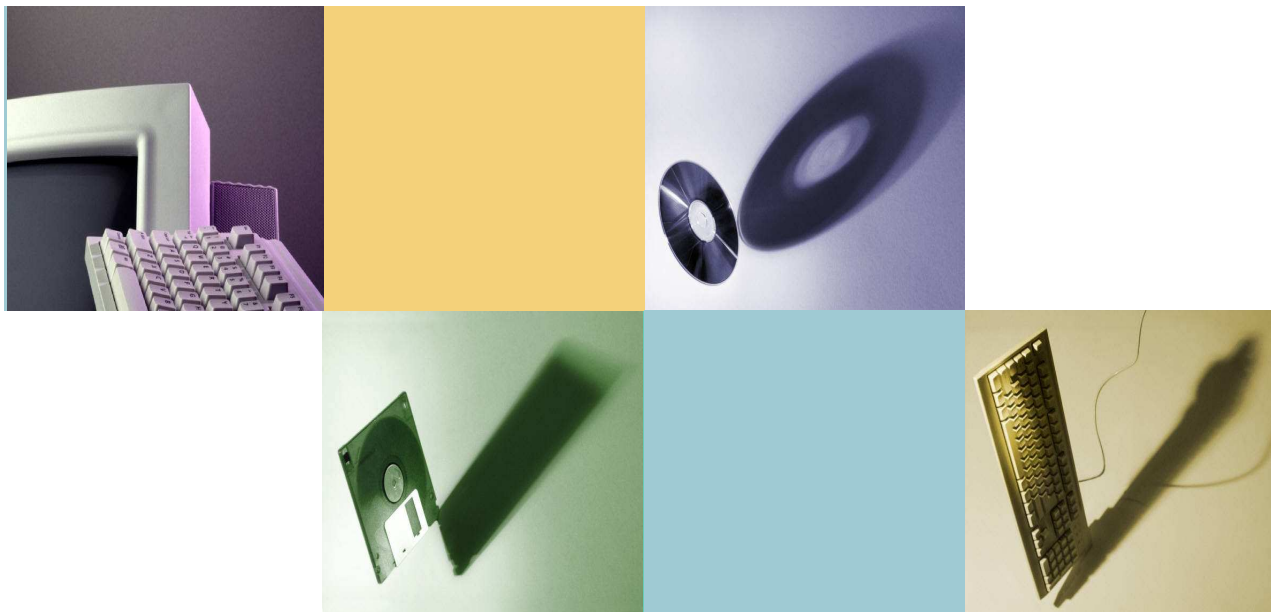


IPv6 介紹與應用



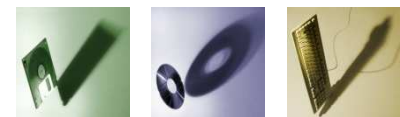
2011/08/31

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joechen@niu.edu.tw

大綱

- ISO/OSI and TCP/IP
 - IPv4
 - IPv6
- Transition
- Supported OS
- Router and IPv6
- Windows and IPv6
- Linux and IPv6
- Application for IPv6

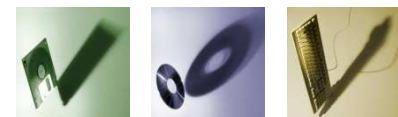


ISO/OSI and TCP/IP

- OSI/ISO , TCP/IP and MS Network

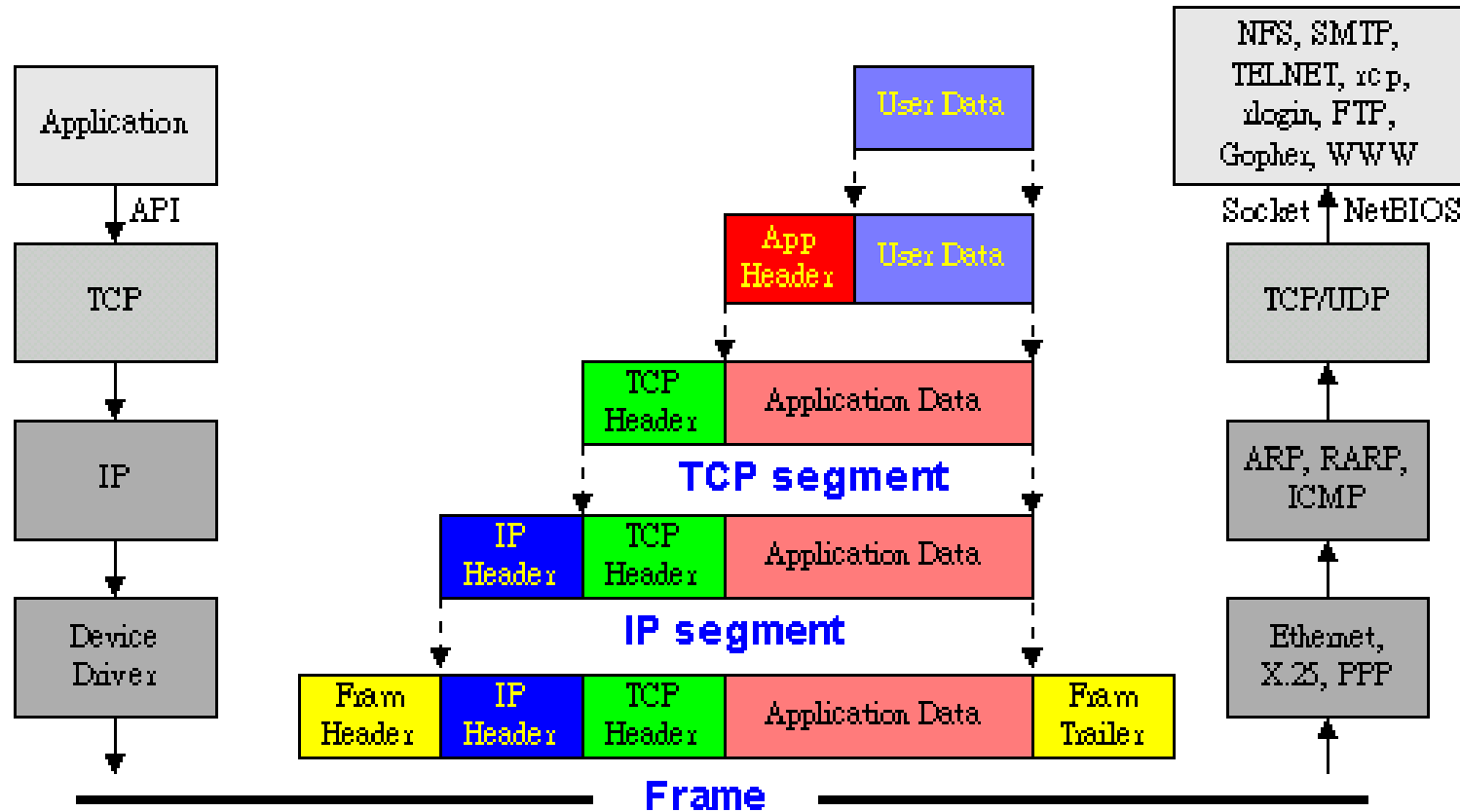
Open System Interconnection	Internet Protocol Suite	Microsoft Network
應用層 (Application)	應用層 (Application)	應用界面層 (Application Interface)
表現層 (Presentation)		
會談層 (Session)		
傳送層 (Transport)	傳送層 (Transport)	傳送設備界面層 (Transport Device Interface)
網路層 (Network)	網路層 (Network)	
資料連接層 (Data Link)	實體層 (Physical)	網路驅動界面層 (Network Driver Interface)
實體層 (Physical)		實體網路層 (Physical Network Layer)

參考來源: http://www.study-area.org/network/network_ip_model.htm

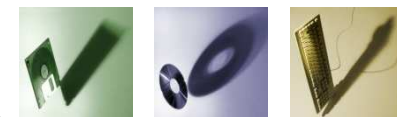


ISO/OSI and TCP/IP

- Encapsulation



參考來源: http://www.study-area.org/network/network_ip_model.htm



IPv4

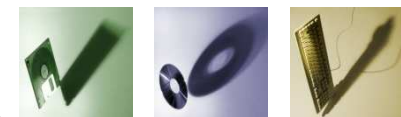
- IPv4 Packet Header



參考來源:

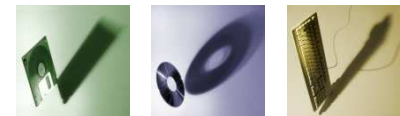
1. <http://en.wikipedia.org/wiki/IPv4>

2. http://www.cisco.com/en/US/technologies/tk543/tk766/technologies_white_paper09186a00800a3e2f.html



IPv4

- IP address ($2^{32} \rightarrow 4294967296$)
 - Address: 120.101.5.40
 - Netmask: 255.255.255.0
 - Default gateway: 120.101.5.254
- NAT (Network address translation)
 - Public IP
 - Private IP
- Obtain IP
 - Manual
 - DHCP



IPv6

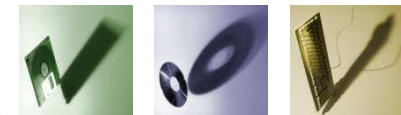
IPv6 Packet Header



參考來源:

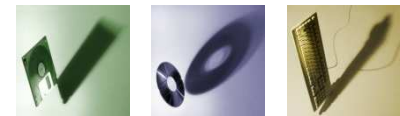
1. <http://en.wikipedia.org/wiki/IPv6>

2. http://www.cisco.com/en/US/technologies/tk543/tk766/technologies_white_paper09186a00800a3e2f.html



