

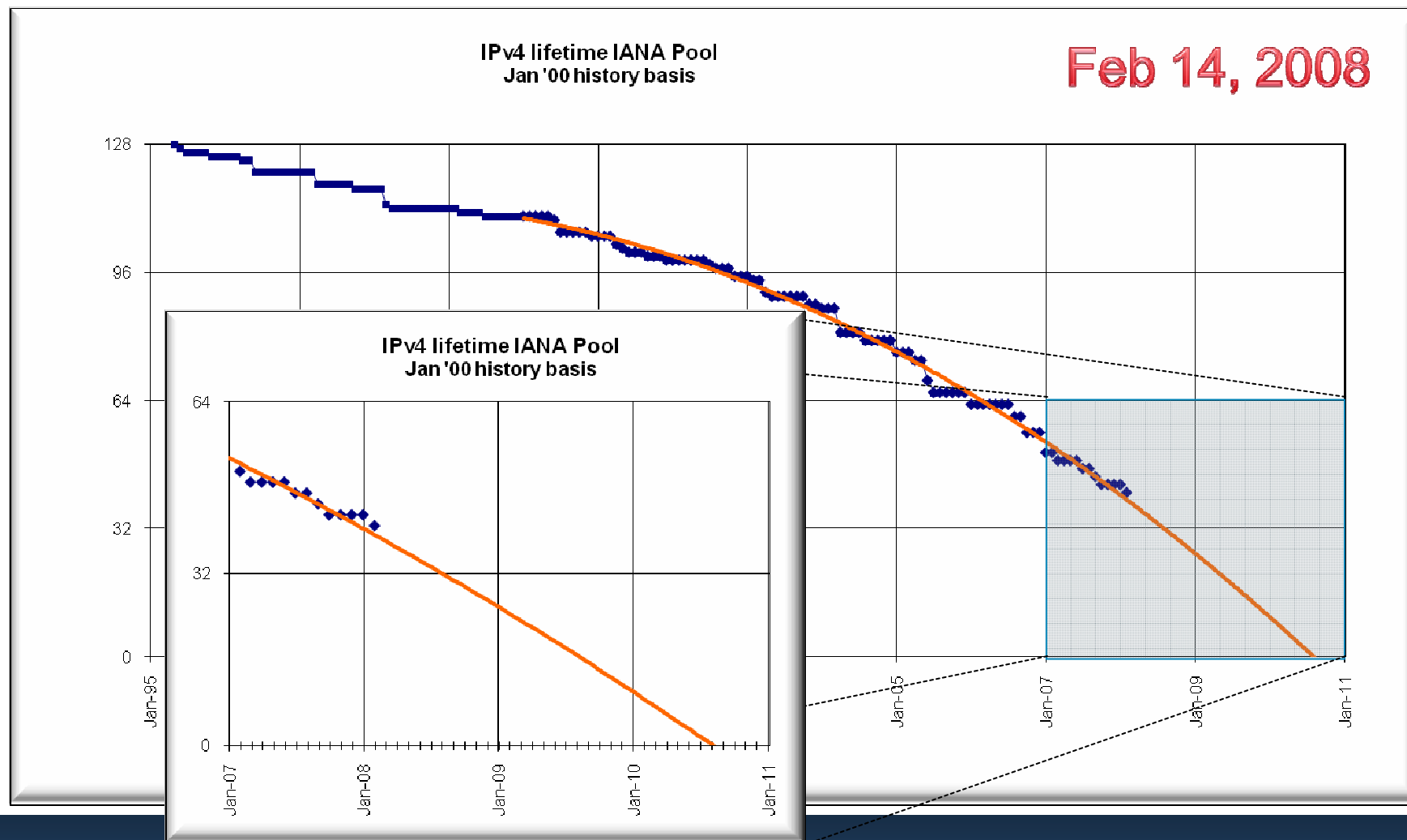


CiscoのIPv6対応と プレゼンマ



Hiroynuki Kodama [hkodama@cisco.com]
13 Mar 2009

Remaining IANA IPv4 pool



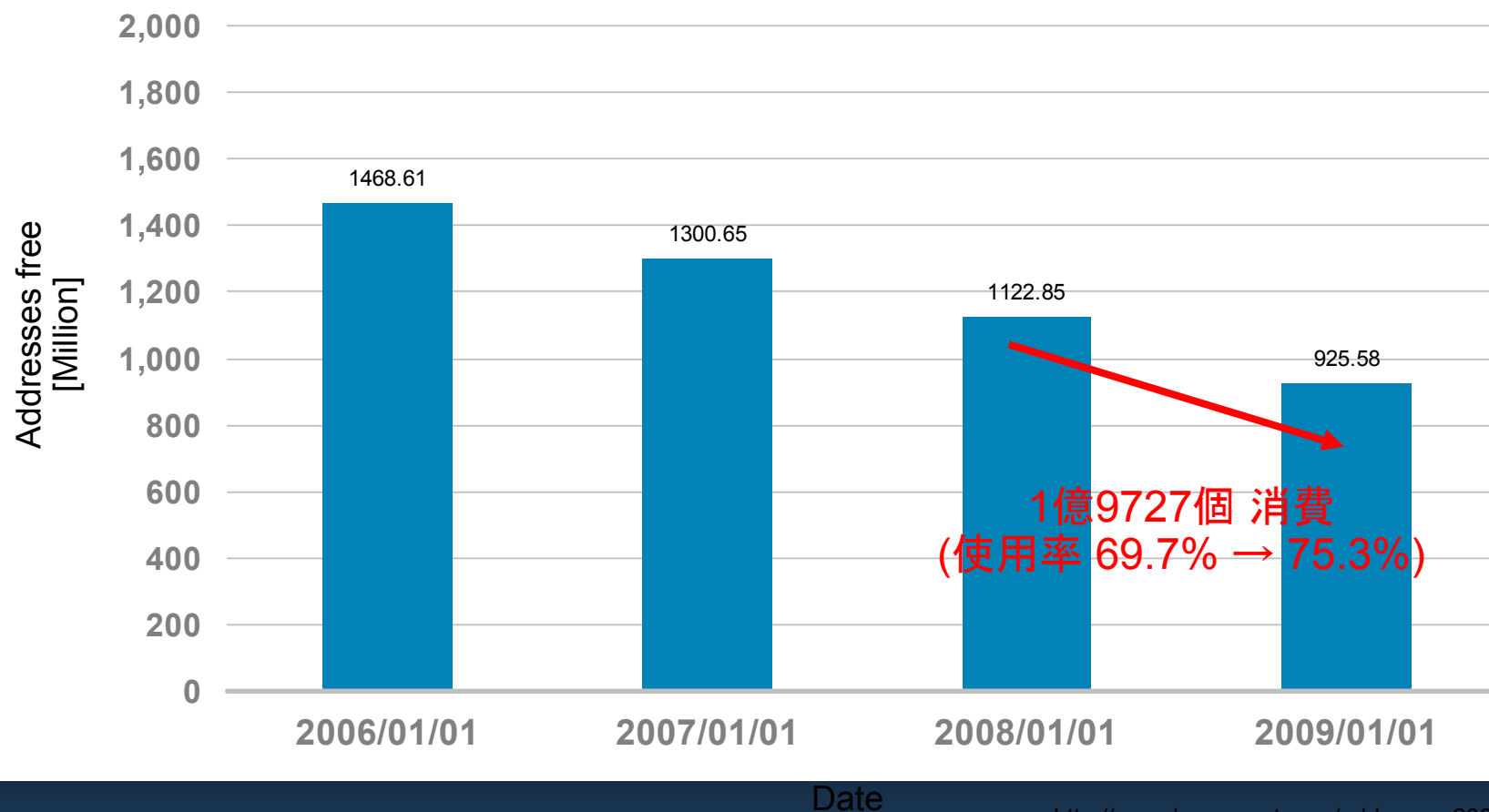
IPv4 Address Fractal Map Jan-2011

000 Reserved	001 Reserved	014 Next	015 HP	016 DEC	019 Ford	020 CsC	021 US DoD	234 Multicast	235 Multicast	236 Multicast	239 Multicast	240 Class E	241 Class E	254 Class E	255 Class E
003 GE	002 Next	013 Xerox	012 AT&T	017 Apple	018 MIT	023 Next	022 US DoD	233 Multicast	232 Multicast	237 Multicast	238 Multicast	243 Class E	242 Class E	253 Class E	252 Class E
004 L3	007 Next	008 L3	011 US DoD	030 US DoD	029 US DoD	024 Cable	025 UK Defense	230 Multicast	231 Multicast	226 Multicast	225 Multicast	244 Class E	247 Class E	248 Class E	251 Class E
005 Next	006 US DoD	009 IBM	010 Private	031 Next	028 US DoD	027 Next	026 US DoD	229 Multicast	228 Multicast	227 Multicast	224 Multicast	245 Class E	246 Class E	249 Class E	250 Class E
058 APnic	057 SITA	054 Merck	053 Cap Debis	032 AT&T	035 MERIT	036 Next	037 Next	218 APnic	219 APnic	220 APnic	223 Next	202 APnic	201 LACnic	198 Various	197 Next
059 APnic	056 US Postal	055 US DoD	052 EI duPONT	033 US DoD	034 Haliburton	039 Next	038 PSI	217 RIPE	216 ARIN	221 APnic	222 APnic	203 APnic	200 LACnic	199 ARIN	196 AFRnic
060 APnic	061 APnic	050 Next	051 UK DSS	046 Next	045 Interop	040 Eli Lilly	041 AFRNIC	214 US DoD	215 US DoD	210 APnic	209 ARIN	204 ARIN	205 ARIN	194 RIPE	195 RIPE
