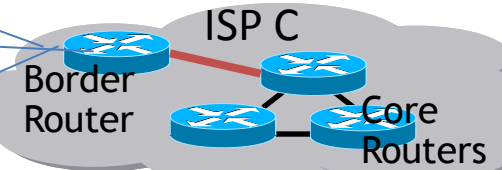
ISP B



Border Router

Core Routers

ISP A



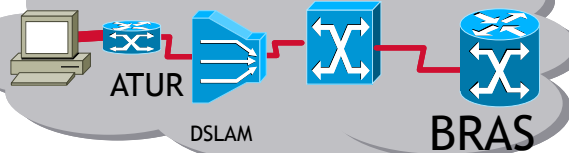
Border Router

Core Routers

ISP C

## Access Network

ADSL

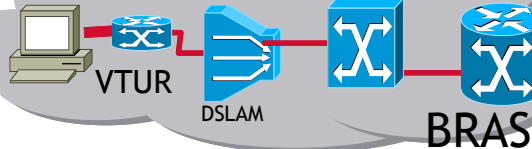


ATUR

DSLAM

BRAS

FTTx

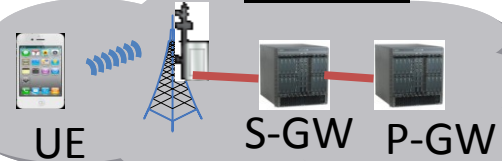


VTUR

DSLAM

BRAS

4G(LTE)



UE

S-GW

P-GW

Cable



Cable Modem

DOCSIS 3.0 proposal

CMTS

WiFi



802.11

WiFi AP

WiFi Gateway

3G(UTRAN)



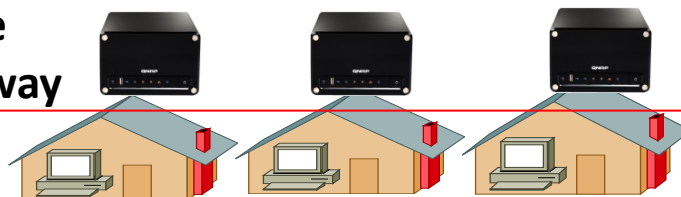
3G UE (voice & data)

