Policy Development Framework for Government IPv6 Deployment

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Policy Theme

Government IPv6 Policy

Options beyond IPv6
- CGN
- Transfer or Reclamation
- Exclusive Resources

Timing
- IPv4 Exhaustion
- Policies in other countries
- Activation time

Cost
- Variables
- Priority
- Cost distribution Schedule
Options/Solutions for IPv4 Exhaustion
IPv6 excluded

• s1 CGN (Carrier Grade NAT)
  – Increase CapEx, reduce network quality
• s2 Transfer/Reclamation IPv4
  – C1: Cost of IPv4 ownership/right to use
  – C2: Renumber
  – C3: H/W S/W cost
• r1: exclusive
  – IPv6 is the only practical and readily resource after IPv4 exhaustion
implication to private/public sector for alternative solutions

• Implication to private sector
  – s1/s2 are all feasible solutions to private sectors. Corporate chooses solution based on its existing requirements

• Implication to public sector
  – Beyond s1/s2, public sector has to provide a feasible mechanism for r1 (IPv6)
  – Public section should consider IPv6 deployment is necessary but not sufficient requirement
    • In addition to deploy IPv6 (must), public sector can also choose s1/s2 based on its own requirements
Timing

• IPv4 exhaustion
  – IANA IPv4 exhausted in 2011 Feb
  – APNIC IPv4 exhausted in 2011 Aug
  – IPv6 is the only practical and readily resource

• Government IPv6 deployment in other countries
  – Several countries already launched government IPv6 plan
Timing – Future Potential

IPv6 / IPv4 BGP Table Size Ratio

Global Financial Crisis

0.5% /quarter

IPv6 location in 3 years
Timing – IPv6 Population Estimation

Assuming APNIC Exhaustion end of 2011, simulating IPv6 population in the end of 2012

Linear forecast
IPv6 deploy 5.3%, pure IPv6 3.3%
IPv6 population 160M
Pure IPv6 population 66M
TW pure IPv6 population 528K

Can’t access IPv4 Internet
Activation Time

• Activation Time
  – Pure IPv6 ISP, IPv6 users can’t access IPv4
    Government networks and websites
  – Act Now
    • Government should issue a position statement in
      support IPv6 deployment now
Cost

• Cost variables for IPv6 deployment
  – One time or phased deployment
  – Coverage ?
  – How long
  – Indirect cost (Training, Security, Service Quality)

• Economical solution
  – Dynamic provisioning
    • Server system: hosting, or enable dualstack in legacy systems
    • Network traffic: Rate limiting
## Taiwan Trade vs. IPv6 Allocation

<table>
<thead>
<tr>
<th>Taiwan Trade with Partners, Jan 2010 – Oct 2010</th>
<th>Share of Total Exports</th>
<th>Share of Total Imports</th>
<th>Share of IPv6 /48s Allocated to Date</th>
<th>Share of IPv6 /48s Allocated Per Capita</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHINA</td>
<td>28.129%</td>
<td>14.105%</td>
<td>0.28%</td>
<td>0.063</td>
</tr>
<tr>
<td>JAPAN</td>
<td>6.64%</td>
<td>20.916%</td>
<td>7.46%</td>
<td>7.195</td>
</tr>
<tr>
<td>UNITED STATES</td>
<td>11.395%</td>
<td>9.962%</td>
<td>10.68%</td>
<td>4.234</td>
</tr>
<tr>
<td>HONG KONG</td>
<td>13.868%</td>
<td>0.653%</td>
<td>0.03%</td>
<td>0.657</td>
</tr>
<tr>
<td>KOREA</td>
<td>3.9%</td>
<td>6.387%</td>
<td>3.57%</td>
<td>8.643</td>
</tr>
<tr>
<td>SINGAPORE</td>
<td>4.45%</td>
<td>3.102%</td>
<td>0.03%</td>
<td>0.785</td>
</tr>
<tr>
<td>GERMANY</td>
<td>2.352%</td>
<td>3.258%</td>
<td>7.18%</td>
<td>10.546</td>
</tr>
<tr>
<td>MALAYSIA</td>
<td>2.164%</td>
<td>3.097%</td>
<td>0.03%</td>
<td>0.15</td>
</tr>
<tr>
<td>SAUDI ARABIA</td>
<td>0.367%</td>
<td>4.735%</td>
<td>0.01%</td>
<td>0.105</td>
</tr>
<tr>
<td>AUSTRALIA</td>
<td>1.156%</td>
<td>3.62%</td>
<td>5.57%</td>
<td>31.669</td>
</tr>
<tr>
<td>Total</td>
<td>74.42%</td>
<td>69.84%</td>
<td>34.84%</td>
<td>64.047</td>
</tr>
<tr>
<td>TAIWAN</td>
<td>n/a</td>
<td>n/a</td>
<td>1.59%</td>
<td>9.418</td>
</tr>
</tbody>
</table>
Cost: Number Please