063 ARIN	062 RIPE	049 Next	048 Prudential	047 Bell North	044 Radio	043 Inet	042 Next	213 RIPE	212 RIPE	211 APnic	208 ARIN	207 ARIN	206 ARIN	192 RIPE	192 Various
064 ARIN	067 ARIN	068 ARIN	069 ARIN	122 APnic	123 APnic	124 APnic	127 Loopback	128 Various	131 Various	132 Various	133 Various	186 LANnic	187 LANnic	188 Various	191 Various
065 ARIN	066 ARIN	071 ARIN	070 ARIN	121 APnic	120 APnic	125 APnic	126 APnic	129 Various	130 Various	135 Various	134 Various	185 Next	184 Next	189 LACnic	190 LACnic
078 RIPE	077 RIPE	072 ARIN	073 ARIN	118 APnic	119 APnic	114 APnic	113 Next	142 Various	141 Various	136 Various	137 Various	182 Next	183 Next	178 Next	177 Next
079 RIPE	076 ARIN	075 ARIN	074 ARIN	117 APnic	116 APnic	115 APnic	112 Next	143 Various	140 Various	139 Various	138 Various	181 Next	180 Next	179 Next	176 Next
080 RIPE	081 RIPE	094 RIPE	095 RIPE	096 ARIN	097 ARIN	110 Next	111 Next	144 Various	145 Various	158 Various	159 Various	160 Various	161 Various	174 Next	175 Next
083 RIPE	082 RIPE	093 RIPE	092 RIPE	099 ARIN	098 ARIN	109 Next	108 Next	147 Various	146 Various	157 Various	156 Various	163 Various	162 Various	173 Next	172 Various
084 RIPE	087 RIPE	088 RIPE	091 RIPE	100 Next	103 Next	104 Next	107 Next	148 Various	151 Various	152 Various	155 Various	164 Various	167 Various	168 Various	171 Various
085 RIPE	086 RIPE	089 RIPE	090 RIPE	101 Next	102 Next	105 Next	106 Next	149 Various	150 Various	153 Various	154 Various	165 Various	166 Various	169 Various	170 Various