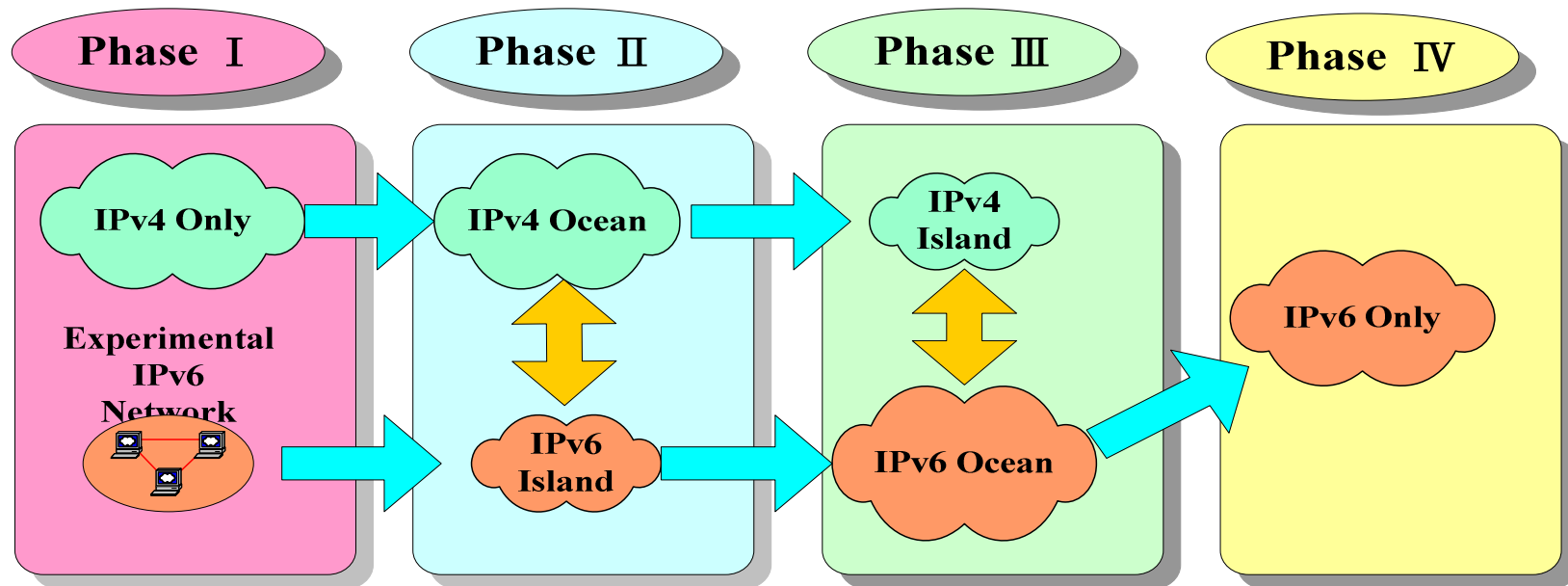
IPv6

- IP address
 - ($2^{128} \rightarrow 3.4028236692093846346337460743177e+38$)
 - Address: 2001:288:a001:5:4e0:ab2c:a7cc:97ce
 - Netmask: /64
 - Default gateway: 2001:288:a001:5::1
- NAT (Network address translation)
 - ~~Well, It doesn't need NAT.~~
- Obtain IP
 - Manual
 - RA (Router Advertisement)
 - DHCPv6



Transition

- IPv4/IPv6 轉換發展過程(藍圖)



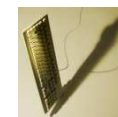
參考來源: [http:// www.pcnase.csie.ncku.edu.tw/mmnetlab/web/class/TCPIP2006.../ch2.ppt](http://www.pcnase.csie.ncku.edu.tw/mmnetlab/web/class/TCPIP2006.../ch2.ppt)



Transition

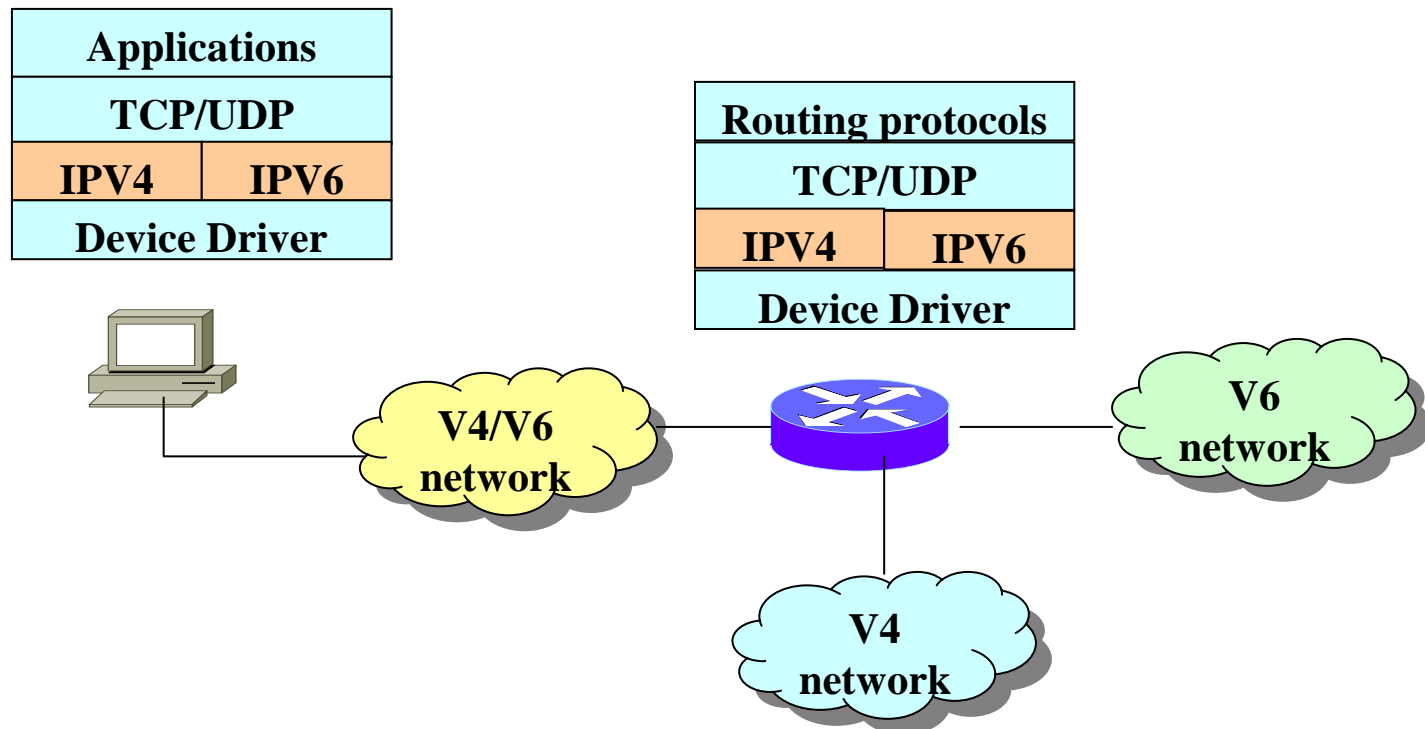
- IPv4/IPv6 轉換發展過程(做法)
 - 完全IPv4 網路
 - 第1階段：建立IPv4/IPv6 雙協定核心網路
 - 第2階段：為測試目的或特殊服務有範圍地進行IPv6 接取網路佈建
 - IPv4 位址枯竭
 - 第3階段：為了IPv4網路服務的延續性，建立IPv6 接取網路
 - 第4階段：提供IPv6連線服務給使用者

參考來源: <http://www.ipv6.org.tw/docu/elearning2/02.20100804MOI-transition.pdf>

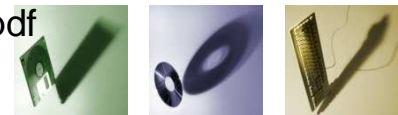


Transition

- Transition Mechanisms
 - RFC 2893, 4213



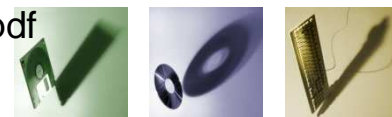
參考來源: <http://www.ipv6.org.tw/docu/elearning2/02.20100804MOI-transition.pdf>



Transition

- IPv4/IPv6 三大類過渡技術
 - IPv6/IPv4 Dual Stack (即在同一條線路上，同時提供IPv6及IPv4的通訊協定)
 - Tunneling (即在現有的兩個IPv4的端點間，建IPv6的隧道，使兩端後的使用Dual Stack作業系統的使用者能以IPv6互通)
 - Translator (理論上，透過轉換機制可讓僅支援IPv4的使用者，可與僅支援IPv6的HOST連線，並讓僅支援IPv6的使用者，與僅支援IPv4的HOST連線)

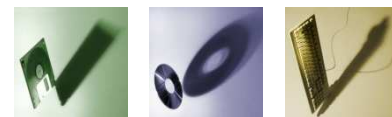
參考來源: <http://www.ipv6.org.tw/docu/elearning2/02.20100804MOI-transition.pdf>



Transition

- IPv4/IPv6 雙堆疊 (Dual Stack)
 - 此為在同一條線路上，同時提供 IPv4 及 IPv6 通訊協定，讓原先在 IPv4 環境下的使用者直接使用 IPv6 網路。此種作法必須網路層設備同時支援 IPv4 和 IPv6 協定，目前區網中心的骨幹路由器皆已具備 IPv4/IPv6 功能，使得下游連線單位的校園網路都已具備了 IPv4/IPv6 雙堆疊的網路環境。