- **Lack of Generalizability**
  - IPv6 readiness varied among Gov agencies, thus transition cost are different

- **Financial risk**
  - Can’t have precise financial measurement
  - Financial risk can be limited within an acceptable range through sizing/scoping IPv6 deployment

- **Non-financial risk**
  - Apply the existing IT practice /guideline to manage non-financial risk. Such as ITIL standards, Information Security ISO27000 series, or USG IT Enterprise Architecture
Initial Sizing

• DNS Capacity (IPv6 gov.tw)
  – v6 enable: activating dualstack in DNS and adding AAAA RR
  – expansion: no capacity expansion
  – connection: access IPv6 network or IPv6 colocation

• WWW Capacity
  – V6 enable: activating dualstack in the existing systems
  – expansion: existing WWW capacity x 3%-5%
  – connection: access IPv6 network or IPv6 colocation

• Network Capacity
  – V6 enable: activating dualstack in routers
  – expansion: existing bandwidth x3%-5%
  – Transit: purchase IPv6 Transit
Priority Matrix

A. External Services
- WWW, DNS, Email Transit/Peering
- Backbone, IX

B. Connectivity Expansion
- Nodes < 10K?
- Access Networks

C. Internal Use & All IPv6
- Nodes < 10M?
- Internal Services, Database, Desktop
- H/W, S/W

Perceived Value
- H: High
- M: Medium
- L: Low

Cost Estimate
- L: Low
- M: Medium
- H: High
Issue List

1 v6/v4 fallback

- **Why:** Poor IPv6 Connectivity
  - 1 Unmanaged transition mechanism
  - 2 No IPv6 connectivity but AAAA RR existed
  - 3 No IPv6 global connectivity

2 DNS query increase

<table>
<thead>
<tr>
<th></th>
<th>FeeBSD</th>
<th>Linux</th>
<th>MacOS</th>
<th>Vista</th>
</tr>
</thead>
<tbody>
<tr>
<td>A &amp; AAAA query sequence order</td>
<td>A first</td>
<td>AAAA first</td>
<td>A first</td>
<td>A first</td>
</tr>
<tr>
<td>When does domain name completion occur</td>
<td>After A+AAAA</td>
<td>All AAAA completion</td>
<td>Alter A+AAAA</td>
<td></td>
</tr>
</tbody>
</table>
3 Operational practice/technology takes time

<table>
<thead>
<tr>
<th></th>
<th>Idea</th>
<th>Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>IP</td>
<td>1969</td>
<td>1981</td>
</tr>
<tr>
<td>TCP</td>
<td>1974</td>
<td>1981</td>
</tr>
<tr>
<td>Telnet</td>
<td>1969</td>
<td>1983</td>
</tr>
<tr>
<td>IDN</td>
<td>1998</td>
<td>2004</td>
</tr>
<tr>
<td>IPv6</td>
<td>1994</td>
<td>1998</td>
</tr>
</tbody>
</table>

4 Cost of management for long term overlapping period

- doubles number of service interfaces
- requires changes above & below
- major interoperability issues
Gain & Loss

Every action has a price and pleasure

Perceived Gain

1. Meet pure IPv6 users/operators needs
2. Potential address needs: mobile-Internet, Internet of Things
3. Sustain ICT competitiveness

Perceived Loss

1. Financial risk: cost of deployment (ref: initial sizing)
2. Nonfinancial risk: service quality (ref. Issue List)
3. Future management cost (IPv4 Post-Transition)
# Value Assessment

<table>
<thead>
<tr>
<th>Item</th>
<th>Necessity</th>
<th>Perceived Value</th>
</tr>
</thead>
</table>
| A External Services          | MUST      | Complied with Telecom Act.  
s20: universal access right to all citizen  
s21: fair connection service  
s22: undeniable interconnection |
| WWW, DNS, Email Transit/Peering Backbone, IX | MUST      | Complied with Telecom Act.  
s20: universal access right to all citizen  
s21: fair connection service  
s22: undeniable interconnection |
| B Connectivity Expansion     | MUST      | Complied with Telecom Act.  
s20: universal access right to all citizen  
s21: fair connection service  
s22: undeniable interconnection |
| Access Networks              |           |                                                                                                                                                |
| C Internal Use & All IPv6    | MAY       | Only if IPv6 demonstrate its market momentum with positive externality at this stage                                                            |
| Internal Services, Database, Desktop H/W, S/W |           |                                                                                                                                                |
# Proposed Schedule