Fractal map: Layout by Randall Munroe, Time Sequence by Tony Hain, Highlighted by Jeff Apcar

2008 IPv4 Address Use Report

IPv4アドレスの消費数



<http://www.bgpexpert.com/addrspace2008.php>

2008 IPv4 Address Use Report (3)

Rank	Was	2009-01-01 (millions)	2008-01-01 (millions)	Increase	Country
1		1458.21	1408.15	4%	United States
2	3	181.80	135.31	34%	China
3	2	151.56	141.47	7%	Japan
4		120.29	120.35	0%	Europe general
5		86.31	83.50	3%	United Kingdom
6	7	81.75	72.46	13%	Germany
7	6	74.49	73.20	2%	Canada
8		68.04	67.79	0%	France
9		66.82	58.86	14%	Korea
10		36.26	33.43	8%	Australia
11	12	29.75	23.46	27%	Brazil
12	11	29.64	24.04	23%	Italy
13	16	24.01	19.83	21%	Taiwan
14	18	23.18	17.01	36%	Russia
15	14	21.67	20.42	6%	Spain

<http://www.bgpexpert.com/addrspace2008.php>

- 上位 3 カ国 = 中国、ブラジル、ロシア (BRICs)

Monitoring Market Drivers

Adresse 枯渴

<http://www.potaroo.net/tools/ipv4/>

インパクト

- Internet 成長の鈍化
- 企業新興諸国への事業拡大への影響
- 新規事業者へのハードル

National IT Strategy

IPv6 Task Force and promotion councils:
Africa, India, Japan, Korea,...

U.S. Federal Mandate

China Next Generation Internet (CNGI)
project

European Commission sponsored
projects



IPv6 “on” & “preferred” by default
IPv6だけで動作するアプリケーション (P2P framework)