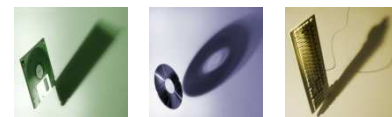
參考來源: http://www.cc.ntu.edu.tw/chinese/epaper/0004/20080320_4008.htm



Transition

- IPv6通道(Tunneling)技術
 - 亦即在兩個IPv4的端點之間建立IPv6通道，使得兩端使用雙堆疊作業系統的使用者能以IPv6協定互通。在純IPv4環境下使用者，便需透過此法與某個提供此服務的伺服器建立IPv6通道，之後便可連上IPv6網路。目前網際網路上已有一些IPv6通道伺服器可提供連線服務，其中最著名的是Hexago(<http://www.hexago.com>)；國內則有中研院(<http://tb2.ipv6.ascc.net>)和中華電信(<http://www.ipv6.hinet.net/installGuide.htm>)提供免費的IPv6通道服務。

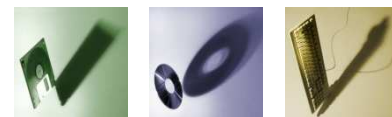
參考來源: http://www.cc.ntu.edu.tw/chinese/epaper/0004/20080320_4008.htm



Transition

- IPv4/IPv6轉換(Translator)機制
 - 由於IPv6協定的封包格式與IPv4不同，因此為了讓原IPv4的應用能夠在IPv6上使用，必須經過轉換機制，將IPv4的模式及IPv6的模式相互轉換，才可能讓應用程式能夠互通。而且，各應用程式運用IP協定的方式不同，必須要依據各應用程式的特性量身訂做專屬的轉換機制。

參考來源: http://www.cc.ntu.edu.tw/chinese/epaper/0004/20080320_4008.htm



Transition

- 雙協定(Dual Stack)技術優缺點比較表

IPv4/IPv6雙協定堆疊(Dual Stack)轉移技術	
優點	缺點
容易設置與易懂。	擴展性(scalability)差。因為每個節點需1個IPv6位址及1個IPv4位址。
端點對端點連線模式未遭破壞。	系統複雜度及負擔增加，需維持2個IP協定個別的routing table及相關網管資訊。
雙堆疊主機可與其它雙協定堆疊主機、純IPv4主機或純IPv6主機互連。	無法提供純IPv4主機與純IPv6主機的互通。

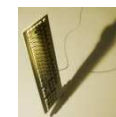
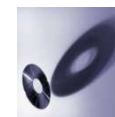
參考來源: <http://www.ipv6.org.tw/docu/elearning2/02.20100804MOI-transition.pdf>



Transition

- 核心網路支援IPv6 之常見過程
 - 規劃期(Planning)
 - 取得IPv6 位址：進行IPv6位址分配及規劃
 - 網路架構規劃及設備準備：如IPv4/IPv6 Dual stack、IPv4/IPv6 VLAN/MPLS、IPv4與IPv6實體網路分開等
 - 測試期(Trial)
 - Lab Trial：如Connectivity、Performance、Loading Testing等
 - Service Trial：整體服務之試驗
 - 建置期(Implementation)
 - IPv6 對外連線規劃及準備：IPv6 IX
 - 網路設備(含路由器及交換機) 啟動IPv6 功能
 - 啟動IPv6 路由
 - 網路管理系統啟動管理IPv6 網路功能

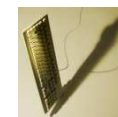
參考來源: <http://www.ipv6.org.tw/docu/elearning2/02.20100804MOI-transition.pdf>



Transition

- 接取網路支援IPv6 之常見過程
 - 規劃期(Planning)
 - 分配IPv6 位址
 - IPv6 自動組態/DHCPv6 與認證等伺服器之準備
 - 測試期(Trial)
 - Lab Trial：如Connectivity、Performance、Loading Testing 等
 - Service Trial：整體服務之試驗
 - 建置期(Implementation)
 - 網路設備(如：路由器、Layer 3 Switch、BRAS、CMTS等)、用戶端設備(如：ATU-R、Cable Modem) 及管理伺服器等具備並啟動IPv6 功能
 - 啟動IPv6 路由
 - 網路管理系統啟動管理IPv6 網路功能

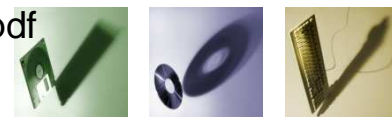
參考來源: <http://www.ipv6.org.tw/docu/elearning2/02.20100804MOI-transition.pdf>



Transition

- 導入IPv6應用服務之常見過程
 1. 現有IPv4 服務升級至IPv6 網路環境
 - 根據康卡斯特(Comcast) 技術長辦公室主任 Alain Durand 在2006 年的一份公開簡報資料表示：測試研究的100 個管理系統程式當中，只有10 個需要做重大的修正、30 個要做小修改，其餘60 個是可以直接轉換到IPv6 使用的。
 - **服務升級需查驗項目**包括作業系統、應用程式（含資料庫、網站、軟體等）、網路環境（如：colocation環境、防火牆等）。

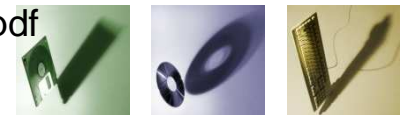
參考來源: <http://www.ipv6.org.tw/docu/elearning2/02.20100804MOI-transition.pdf>



Transition

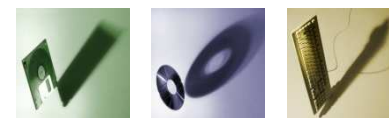
- 導入IPv6應用服務之常見過程
 2. 新開發之應用服務
 - 開發之新系統應具備dual stack 功能
 - 新系統開發時多使用domain name, 少用IP
 - 需考量使用IPv6 特性之應用服務，如需要大量實體IP位址或可以使用IPv6 mobility 等優點之感測網路，VoIP，Healthcare等相關應用。
 - 應用開發所須流程包括可行性分析、雛型系統開發、技術試驗、系統測試、服務試驗、及服務上線等過程。

參考來源: <http://www.ipv6.org.tw/docu/elearning2/02.20100804MOI-transition.pdf>



Transition

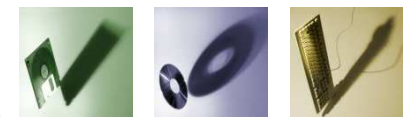
- 使用者導入IPv6之常見過程
- 使用者包含企業用戶及一般使用者
- 一般使用者學習IPv6 之常見過程
 - 學習期：學習IPv6 之使用
 - 移轉期：將使用者端的軟體升級至可支援IPv6
- 企業用戶導入IPv6 之常見過程
 - 規劃期：人員教育訓練、及設備和網路服務(Web, mail server等) 支援IPv6 等規劃
 - 測試期：設備及網路服務支援IPv6 之測試
 - 導入期：網路及服務正式使用IPv6



Supported OS

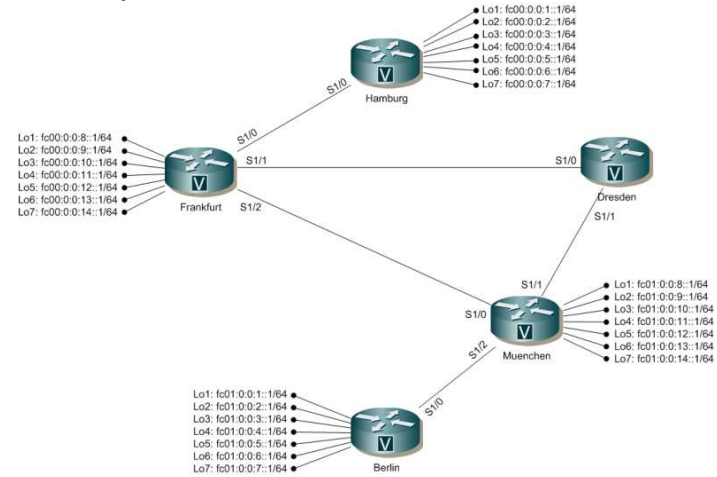
Operating system	Firewall	DHCPv6	6to4	Configured tunnels	PPPoE
AIX (4.3 ~)	?	Yes	Yes	Yes	Yes
Cisco IOS	Yes	Yes	Yes	Yes	Yes
FreeBSD (6.1 ~)	Yes	Addon	Yes	Yes	Yes
HP-UX 11i	Yes	Yes	Yes	Yes	Yes
Linux (kernel 2.6)	Yes	Addon	Yes	Yes	Yes
Mac OS X (10.4 ~)	Yes	No	Yes	Yes	Yes
NetBSD	Yes	Addon	Yes	Yes	?
OpenBSD	Yes	Addon	Yes	Yes	?
Solaris (8 ~)	Yes	Yes	Yes	Yes	Yes
Windows XP	Yes	Addon	Yes	Yes	No
Windows Vista	Yes	Yes	Yes	Yes	Yes
Windows 7	Yes	Yes	Yes	Yes	Yes

參考來源: <http://ipv6int.net/systems/index.html>



Router and IPv6

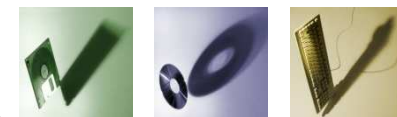
- RIPng
 - 距離向量(Distance Vector)方式
 - UDP埠號521
- OSPFv3
 - 鏈路狀態(Link State)方式
 - 用來克服RIP所產生的問題
- BGP-4
 - 在多個自治系統間交換網路可到達的資訊
 - 強化路由的政策及避免路由迴圈
 - 使用TCP作為傳輸協定，並以埠號179來建立連線。