SGSN

GGSN

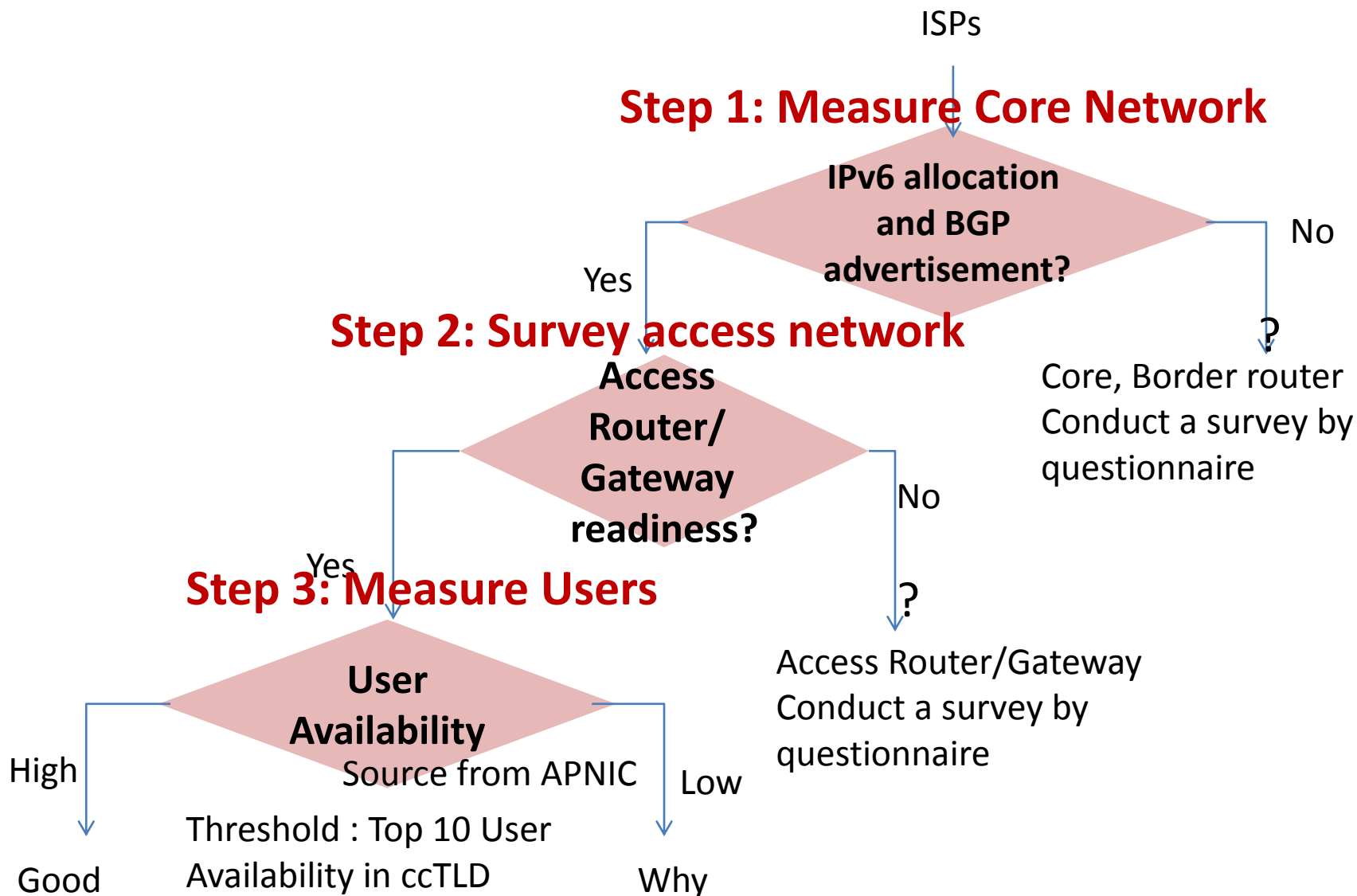
## Users

Home Gateway





# Measurement Methods for ISP IPv6 Service Availability





# ISP Service Availability

- **Step 1: Measure Core Network**
  - Measure the IPv6 allocation and BGP advertisement of core router and border router
    - Assume the owners of ASes can classify Governmental domain , Academic domain and Commercial domain.
    - Use the percentage of ASes that announce IPv6 Prefix and source from global routing table
  - If the ISP announced IPv6 advertisement, then the core network supports IPv6.
  - If the ISP did not announce IPv6 advertisement, check core router and border router.



# ISP Service Availability

- **Step 2: Survey Access Network**
  - Survey the Governmental domain , Academic domain and Commercial domain IPv6 capable of access services, conduct a survey by questionnaire.
  - Six different major access services includes FTTx, ADSL, Cable, WiFi, 3G and 4G, and to know the status of IPv6 capable of their access router/gateway ( BRAS, CMTS, WiFi Gateway, GGSN/SGSN, and MME/S-GW/P-GW)



# Steps of ISP Service Availability

- **Step 3: Measure Users**

- Measure user availability

- Use APNIC data to check the user availability of ISPs.

- Threshold

- Set up threshold to find the Top 10 ISPs with high user availability.
- If the ISP's user availability is too low, check the user network equipment.





# Step 1: Status of the IPv6 Allocation and BGP advertisement in Taiwan

- The Governmental domain, Academic domain and Commercial domain of IPv6 Allocation and BGP advertisement (# of ASN with IPv6 advertisement/# of ASN in global Routing Table)**

Last updated: Aug., 2015

|                                     | Taiwan | Governmental domain (GSN) | Academic domain (TANet, ASnet, TWAREN) | Commercial domain   |
|-------------------------------------|--------|---------------------------|----------------------------------------|---------------------|
| # of ASN in Global Routing Table(A) | 130    | 1                         | 17                                     | 112                 |
| # of ASN with IPv6 advertisement(B) | 45     | 1                         | 5                                      | 39                  |
| Ratio(B/A)                          | 34.62% | 100%                      | 29.41%                                 | 34.82% <sup>9</sup> |