IP NGN

DOCSIS 3.0, FTTH, HDTV, Quad
Play

Mobile SP – 3G, WiMax, PWWAN

Networks in Motion

Networked Sensors, ie: AIRS

NAT Overlap – M&A

MSFT Vista & Server 2008

Infrastructure Evolution

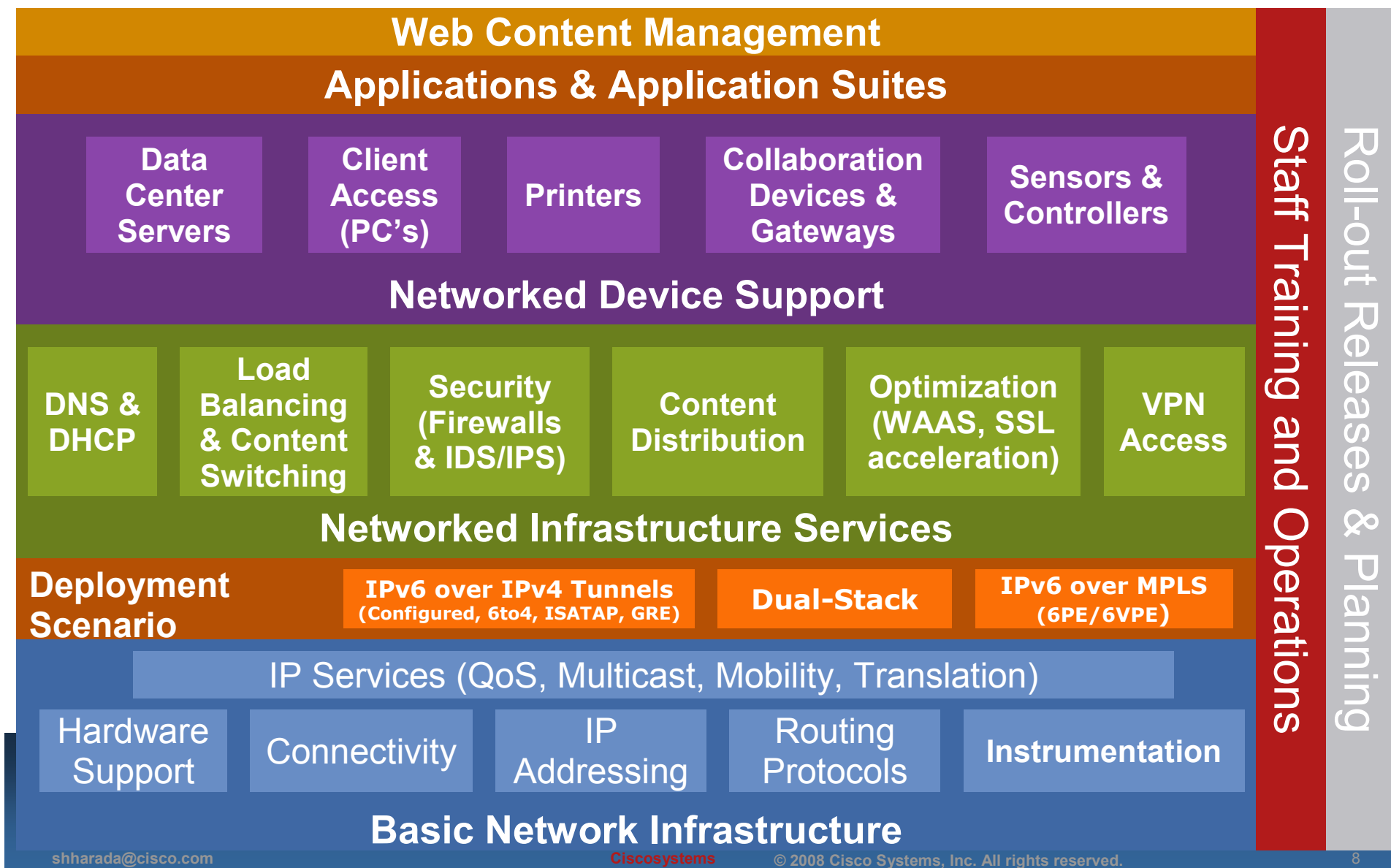
他国政府関係

- EUも目標25%@2010です

http://ec.europa.eu/information_society/policy/ipv6/docs/european_day/communication_final_27052008_en.pdf

- 中国も同様に、必須項目(BRICs ?)
- US Fed 特にDoDは必須。おかげでreadyLogo-2が。。。。

The Scope of IPv6 Deployment



IntelのEthernet NICのIPv6対応

Intel® Network Adapters – Do Intel adapters support IPv6?

1/1 ページ



Network Connectivity

Search

Support & Downloads

☐ All of Support

☒ This Category

Search

Intel® Network Adapters

Do Intel adapters support IPv6?

Yes, Intel network adapters and network connections are tested with and support IPv6.

Intel tests our network adapters with IPv6 traffic using current versions of Microsoft Windows®, Linux®, and FreeBSD®.

This applies to:

EtherExpress™ 10 ISA adapter	Intel® PRO/1000 CT Network Connection
EtherExpress™ 16 Adapter	Intel® PRO/1000 F Server Adapter
EtherExpress™ 32 Adapter	Intel® PRO/1000 Gigabit Server Adapter
EtherExpress™ 32N Adapter	Intel® PRO/1000 GT Desktop Adapter
EtherExpress™ Classic Adapter	Intel® PRO/1000 GT Quad Port Server Adapter
EtherExpress™ Flash 32 Adapter	Intel® PRO/1000 MF Dual Port Server Adapter
EtherExpress™ PRO/10 and PRO/10+ ISA adapters	Intel® PRO/1000 MF Server Adapter
EtherExpress™ PRO/10 PCI Adapter	Intel® PRO/1000 MF Server Adapter (LX)
EtherExpress™ PRO/10+ PCI Adapter	Intel® PRO/1000 MT Desktop Adapter
Intel® 10 Gigabit AF DA Dual Port Server Adapter	Intel® PRO/1000 MT Dual Port Server Adapter
Intel® 10 Gigabit AT Server Adapter	Intel® PRO/1000 MT Quad Port Server Adapter
Intel® 10 Gigabit CX4 Dual Port Server Adapter	Intel® PRO/1000 MT Server Adapter
Intel® 10 Gigabit XF LR Server Adapter	Intel® PRO/1000 PF Dual Port Server Adapter
Intel® 10 Gigabit XF SR Dual Port Server Adapter	Intel® PRO/1000 PF Quad Port Server Adapter
Intel® 10 Gigabit XF SR Server Adapter	Intel® PRO/1000 PF Server Adapter
Intel® Gigabit CT Desktop Adapter	Intel® PRO/1000 PT Desktop Adapter
Intel® Gigabit ET Dual Port Server	

OSの対応



- 一般利用されるOSのほとんどがIPv6サポート
- Top-to-bottom TCP/IP stack re-design
- IPv6 is on by default and preferred over IPv4 (considering network/DNS/application support)
- Tunnels will be used before IPv4 if required by IPv6-enabled application
ISATAP, Teredo, 6to4, Configured
- Vista/Server 2008 support IPv4 and IPv6 (IPv6-only is supported)
Active Directory, IIS, File/Print/Fax, WINS/DNS/DHCP/LDAP, Windows Media Services, Terminal Services, Network Access Services – Remote Access (VPN/Dial-up), Network Access Protection (NAP), Windows Deployment Service, Certificate Services, SharePoint services, Network Load-Balancing, Internet Authentication Server, Server Clustering, etc...
- <http://www.microsoft.com/technet/network/ipv6/default.msp>