Router and IPv6

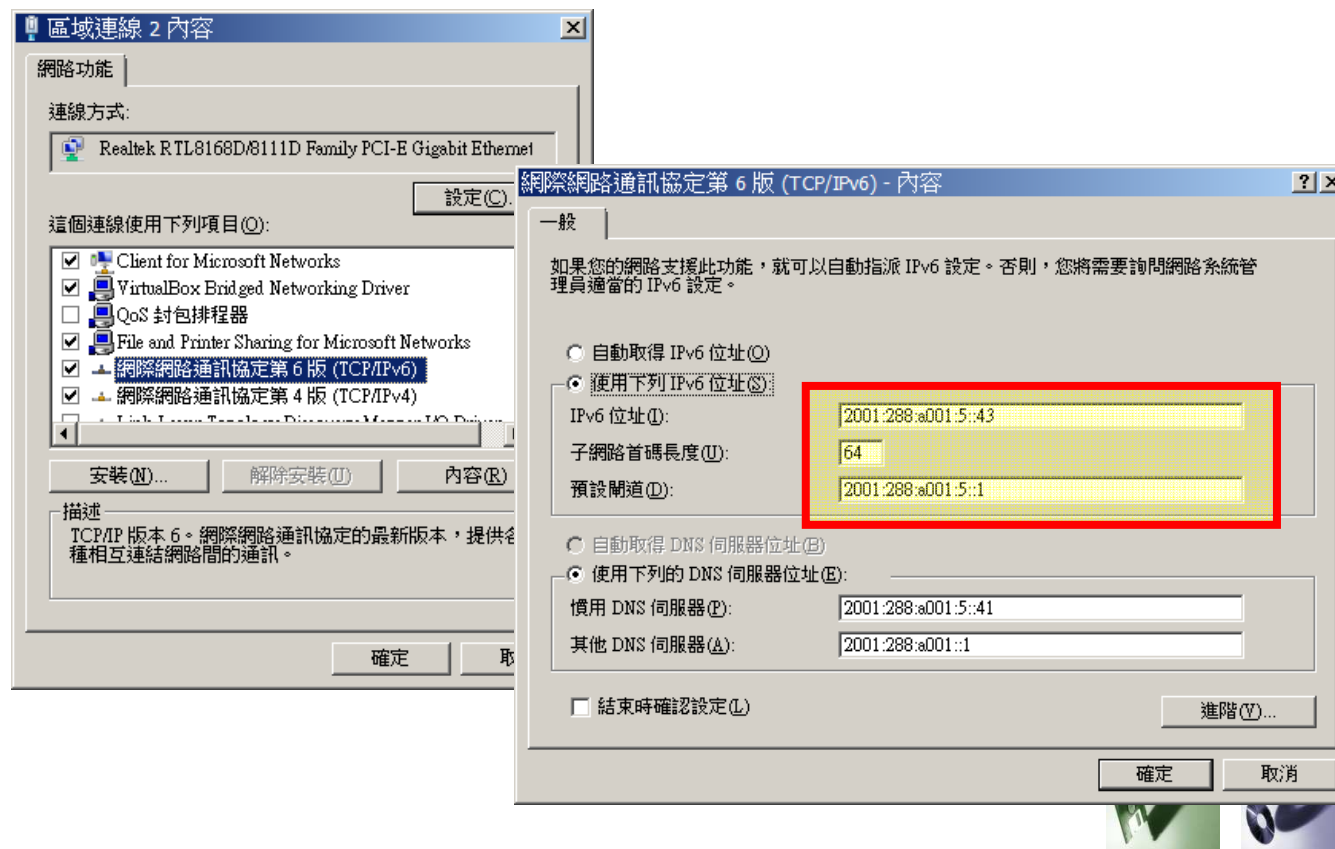
- 路由器設定 (以 RIPng 為例)

```
ipv6 unicast-routing
!
interface Ethernet0/0
  no ip address
  full-duplex
  ipv6 address 2001:E10:FFFF:2101::2/64
  ipv6 enable
  ipv6 nd ns-interval 1000
  ipv6 nd ra-interval msec 1000
  ipv6 nd prefix 2001:E10:FFFF:2101::/64
  ipv6 rip DEMO enable
!
interface Ethernet0/1
  no ip address
  full-duplex
  ipv6 address 2001:E10:1440:FFFF::1/64
  ipv6 enable
  ipv6 nd prefix 2001:E10:1440:FFFF::/64
  ipv6 rip DEMO enable
!
ipv6 route ::/0 2001:E10:FFFF:2101::1
ipv6 router rip DEMO
 redistribute connected
```



Windows and IPv6

- 手動設定 IP (Windows Vista/7)
 - [開始] -> [控制台] -> [網路和網際網路] -> [網路和共用中心] -> [變更介面卡設定]



Windows and IPv6

- 檢視網路設定 (ipconfig 指令)
 - [開始] -> [所有程式] -> [附屬應用程式] -> [命令提示字元]
 - 輸入 ipconfig

```
命令提示字元
C:\Users\JoeChen>ipconfig

Windows IP 設定

以太网網路卡 区域連線 2:

    連線特定 DNS 尾碼 . . . . . : niu.edu.tw
    IPv6 位址 . . . . . : 2001:288:a001:5::43
    IPv6 位址 . . . . . : 2001:288:a001:5:4e0:ab2c:a7cc:97ce
    臨時 IPv6 位址 . . . . . : 2001:288:a001:5:19db:ec29:5e58:de17
    連結-本機 IPv6 位址 . . . . . : fe80::4e0:ab2c:a7cc:97ce%13
    IPv4 位址 . . . . . : 120.101.5.43
    子網路遮罩 . . . . . : 255.255.255.128
    預設閘道 . . . . . : 2001:288:a001:5::1
                          fe80::21e:7aff:fe56:e2c0%13
                          120.101.5.126

通道介面卡 isatap.<D45B491E-46A7-49E7-A167-B98C6F3D4330>:

    媒體狀態 . . . . . : 媒體已中斷連線
    連線特定 DNS 尾碼 . . . . . :

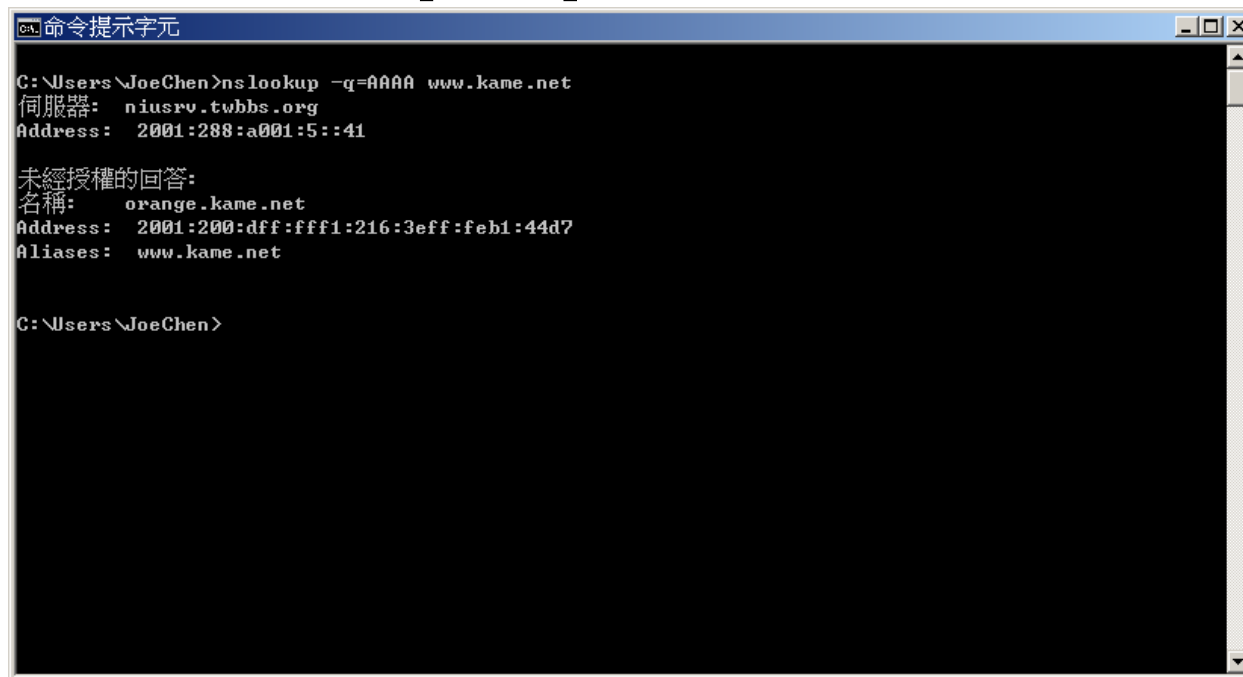
通道介面卡 Teredo Tunneling Pseudo-Interface:

    媒體狀態 . . . . . : 媒體已中斷連線
    連線特定 DNS 尾碼 . . . . . :

C:\Users\JoeChen>
```