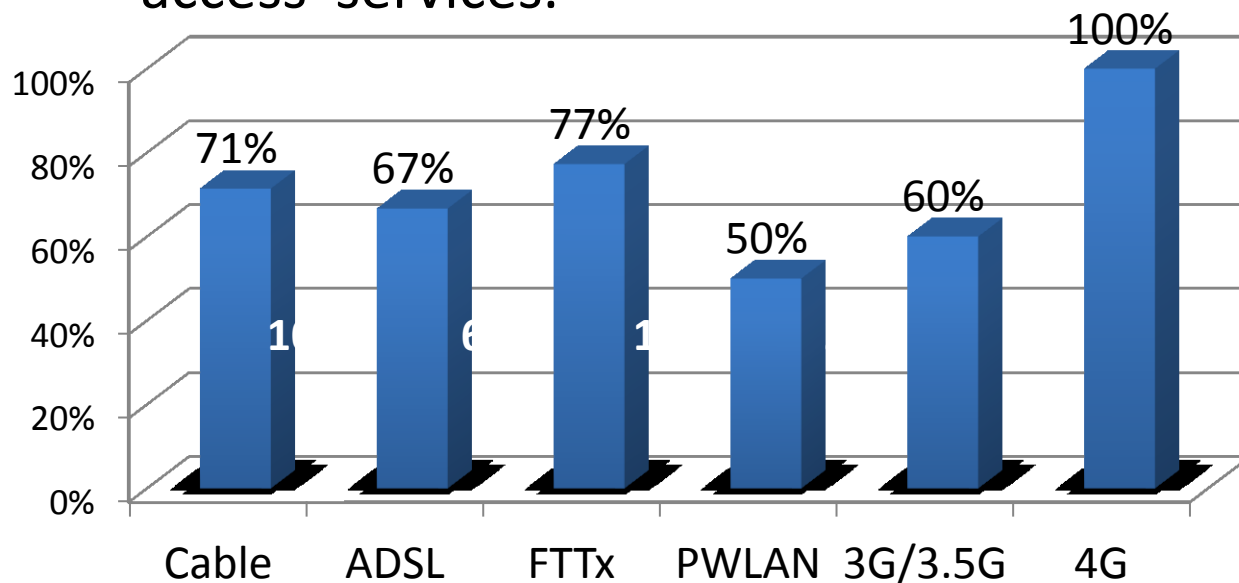
# The status of IPv6 Allocation and BGP advertisement in Taiwan

- GSN has only one ASN, so it is easy to reach 100%.
- Since the Academic network uses the hierarchical structure and has /32 IPv6, so the major Academic network have announced IPv6 prefix.
- Some major commercial domain have announced IPv6 prefix.



## Step 2: Status of IPv6 Access Router/Gateway Availability in Taiwan

- Conduct a survey by questionnaire to check whether ISP internet access service device is ipv6 capable in Aug 2015
- Among 60 LIRs , 48 LIRs provide wired/wireless internet access services.



| Internet Access Service | # of ISPs |
|-------------------------|-----------|
| FTTx                    | 21        |
| ADSL                    | 7         |
| Cable Modem             | 14        |
| PWLAN                   | 4         |
| 3G/3.5G                 | 5         |
| 4G                      | 5         |

| Internet access Service | Cable | ADSL | FTTx            | WiFi         | 3G/3.5G    | 4G              |
|-------------------------|-------|------|-----------------|--------------|------------|-----------------|
| Access Device           | CMTS  | BRAS | BRAS, L3 Switch | WiFi Gateway | GGSN, SGSN | MME, S-GW, P-GW |



# Findings of the IPv6 Access Router/Gateway Availability

- Regarding ipv6 promotion, to provide ipv6 internet access service is the most concern .
- For providing internet access service ,ipv6 capable access router/gateway is a must .
- Governmental domain and Academic domain 's access routers/ gateways can support IPv6.
- Most commercial domain 's access routers/ gateways can support IPv6.



## Step 3: Status of the IPv6 User Availability in Taiwan

- User Availability**

|       | Taiwan | Government<br>al domain<br>(GSN) | Academic<br>domain<br>(TANet, ASNet,<br>TWAREN) | Commercial<br>domain |
|-------|--------|----------------------------------|-------------------------------------------------|----------------------|
| Ratio | 0.58%  | 1.31%                            | 9.12%                                           | 0.35%                |



# Status of the IPv6 User Availability in Taiwan

- **Top 10 of the User Availability in Taiwan**

| ASN                     | Org    | IPv6 User Availability | Domain              |
|-------------------------|--------|------------------------|---------------------|
| <a href="#">AS1659</a>  | TANET  | 11.55%                 | Academic domain     |
| <a href="#">AS9505</a>  | TWGATE | 11.54%                 | Commercial domain   |
| <a href="#">AS7539</a>  | TWREAN | 9.20%                  | Academic domain     |
| <a href="#">AS7482</a>  | APTG   | 7.95%                  | Commercial domain   |
| <a href="#">AS9916</a>  | NCTU   | 3.49%                  | Academic domain     |
| <a href="#">AS18422</a> | ITRI   | 1.87%                  | Commercial domain   |
| <a href="#">AS4782</a>  | GSN    | 1.43%                  | Governmental domain |
| <a href="#">AS17709</a> | APTG   | 0.94%                  | Commercial domain   |
| <a href="#">AS9264</a>  | ASNET  | 0.73%                  | Academic domain     |
| <a href="#">AS3462</a>  | HINET  | 0.50%                  | Commercial domain   |