Content sites are taking initial steps

ipv6.google.com

米Googleは2008年5月13日、同社の検索機能がIPv6に対応したと[公式ブログ](#)の中で発表した。IPv6版Google検索サイトのアドレスは「<http://ipv6.google.com/>」
GoogleMapも : <http://ipv6.google.com/maps>



CiscoのIPv6への貢献



- Long standing support for IPv6 by Cisco

IETF Working Group Chairs: IPv6; ngtrans; v6ops; dhcpv6;
mipv6; roll; softwire

Cisco engineers originated many IETF proposals

IPv6, MP-BGP4, NAT-PT, 6PE/6VPE, DHCPv6 PD, ...

Founding member of the IPv6 Forum

Founding partner of 6Net

IPv6 Ready Logo

Mobile Networking demo – IPv6 Promotion council

“Jun Murai award”



IPv6 対応製品 (Router-1)

Product	IPv6	H/W	Comments
Cisco CRS-1	Now	Yes	HW Performance up to 40Gb/s (OC-768 line card)
Cisco 12000 Series	Now	Yes	HW Performance up to 10 Gb/s (Engine 5)
Cisco 10720 Series	Now	Yes	
Cisco ASR 1000 Series	Now	Yes	
Cisco 10000 Series	Now	Yes	With PRE2, PRE3 and PRE4
Cisco 7600 Series	Now	Yes	With Supervisor Engine 720, 720-3BXL, and 32W, RSP720, as well as 10Gb/s support (10GE and OC-192)
Cisco 7304	Now	–	
Cisco 7301	Now	–	
Cisco 7200 Series	Now	–	

IPv6 対応製品 (Router-2)

Product	IPv6	H/W	Comments
Cisco 3800 Series	Now	–	
Cisco 3200 Series	Now	–	
Cisco 2800 Series	Now	–	
Cisco 1800 Series	Now	–	
Cisco 870 series	Now	–	
Cisco 860 series	Now	–	
Cisco 850 series	No	–	No IPv6 support
Cisco 830 Series	Now	–	Beginning on Release 12.3(4)XG

IPv6 対応製品 (Router-3)

Product	IPv6	H/W	Comments
Cisco 7500 Series	Now	–	End of Life
Cisco 4000 Series	–	–	End of Life
Cisco AS5850	Now	–	
Cisco AS5400	Now	–	
Cisco AS5350	Now	–	
Cisco 3700 Series	Now	–	
Cisco 3600 Series	Now	–	Refer to Product Bulletin #1975 on Cisco 3620
Cisco 2600 Series	Now	–	Refer to Product Bulletin #1975 for non-XM Cisco 2600 (except 2691)
Cisco 2500 Series	Now	–	End of LifeLimited support from Cisco IOS Software Release 12.2T
Cisco 1700 Series	Now	–	

IPv6 対応製品 (CatalystSwitch)

Product	IPv6	H/W	Comments
Cisco Catalyst 6500 Series	Now	Yes	With Supervisor Engine 720 and 720-3BXL, and 32W as well as 10Gb/s support(10GE and OC-192)
Cisco Catalyst 4500 Series	Now	Yes	With Supervisor Engine 6E
Cisco Catalyst 3750 and 3750-E Series	Now	Yes	
Cisco Catalyst 3560 and 3560-E Series	Now	Yes	

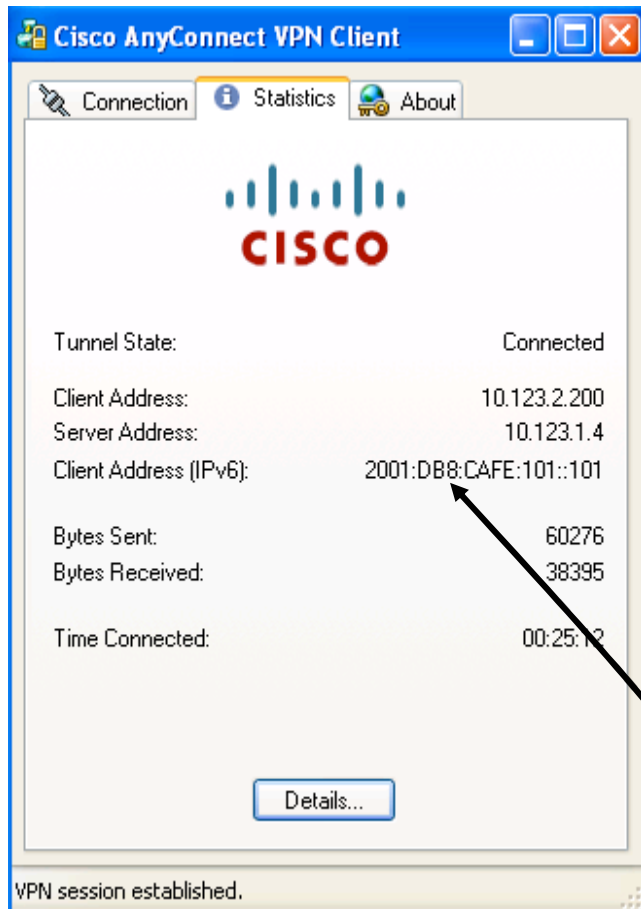
IPv6 対応 Datacenter

- Nexus 7000
 - supports IPv6 addressing
MLD v2 / PIM SSM / PIM BIDR / EIGRP
 - features support IPv6
QoS / uRPF / ACLs-PACLs / VACLs / RACLs
CoPP matching packets / NetFlow
- Cisco MDS 9000 with SAN-OS rel 3.x
 - MDS 95xx、92xx、91xx