Windows and IPv6

- 測試網路連線 (nslookup 指令)
 - [開始] -> [所有程式] -> [附屬應用程式] -> [命令提示字元]
 - 輸入 `nslookup www.kame.net`
(或使用 `nslookup -q=AAAA www.kame.net`)



```
命令提示字元
C:\Users\JoeChen>nslookup -q=AAAA www.kame.net
伺服器:      niusrv.twbbs.org
Address:     2001:288:a001:5::41

未經授權的回答:
名稱:       orange.kame.net
Address:    2001:200:df:fff1:216:3eff:feb1:44d7
Aliases:    www.kame.net

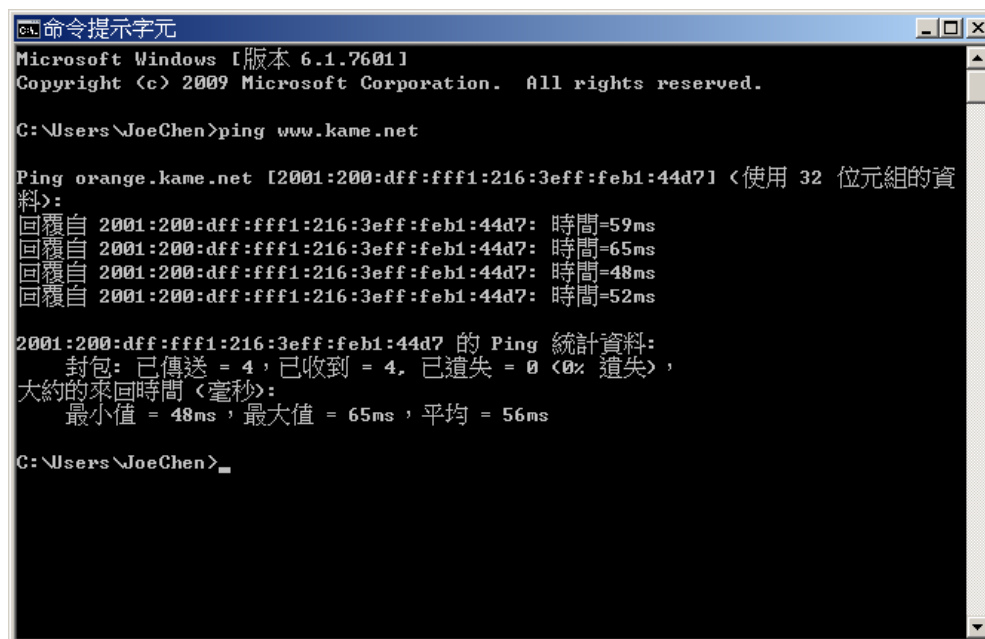
C:\Users\JoeChen>
```

Windows and IPv6

- 測試網路連線 (ping 指令)

- [開始] -> [所有程式] -> [附屬應用程式] -> [命令提示字元]

- 輸入 ping *www.kame.net*



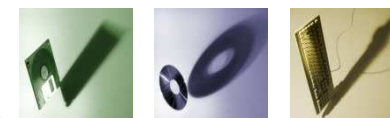
```
C:\命令提示字元
Microsoft Windows [版本 6.1.7601]
Copyright (c) 2009 Microsoft Corporation. All rights reserved.

C:\Users\JoeChen>ping www.kame.net

Ping orange.kame.net [2001:200:dff:fff1:216:3eff:feb1:44d7] <使用 32 位元組的資料>:
回覆自 2001:200:dff:fff1:216:3eff:feb1:44d7: 時間=59ms
回覆自 2001:200:dff:fff1:216:3eff:feb1:44d7: 時間=65ms
回覆自 2001:200:dff:fff1:216:3eff:feb1:44d7: 時間=48ms
回覆自 2001:200:dff:fff1:216:3eff:feb1:44d7: 時間=52ms

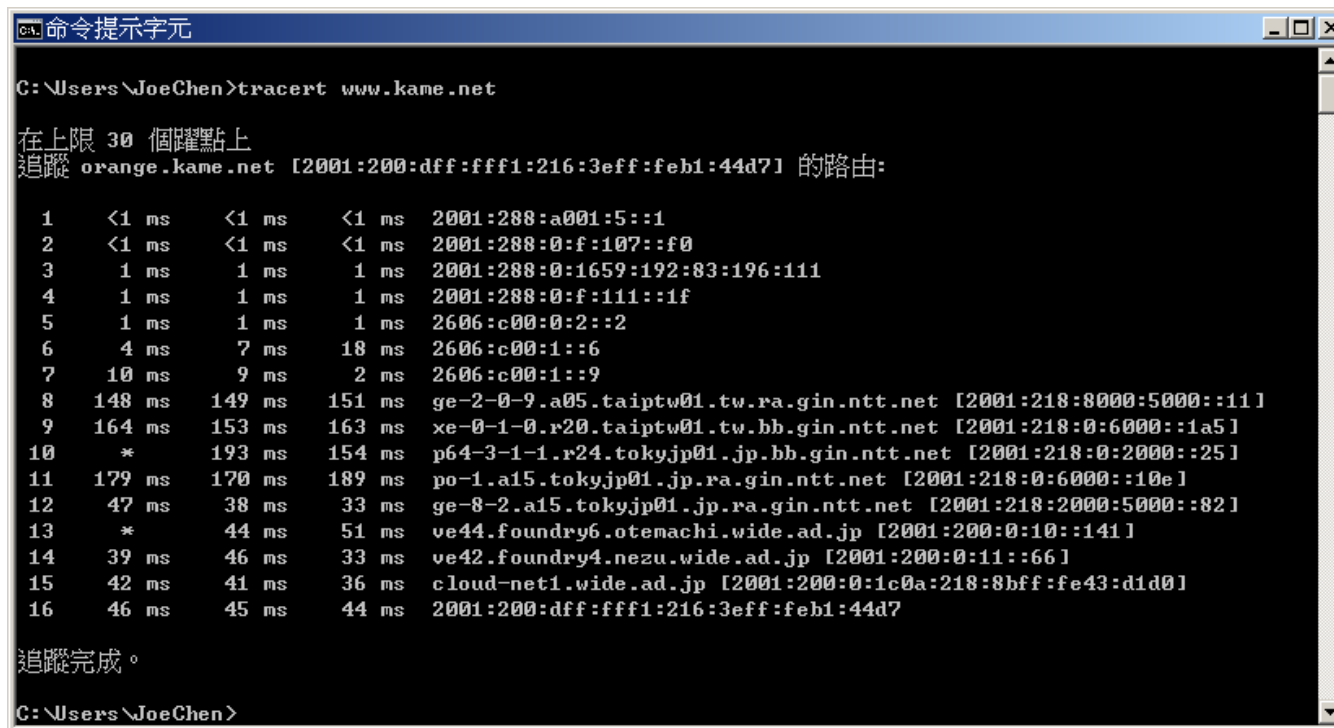
2001:200:dff:fff1:216:3eff:feb1:44d7 的 Ping 統計資料:
    封包: 已傳送 = 4, 已收到 = 4, 已遺失 = 0 (0% 遺失),
    大約的來回時間 (毫秒):
        最小值 = 48ms, 最大值 = 65ms, 平均 = 56ms

C:\Users\JoeChen>
```



Windows and IPv6

- 測試網路連線 (tracert 指令)
 - [開始] -> [所有程式] -> [附屬應用程式] -> [命令提示字元]
 - 輸入 `tracert www.kame.net`



```
命令提示字元
C:\Users\JoeChen>tracert www.kame.net

在上限 30 個躍點上
追蹤 orange.kame.net [2001:200:dff:fff1:216:3eff:feb1:44d7] 的路由:

  1  <1 ms    <1 ms    <1 ms    2001:288:a001:5::1
  2  <1 ms    <1 ms    <1 ms    2001:288:0:f:107::f0
  3   1 ms     1 ms     1 ms     2001:288:0:1659:192:83:196:111
  4   1 ms     1 ms     1 ms     2001:288:0:f:111::1f
  5   1 ms     1 ms     1 ms     2606:c00:0:2::2
  6   4 ms     7 ms     18 ms    2606:c00:1::6
  7  10 ms     9 ms     2 ms     2606:c00:1::9
  8  148 ms   149 ms   151 ms   ge-2-0-9.a05.taipw01.tw.ra.gin.ntt.net [2001:218:8000:5000::11]
  9  164 ms   153 ms   163 ms   xe-0-1-0.r20.taipw01.tw.bb.gin.ntt.net [2001:218:0:6000::1a5]
 10  *        193 ms   154 ms   p64-3-1-1.r24.tokyjp01.jp.bb.gin.ntt.net [2001:218:0:2000::25]
 11  179 ms   170 ms   189 ms   po-1.a15.tokyjp01.jp.ra.gin.ntt.net [2001:218:0:6000::10e]
 12  47 ms    38 ms    33 ms    ge-8-2.a15.tokyjp01.jp.ra.gin.ntt.net [2001:218:2000:5000::82]
 13  *        44 ms    51 ms    ve44.foundry6.otemachi.wide.ad.jp [2001:200:0:10::141]
 14  39 ms    46 ms    33 ms    ve42.foundry4.nezu.wide.ad.jp [2001:200:0:11::66]
 15  42 ms    41 ms    36 ms    cloud-net1.wide.ad.jp [2001:200:0:1c0a:218:8bff:fe43:d1d0]
 16  46 ms    45 ms    44 ms    2001:200:dff:fff1:216:3eff:feb1:44d7

追蹤完成。
C:\Users\JoeChen>
```