<table>
<thead>
<tr>
<th></th>
<th>Proposed Schedule</th>
<th>Reason</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>T₀</strong></td>
<td>Now</td>
<td>Ref : Activation Time</td>
<td>Must</td>
</tr>
<tr>
<td><strong>Tₐ</strong></td>
<td>T₀+2 Y</td>
<td>12M after IPv4 exhaustion</td>
<td>Must</td>
</tr>
<tr>
<td><strong>Tₗ</strong></td>
<td>T₀+4 Y</td>
<td>Ref other country policy</td>
<td>Adjusted by budget</td>
</tr>
<tr>
<td><strong>Tₑ</strong></td>
<td>T₀+4 Y</td>
<td>Ref other country policy</td>
<td>Adjusted by budget</td>
</tr>
</tbody>
</table>
Policy defined, It is just the beginning

IPv6 is not “plug and play”

Standards/mandatory?
Infrastructure readiness?
Transit/peering?
Addressing?
Dual-stack/tunnelling?
v6 Routing protocols?
Security?
Cost?
Think Post-Transition Strategy First

AS IS Internet → Transition Strategy → TO BE Internet Mutation

Overlapping Period
Post Transition Management

> 20 Years?
## IT Maturity Model

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
<th>Understanding and Awareness</th>
<th>Training and Communication</th>
<th>Process and Practice</th>
<th>Techniques and Automation</th>
<th>Compliance</th>
<th>Expertise</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Recognition</td>
<td>Recognition</td>
<td>Sporadic communication on issues</td>
<td>Ad hoc approach to process and practice</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Awareness</td>
<td>Communication on the overall issue and needs</td>
<td>Similar but intuitive process emerges</td>
<td>Common tools are appearing</td>
<td>Inconsistent monitoring on isolated issues</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Understanding of need to act</td>
<td>Informal training supports individual initiatives</td>
<td>Practices are defined, standardized and documented; sharing of better practices begins</td>
<td>Tool set is standardized; currently available practices are used and enforced</td>
<td>Inconsistent monitoring; measurement emerges; balanced score card adopted; root cause analysis is intuitive</td>
<td></td>
<td>Involvement of IT specialists in business processes</td>
</tr>
<tr>
<td>4</td>
<td>Understand full requirements</td>
<td>Formal training supports a managed program</td>
<td>Process ownership and responsibilities are set; process is sound and complete; internal best practices are applied</td>
<td>Mature techniques are used; standard tools are enforced; limited tactical use of technology</td>
<td>Balanced scorecard are used in some areas; root cause analysis is standardized</td>
<td></td>
<td>Involvement of all internal domain experts</td>
</tr>
<tr>
<td>5</td>
<td>Advanced. Forward-looking understanding</td>
<td>Training and communications support external best practices and use leading edge concepts</td>
<td>Best external practices are applied</td>
<td>Sophisticated techniques are deployed; extensive optimized use of technology</td>
<td>Balanced scorecard is globally applied; root cause analysis is always applied</td>
<td></td>
<td>Use of external experts and industry leaders for guidance</td>
</tr>
</tbody>
</table>
Organization vs. IT Transformation

**Current Arch.**

- **Strategic**
  - Enterprise
  - Services / Product Lines
  - Requires
  - Programs / Markets

- **Operational**
  - Processes
  - Resources
  - Organization
  - Activities
  - Activities
  - Activities
  - Activities
  - Activities

**Plan and Define**

**Target Arch.**

- **Strategic**
  - Enterprise
  - Services / Product Lines
  - Requires
  - Programs / Markets

- **Operational**
  - Processes
  - Resources
  - Organization
  - Activities
  - Activities
  - Activities
  - Activities
  - Activities

**Corporate Initiatives**

- Internet Connectivity
- External Web/Email
- Internal System
- Internal Desktop/Apps

Design Build and Operate
IPv6 Transition Model

IPv6 Inventory Assessment
IPv6 Strategy & Architecture
IPv6 Transition & Governance
IPv6 Design & Engineering
IPv6 Transition Planning
IPv6 Testing & Piloting
IPv6 Inventory Assessment

**Item**

- Discover and document infrastructure readiness
- Cost impacts of transition to IPv6
- Inventory IP elements to understand the ability to support IPv6
- Align element mapping to refresh cycles
- Understand vendor and carrier dual stack roadmap

**Methodology**

- Requirement Analysis Framework
- Document Review Technique
# Strategic Policy for IPv6 Deployment

## 1. Political Return

<table>
<thead>
<tr>
<th>P1</th>
<th>Position statement for IPv6 deployment</th>
</tr>
</thead>
<tbody>
<tr>
<td>P2</td>
<td>RIR policy development</td>
</tr>
<tr>
<td>P3</td>
<td>IPv4 exhaustion</td>
</tr>
<tr>
<td>P4</td>
<td>Reduce risk of ISP/ICP</td>
</tr>
</tbody>
</table>