IPv6 対応 Security

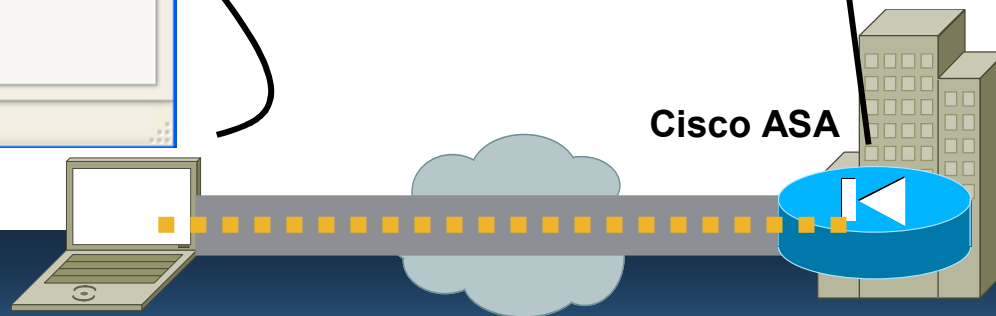
Feature Set	Solution/Product	Status
IPv6 IPsec	OSPFv3 authentication on Cisco IOS Software	Now
	Site-to-site tunnel	Now
	IPv6 hardware encryption modules – NM-AIM/VPN, VAM2+	Now
Firewall	Cisco IOS Software IPv6 firewall	Now
	Cisco PIX Firewall	Now
	Cisco ASA 5500	Now
	Cisco Catalyst 6500/7600 Series Firewall Services Module (FWSM)	Now

AnyConnect 2.x—SSL VPN

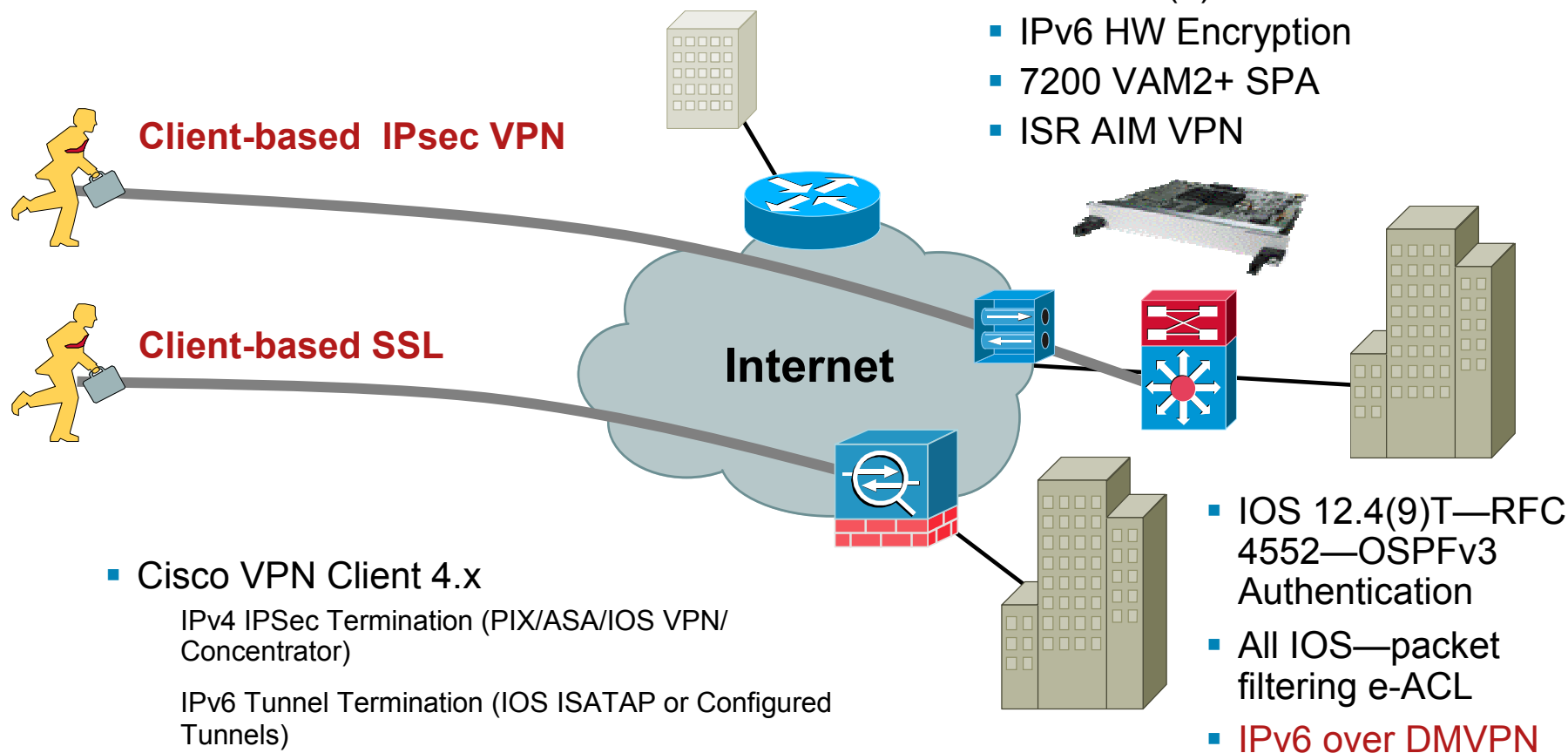


```
asa-edge-1#show vpn-sessiondb svc
Session Type: SVC
Username      : ciscoese                      Index      : 14
Assigned IP   : 10.123.2.200                  Public IP   : 10.124.2.18
Assigned IPv6 : 2001:db8:cafe:101::101
Protocol      : Clientless SSL-Tunnel DTLS-Tunnel
License       : SSL VPN
Encryption    : RC4 AES128                   Hashing     : SHA1
Bytes Tx      : 79763                        Bytes Rx    : 176080
Group Policy  : AnyGrpPolicy                  Tunnel Group: ANYCONNECT
Login Time    : 14:09:25 MST Mon Dec 17 2007
Duration      : 0h:47m:48s
NAC Result    : Unknown
VLAN Mapping  : N/A                          VLAN        : none
```