Linux and IPv6

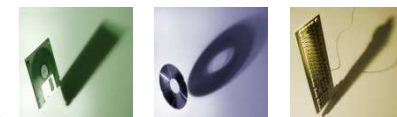
- 手動設定 IP (CentOS 5.x)
 - 修改 /etc/sysconfig/network-scripts/ifcfg-eth0

```
root@niusrv:/etc/sysconfig/network-scripts [80x24]
連線(C) 編輯(E) 檢視(V) 視窗(W) 選項(O) 說明(H)
#DEVICE=eth0
BOOTPROTO=none
ONBOOT=yes
USERCTL=no
TYPE=Ethernet
HWADDR=00:0c:29:05:f8:5d

IPADDR=120.101.5.41
NETMASK=255.255.255.128
NETWORK=120.101.5.0
BROADCAST=120.101.5.127
GATEWAY=120.101.5.126

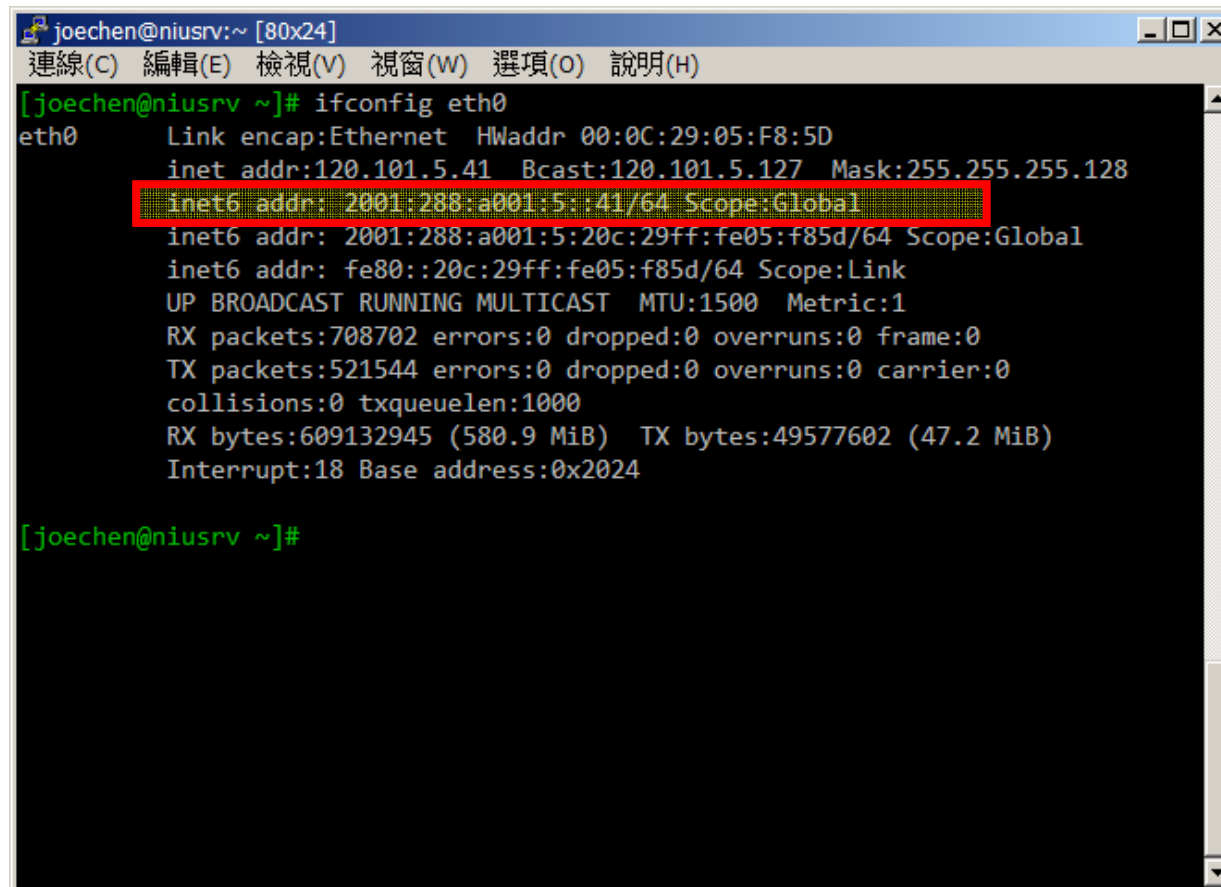
IPV6INIT=yes
IPV6_AUTOCONF=no
IPV6ADDR=2001:288:a001:5::41/64
IPV6_DEFAULTGW=2001:288:a001:5::1

DNS1=120.101.0.9
DNS2=2001:288:a001::9
~
~
~
"ifcfg-eth0" 20L, 336C 1,1 All
```



Linux and IPv6

- 檢視網路設定 (ifconfig 指令)
 - 輸入 ifconfig eth0

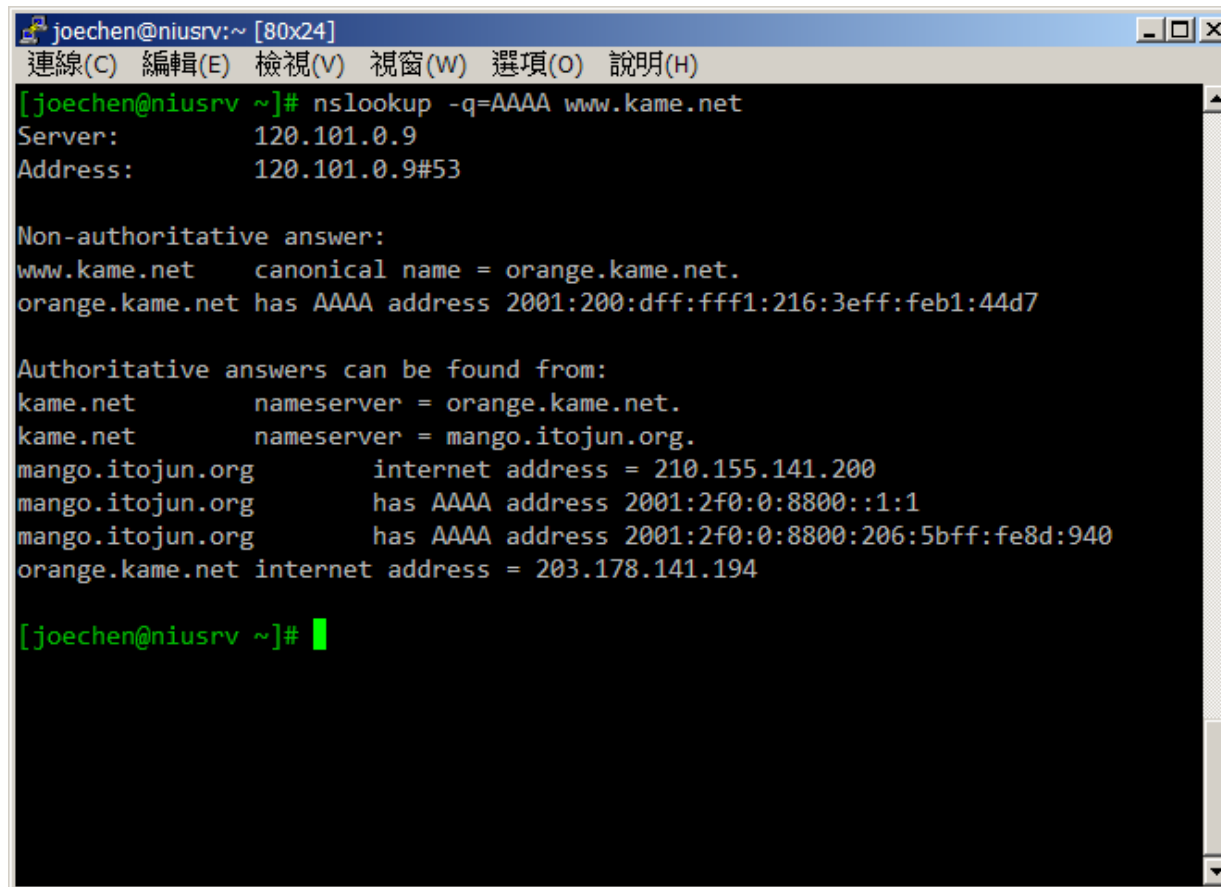


```
joechen@niusrv:~ [80x24]
連線(C) 編輯(E) 檢視(V) 視窗(W) 選項(O) 說明(H)
[joechen@niusrv ~]# ifconfig eth0
eth0      Link encap:Ethernet  HWaddr 00:0C:29:05:F8:5D
          inet addr:120.101.5.41  Bcast:120.101.5.127  Mask:255.255.255.128
          inet6 addr: 2001:288:a001:5::41/64 Scope:Global
          inet6 addr: 2001:288:a001:5:20c:29ff:fe05:f85d/64 Scope:Global
          inet6 addr: fe80::20c:29ff:fe05:f85d/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:708702 errors:0 dropped:0 overruns:0 frame:0
          TX packets:521544 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:609132945 (580.9 MiB)  TX bytes:49577602 (47.2 MiB)
          Interrupt:18 Base address:0x2024

[joechen@niusrv ~]#
```