## 2. Constituent Service

<table>
<thead>
<tr>
<th>C1</th>
<th>Increase value</th>
</tr>
</thead>
<tbody>
<tr>
<td>C2</td>
<td>Reduce cost</td>
</tr>
<tr>
<td>C3</td>
<td>Single POC</td>
</tr>
<tr>
<td>C4</td>
<td>Service availability</td>
</tr>
</tbody>
</table>

- Training and awareness
- IPv6 product certification
- Technology
- Industrial innovative Act: Tax Credit
- IPv6 transition office
- Government network dualstack

## 3. Operation Efficiency

<table>
<thead>
<tr>
<th>O1</th>
<th>Government IPv6 deployment</th>
</tr>
</thead>
<tbody>
<tr>
<td>O2</td>
<td>Business / service continuity</td>
</tr>
<tr>
<td>O3</td>
<td>Complied with Telecom Act</td>
</tr>
</tbody>
</table>

## Feasibility

- Technology
- Operation
- Economy
- Legal
<table>
<thead>
<tr>
<th>Policy Value Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Policy Component</strong></td>
</tr>
<tr>
<td><strong>Current State</strong></td>
</tr>
<tr>
<td><strong>Political Return</strong></td>
</tr>
<tr>
<td>Policy making</td>
</tr>
<tr>
<td>Greater participation</td>
</tr>
<tr>
<td>Crisis management</td>
</tr>
<tr>
<td><strong>Constituent Service</strong></td>
</tr>
<tr>
<td>Constituent value</td>
</tr>
<tr>
<td>Lower constituent cost</td>
</tr>
<tr>
<td>Single point of contact</td>
</tr>
<tr>
<td>Greater service availability</td>
</tr>
<tr>
<td><strong>Operational Efficiency</strong></td>
</tr>
<tr>
<td>Service Transformation</td>
</tr>
<tr>
<td>Policy objectives</td>
</tr>
<tr>
<td>Gov responsibility</td>
</tr>
</tbody>
</table>
## IPv6 Policy Deliveries

<table>
<thead>
<tr>
<th>Current State</th>
<th>Intended State</th>
<th>Project Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>Policy Making</td>
<td>Clear IPv6 Strategy</td>
<td>Position Statement</td>
</tr>
<tr>
<td>GRE participation</td>
<td>RIR participation</td>
<td></td>
</tr>
<tr>
<td>Cross management</td>
<td>IPv6 exhaustion</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Minimal impact</td>
<td></td>
</tr>
<tr>
<td></td>
<td>IPv6 Transition</td>
<td></td>
</tr>
</tbody>
</table>

### Constituent Service

<table>
<thead>
<tr>
<th>Constituent value</th>
<th>Certification/loan transfer</th>
<th>IPv6 Tech Support Center</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower constituent cost</td>
<td>Lower cost for ISPs</td>
<td></td>
</tr>
<tr>
<td>Single point of contact</td>
<td>Single POC</td>
<td></td>
</tr>
<tr>
<td></td>
<td>IPv4/IPv6 availability</td>
<td></td>
</tr>
<tr>
<td>Operational Efficiency</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Service Transformation</th>
<th>Best practice</th>
<th>Phased IPv6 transition plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Policy objectives</td>
<td>Sustained service availability</td>
<td>Secure IPv6 migration</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IPv6 transition plan</td>
</tr>
</tbody>
</table>

### Procurement Drive Innovation

- 6PIX
- +6 Million v6 Users

### CapEx OpEx

- Stimulus Plan
- Tax Credit
- Up to $45,000,000,000
- Plus our current offer!
THANK YOU
9. RFC2185 (Routing Aspects of IPv6 Transition)
10. RFC3142 (An IPv6-to-IPv4 Transport Relay Translator)
11. RFC3053 (IPv6 Tunnel Broker)
12. RFC3056 (Connection of IPv6 Domains via IPv4 Clouds)
13. RFC4213 (Basic Transition Mechanisms for IPv6 Hosts and Routers)
14. RFC4214 (Intra-Site Automatic Tunnel Addressing Protocol ISATAP)
15. RFC4380 (Teredo: Tunneling IPv6 over UDP through Network Address Translations NATs)
16. RFC4966 (Reasons to Move the Network Address Translator-Protocol Translator NAT-PT to Historic Status)
17. RFC5211 (An Internet Transition Plan)
18. RFC5569 (IPv6 Rapid Deployment on IPv4 Infrastructures (6rd))
19. RFC5572 (IPv6 Tunnel Broker with the Tunnel Setup Protocol (TSP))
21. 曾憲雄 (2010). 政府網路及 e 政府網站導入 IPv6 參考要點, 新一代網際網路協定互通認證計畫