Dual-Stack Host
AnyConnect Client



Cisco IPv6 Security



- Cisco VPN Client 4.x
 - IPv4 IPsec Termination (PIX/ASA/IOS VPN/Concentrator)
 - IPv6 Tunnel Termination (IOS ISATAP or Configured Tunnels)
- AnyConnect Client 2.x
 - SSL/TLS or DTLS (datagram TLS = TLS over UDP)
 - Tunnel transports both IPv4 and IPv6 and the packets exit the tunnel at the hub ASA as native IPv4 and IPv6.

- IPv6 Firewall
- IOS Firewall 12.3T, 12.4, 12.4T
- FWSM 3.x
- PIX 7.x +, including ASA 5500 series

Cisco.comでの情報提供

- IPv6全般

http://www.cisco.com/en/US/technologies/collateral/tk648/tk872/tk373/technologies_white_paper_09186a00802219bc.html

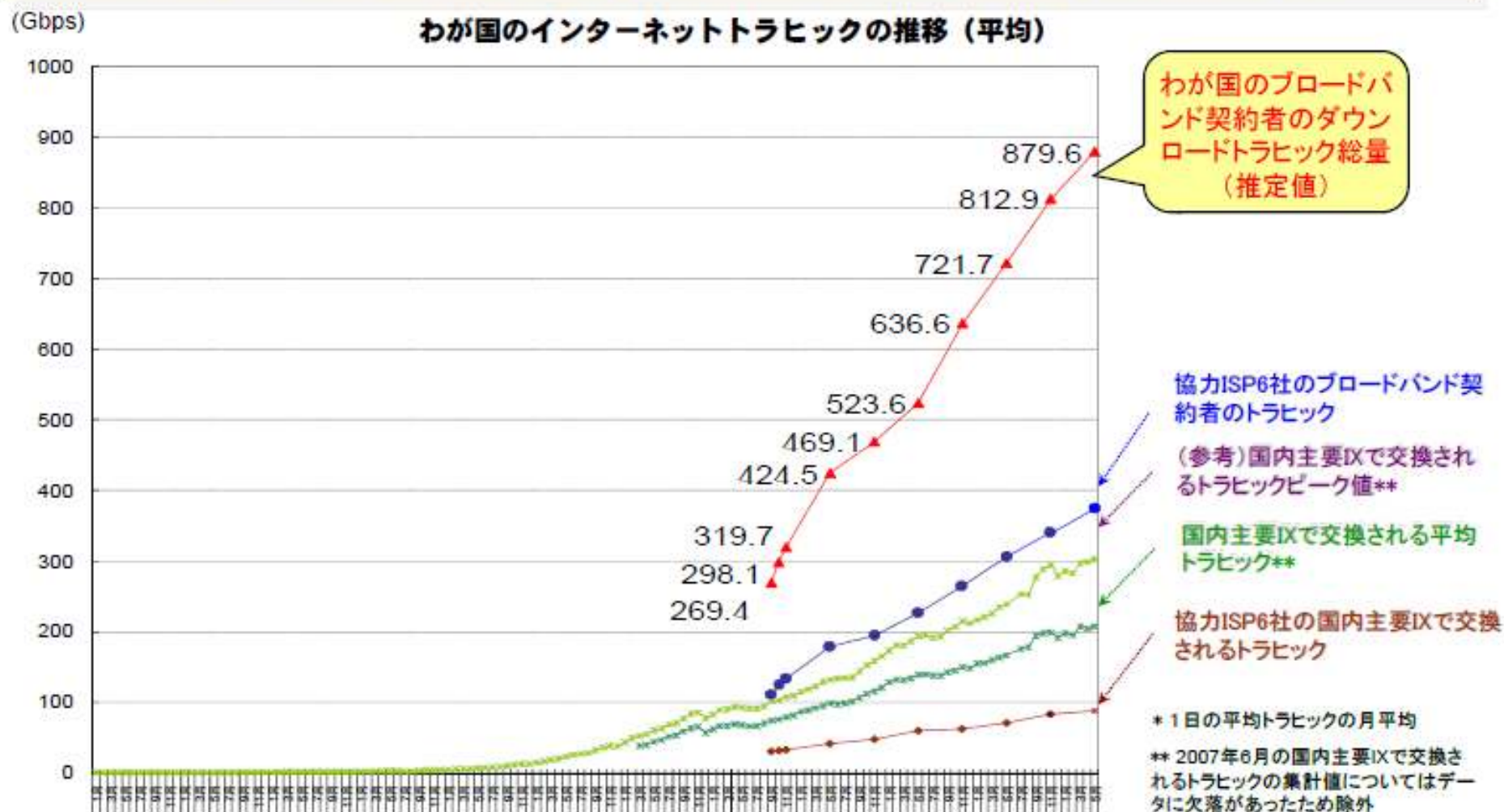
- IPv4/IPv6 ルータパフォーマンス

http://www.cisco.com/web/strategy/docs/gov/IPv6perf_wp1f.pdf

- その他 IPv6 デザインガイドなど

我が国のインターネットトラフィックの推移

○ 我が国のインターネットを流通するトラフィック*の規模は880Gbps相当となり、3年で約2倍の伸び。



(出典) 我が国のインターネットにおけるトラフィック総量の把握(総務省2008年8月)

19

1 環境の変化

1.1 利用者一人当たりのトラフィックの拡大

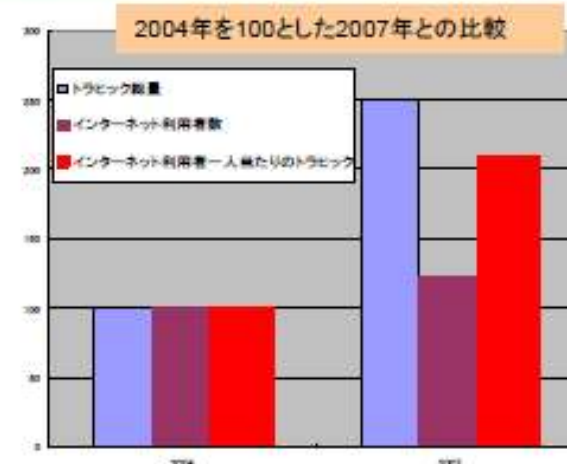
■インターネット利用環境の整備

- FTTH利用が急速に浸透
- 動画などのリッチコンテンツが増加し利用しやすくなった。
- P2P利用が拡大



- 利用者一人当たりのトラフィックが3年で2倍に増加
- インターネット利用者の増加以上に、利用トラフィックの伸びが大きい。