Linux and IPv6

- 測試網路連線 (nslookup 指令)
 - 輸入 `nslookup -q=AAAA www.kame.net`

A terminal window titled 'joechen@niusrv:~ [80x24]' with a menu bar containing '連線(C)', '編輯(E)', '檢視(V)', '視窗(W)', '選項(O)', and '說明(H)'. The terminal shows the command '[joechen@niusrv ~]# nslookup -q=AAAA www.kame.net' and its output. The output includes the server IP (120.101.0.9), a non-authoritative answer for www.kame.net pointing to orange.kame.net with an AAAA address, and authoritative answers for kame.net and mango.itojun.org with their respective AAAA addresses.

```
joechen@niusrv:~ [80x24]
連線(C) 編輯(E) 檢視(V) 視窗(W) 選項(O) 說明(H)
[joechen@niusrv ~]# nslookup -q=AAAA www.kame.net
Server:          120.101.0.9
Address:         120.101.0.9#53

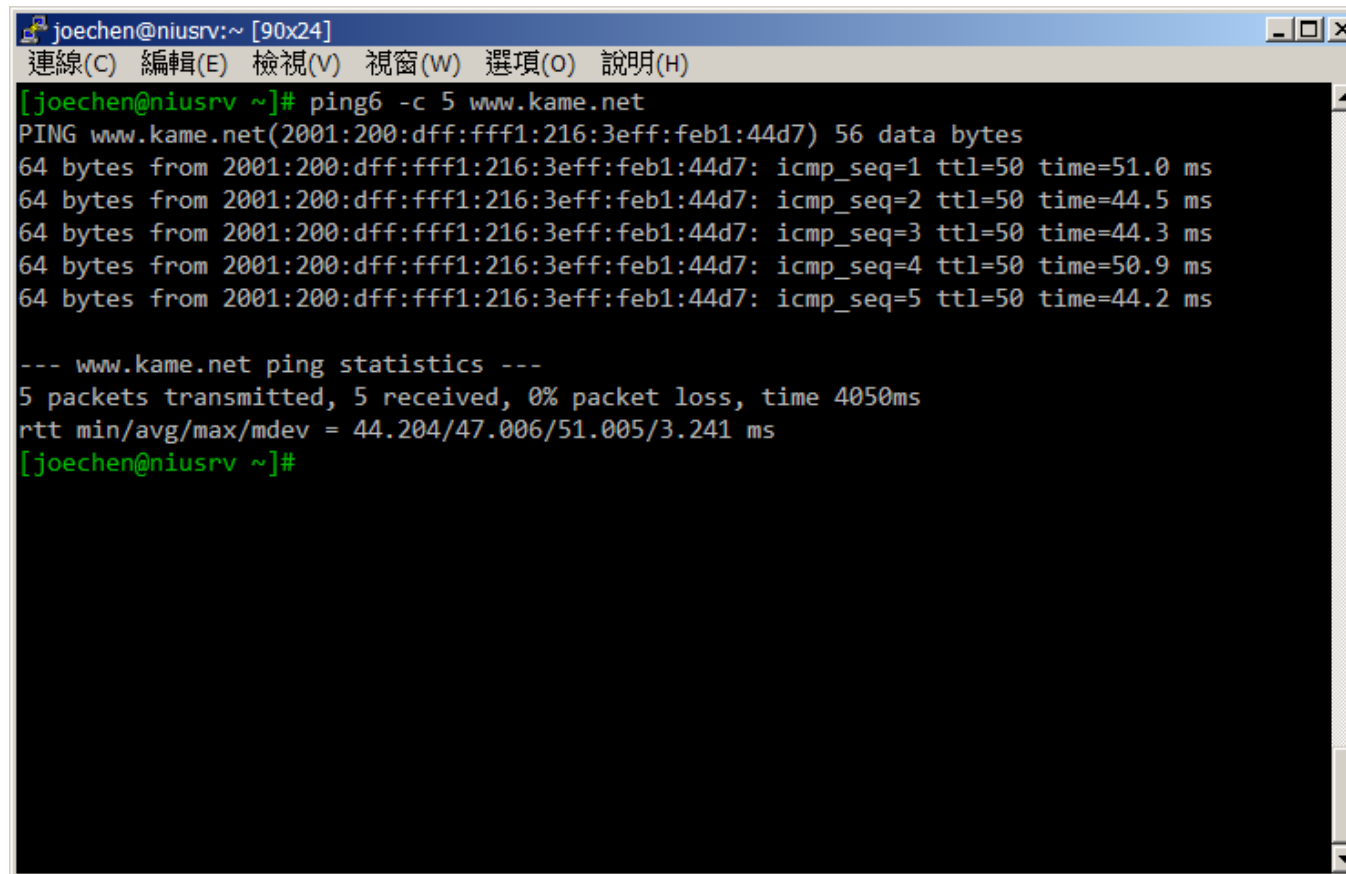
Non-authoritative answer:
www.kame.net     canonical name = orange.kame.net.
orange.kame.net has AAAA address 2001:200:dff:fff1:216:3eff:feb1:44d7

Authoritative answers can be found from:
kame.net         nameserver = orange.kame.net.
kame.net         nameserver = mango.itojun.org.
mango.itojun.org internet address = 210.155.141.200
mango.itojun.org has AAAA address 2001:2f0:0:8800::1:1
mango.itojun.org has AAAA address 2001:2f0:0:8800:206:5bff:fe8d:940
orange.kame.net internet address = 203.178.141.194

[joechen@niusrv ~]#
```


Linux and IPv6

- 測試網路連線 (ping6 指令)
 - 輸入 `ping6 -c 5 www.kame.net` (執行5次)

A terminal window titled 'joechen@niusrv:~ [90x24]' with a menu bar containing '連線(C)', '編輯(E)', '檢視(V)', '視窗(W)', '選項(O)', and '說明(H)'. The terminal shows the execution of the command 'ping6 -c 5 www.kame.net'. The output displays five successful ping requests to the IPv6 address 2001:200:dff:fff1:216:3eff:feb1:44d7, with varying response times between 44.2 ms and 51.0 ms. A summary line indicates '5 packets transmitted, 5 received, 0% packet loss, time 4050ms' and provides RTT statistics: 'rtt min/avg/max/mdev = 44.204/47.006/51.005/3.241 ms'.

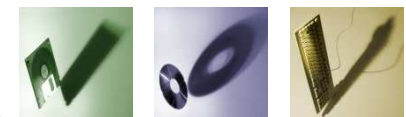
```
joechen@niusrv:~ [90x24]
連線(C) 編輯(E) 檢視(V) 視窗(W) 選項(O) 說明(H)
[joechen@niusrv ~]# ping6 -c 5 www.kame.net
PING www.kame.net(2001:200:dff:fff1:216:3eff:feb1:44d7) 56 data bytes
64 bytes from 2001:200:dff:fff1:216:3eff:feb1:44d7: icmp_seq=1 ttl=50 time=51.0 ms
64 bytes from 2001:200:dff:fff1:216:3eff:feb1:44d7: icmp_seq=2 ttl=50 time=44.5 ms
64 bytes from 2001:200:dff:fff1:216:3eff:feb1:44d7: icmp_seq=3 ttl=50 time=44.3 ms
64 bytes from 2001:200:dff:fff1:216:3eff:feb1:44d7: icmp_seq=4 ttl=50 time=50.9 ms
64 bytes from 2001:200:dff:fff1:216:3eff:feb1:44d7: icmp_seq=5 ttl=50 time=44.2 ms

--- www.kame.net ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4050ms
rtt min/avg/max/mdev = 44.204/47.006/51.005/3.241 ms
[joechen@niusrv ~]#
```

Linux and IPv6

- 測試網路連線 (traceroute6 指令)
 - 輸入 traceroute6 *www.kame.net*

```
joechen@niusrv:~ [109x24]
連線(C) 編輯(E) 檢視(V) 視窗(W) 選項(O) 說明(H)
[joechen@niusrv ~]# traceroute6 www.kame.net
traceroute to www.kame.net (2001:200:dff:fff1:216:3eff:feb1:44d7), 30 hops max, 80 byte packets
 1 2001:288:a001:5::1 (2001:288:a001:5::1) 0.482 ms 0.528 ms 0.570 ms
 2 2001:288:0:f:107::f0 (2001:288:0:f:107::f0) 0.441 ms 0.483 ms 0.523 ms
 3 2001:288:0:1659:192:83:196:111 (2001:288:0:1659:192:83:196:111) 1.311 ms 1.359 ms 1.394 ms
 4 2001:288:0:f:111::1f (2001:288:0:f:111::1f) 1.545 ms 1.579 ms 1.537 ms
 5 2606:c00:0:2::2 (2606:c00:0:2::2) 1.150 ms 1.180 ms 1.127 ms
 6 2606:c00:1::6 (2606:c00:1::6) 3.006 ms 1.513 ms 1.497 ms
 7 2606:c00:1::9 (2606:c00:1::9) 6.336 ms 3.033 ms 3.074 ms
 8 ge-0-0-0.a05.taipw01.tw.ra.gin.ntt.net (2001:218:8000:5000::9) 135.470 ms 135.432 ms 135.479 ms
 9 xe-0-1-0.r20.taipw01.tw.bb.gin.ntt.net (2001:218:0:6000::1a5) 142.946 ms 143.027 ms 143.075 ms
10 p64-3-1-1.r24.tokyjp01.jp.bb.gin.ntt.net (2001:218:0:2000::25) 149.389 ms 149.362 ms 149.447 ms
11 po-1.a15.tokyjp01.jp.ra.gin.ntt.net (2001:218:0:6000::10e) 178.037 ms 130.681 ms 130.705 ms
12 ge-8-2.a15.tokyjp01.jp.ra.gin.ntt.net (2001:218:2000:5000::82) 32.759 ms 32.815 ms 32.794 ms
13 ve44.foundry6.otemachi.wide.ad.jp (2001:200:0:10::141) 37.510 ms 32.246 ms 32.179 ms
14 ve42.foundry4.nezu.wide.ad.jp (2001:200:0:11::66) 37.037 ms 39.772 ms 32.401 ms
15 cloud-net1.wide.ad.jp (2001:200:0:1c0a:218:8bff:fe43:d1d0) 32.623 ms 32.343 ms 32.423 ms
16 2001:200:dff:fff1:216:3eff:feb1:44d7 (2001:200:dff:fff1:216:3eff:feb1:44d7) 42.558 ms 49.859 ms 42.594
ms
[joechen@niusrv ~]#
```