# Findings of the IPv6 User Availability in Taiwan

- The Academic Network uses IPv6 VoIP service to deploy every school IPv6 network. So the IPv6 user availability is higher than others.
- Because IPv6 user availability in Taiwan is mainly Academic domain based, during every winter or summer vacation, the IPv6 user availability rate was going down.
- Government domain users grow smoothly.
- Some ISPs can provide IPv6 access service, but they don't provide it by default. So the ISP's IPv6 users growth is slow.



# Proposed methods for IPv6 service availability

- Definition of three measurement methods of the IPv6 service availability

| Methods | Definition                                                                           |
|---------|--------------------------------------------------------------------------------------|
| (I)     | % of IPv6-enabled ccTLD web services                                                 |
| (II)    | % of IPv6-enabled ccTLD web services of the ccTLD services in top 1 million of Alexa |
| (III)   | % of IPv6-enabled web services in top 500 of a ccTLD ranked by Alexa                 |





# Hypothesis

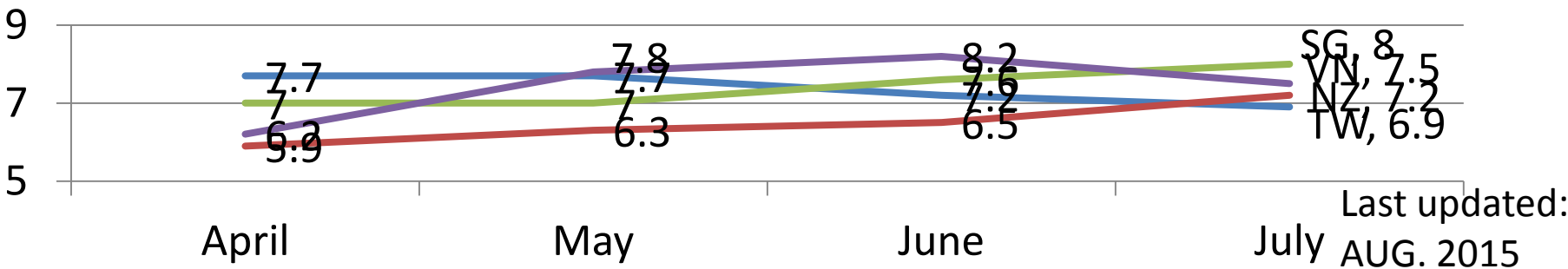
- Hypothesis: The ratio of the IPv6 web service availability for popular web services is at least higher than X times of the overall web services for any ccTLD
- The gap will be slightly decreasing every year. The hypothesis can be used to predict the IPv6 service availability of a certain ccTLD in the next few years.



# Experimental Results

- Comparison of four ccTLD in different measurement methods of the IPv6 service availability
- The ratio of the IPv6 web service availability for popular web services is at least higher than x times of the overall web services

| Methods   | Taiwan(.tw)           | New Zealand(.nz)      | Singapore(.sg)        | Vietnam (.vn)         |
|-----------|-----------------------|-----------------------|-----------------------|-----------------------|
| (I)       | 7564/394939=<br>1.92% | 8303/645945=<br>1.29% | 3216/174817=<br>1.84% | 4436/314414=<br>1.41% |
| (II)      | 389/4725=8.23%        | 61/1325=4.60%         | 209/1388=15.06%       | 64/3985=1.61%         |
| (III)     | 66/500=13.20          | 46/500=9.20%          | 74/500=14.80%         | 53/500=10.60%         |
| (III)/(I) | 13.20/1.92=6.9        | 9.20/1.29=7.2         | 14.80/1.84=8.0%       | 10.60/1.41=7.5        |





# Conclusions

- To find out the root cause of the low user availability, we use three measurement criteria to investigate the user availabilities of the governmental domain, academic domain, and commercial domain of a ccTLD.
- We use the three step to find ISP IPv6 service availability and to find out why ISP's IPv6 users growth slow.



# Conclusions

- The global top one million web sites and ccTLD's top 500 popular web sites from Alexa are used to estimate the service availability of ccTLD.
- We proposed a hypothesis, the hypothesis is that the ratio of the IPv6 web service availability for popular web services is at least higher than X times of the overall web services for any ccTLD.



# Thank You