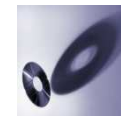


Application for IPv6

- 常見伺服器軟體

Application	IPv6	IPv4
Apache httpd (WWW server)	Yes	Yes
IIS (7.0 ~, WWW server)	Yes	Yes
BIND (DNS server)	Yes	Yes
MS DNS (DNS server)	Yes	Yes
Squid Proxy (Proxy server)	Yes	Yes
OpenLDAP (LDAP server)	Yes	Yes
Active Directory (LDAP server)	Yes	Yes
Windows SMB/CIFS (網路芳鄰)	Yes	Yes
Samba (網路芳鄰)	Yes	Yes
MS SQL server	Yes	Yes

參考來源: http://en.wikipedia.org/wiki/Comparison_of_IPv6_application_support

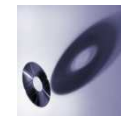


Application for IPv6

- 常見應用程式

Application	IPv6	IPv4
Mozilla Thunderbird (E-mail)	Yes	Yes
Apple Mail (E-mail)	Yes	Yes
MS Outlook / MS Mail (E-mail)	Yes	Yes
Mozilla Firefox (Web Browser)	Yes	Yes
Chrome (Web Browser)	Yes	Yes
I.E. (7.0~, Web Browser)	Yes	Yes
FileZilla (FTP)	Yes	Yes
Telnet/SSH/Putty (遠端控制)	Yes	Yes
MPlayer (multimedia)	Yes	Yes
Windows Media Player (multimedia)	Yes	Yes

參考來源: http://en.wikipedia.org/wiki/Comparison_of_IPv6_application_support



IPv6 Web Site

- 台灣 IPv6 論壇



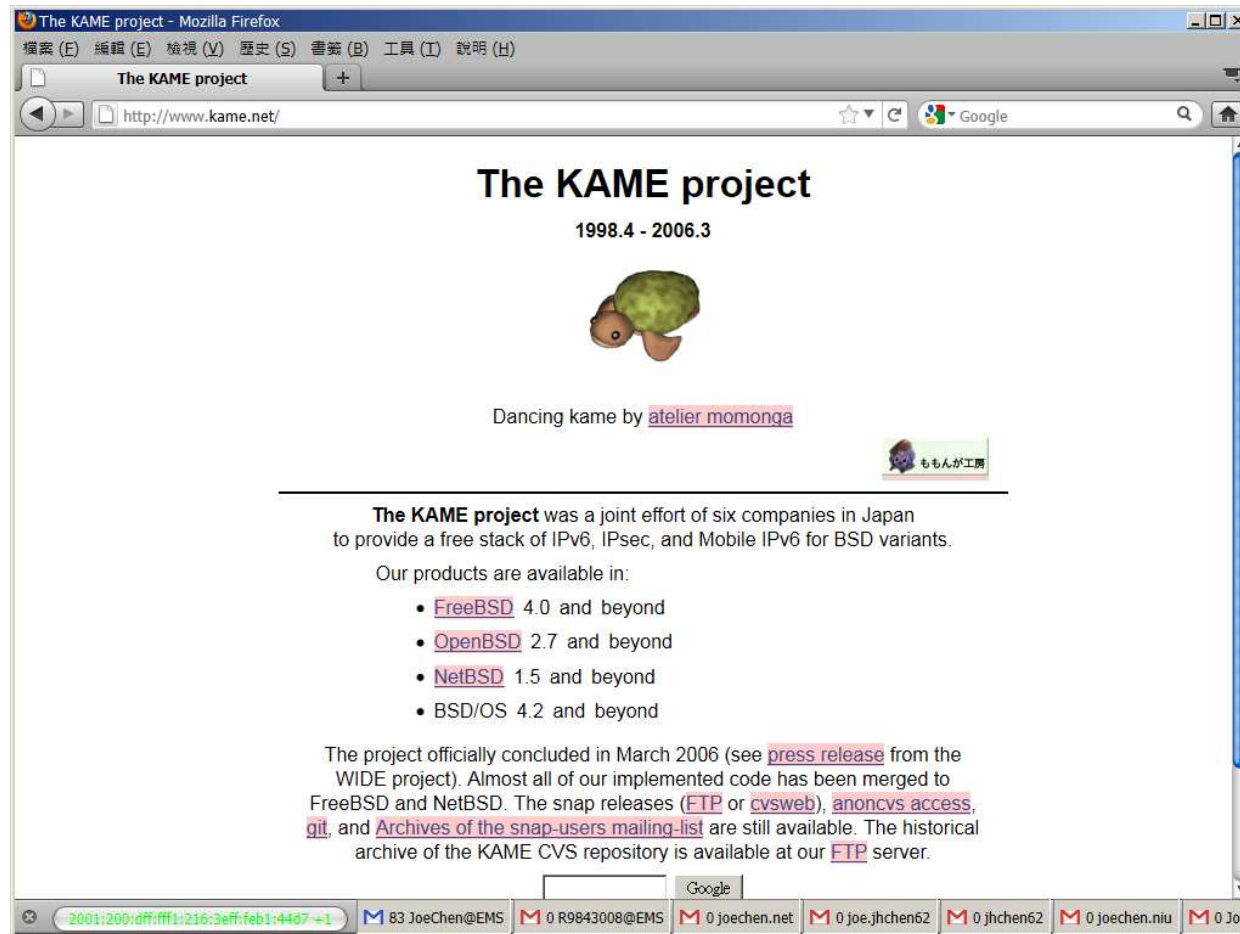
IPv6 Web Site

- IPv6Day



IPv6 Web Site

- The KAME project



IPv6 Web Site

- HiNet IPv6



IPv6 Web Site

- IPv6 Enabled Program

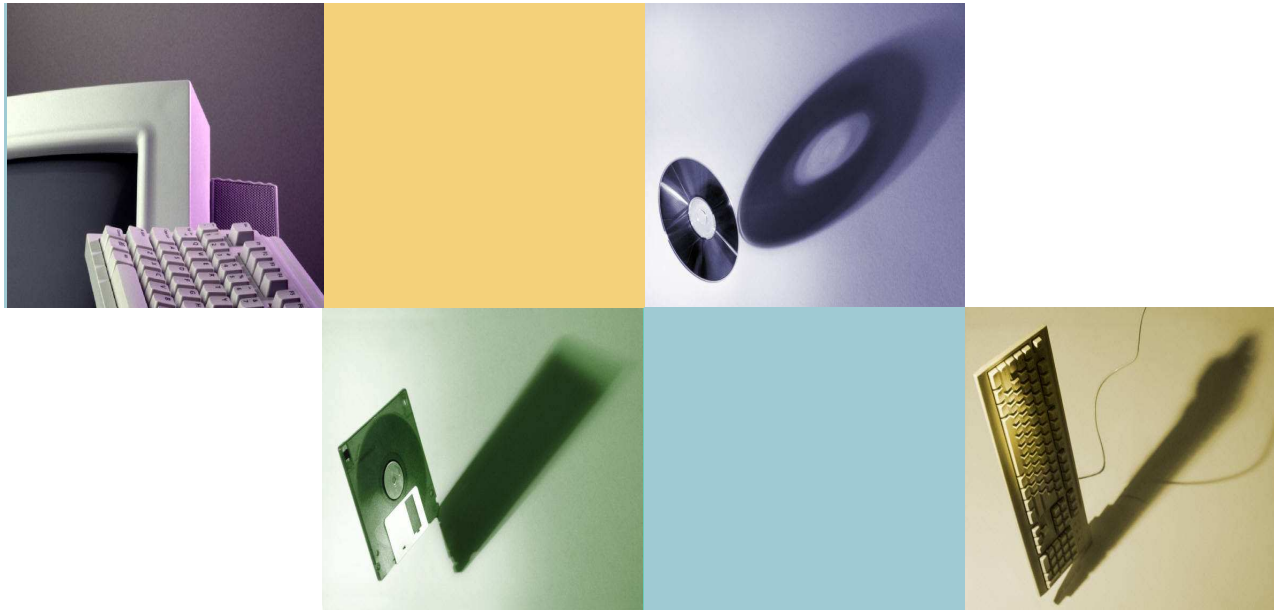
IPv6 Enabled WWW Web Sites List

URL: Search Clear

IPv6 Enabled WWW Web Sites List

Your any query or comment about the validated web sites as follows is deeply appreciated and please [contact us](#)

Status ^(?)	ID	Organization Name	URL	Region/Country	Tags	Approved Time
IPv6 Enabled	W1-TW-00000239	National Chi Nan University	ftp.ncnu.edu.tw	TW	Education Site	2009-06-30 11:53:29
IPv6 Enabled	W1-TW-00000448	Education Network Center of Taichung County	www.tcc.edu.tw	TW	Education Site	2009-11-03 04:37:05
IPv6 Enabled	W1-TW-00000449	Education Network Center of Miaoli County	www.mlc.edu.tw	TW	Education Site	2009-12-07 08:10:40
SERVICE-OUT	W1-TW-00000452	Taichung Hsien Shin-shen Elementary School	www.ssps.tcc.edu.tw	TW	Education Site	2009-11-09 00:52:51



THANKS !