	2004*	2007*	伸び率
A.トラフィック総量 (総務省発表「我が国のインターネットにおけるトラフィックの集計・試算」より)	323.6Gbps	812.9Gbps	2.51倍
B.PCからのインターネット利用者数 (総務省発表「ブロードバンドサービスの契約数等」「通信利用動向調査」より)	6,416万	7,813万	1.22倍
A/B インターネット利用者一人当たりのトラフィック	5.29Kbps	10.9Kbps	2.09倍



*トラフィックは毎年11月、利用者数は12月なので、集計時期に若干のずれはある。

■この結果生じること

ISPの売上は固定料金制度のため、売上の伸びをネットワークコスト増が上回っている。
(売上は利用者数に比例するが、ネットワークコストはピークトラフィックに比例するため)

3

通信事業者にとってのIPv6 現状

IPv4アドレス枯渇は認識

IPv4アドレス枯渇が迫ってきているが、移行計画まで手が回らない

IPv6に移行しても、経費はかかるが、利益は生みにくい

IPv6対応しても、利用者の利便・利益には直結しない

構成が複雑になり品質が落ちる可能性もある

IPv6への対応は他のISPの動向を見ながら、検討

積極的にNAT導入したいわけではないが困ってからでは遅いので

Sever関係は可能な限りIPv6対応しておく

総務省: IPv6接続サービスの提供状況に関する調査の結果について

http://www.soumu.go.jp/menu_02/ictseisaku/ipv6/pdf/080328_1_a1.pdf

課題

- IPv6接続の必然性がないため、ユーザ側のインセンティブが働かない
- IPv6サービスを利用している法人は、全体の1%(約100社)
 - アクセスサービスの導入だけでは新たな収入源になりにくい
 - コスト負担の課題(誰がどこまで? ISP, User?)
 - ISPから利用者へのIPv6移行の付加価値の検討?
 - IPv6対応(コスト)+IPv4枯渇 = 現状のビジネスモデルの崩壊
- IPv6運用のスキル(サービス・運用部分でのIPv6対応が必要)
- 今、一番重要なのはSecurity !
- その前に解決しないといけないトラフィックの増加 !
 - インフラ構築コストは増加しているが収入増に結びついていない
- 他のレイヤー(Sler・Nler、コンテンツプロバイダー、データセンター)への事業展開

Ciscoにしていると色々な依頼が

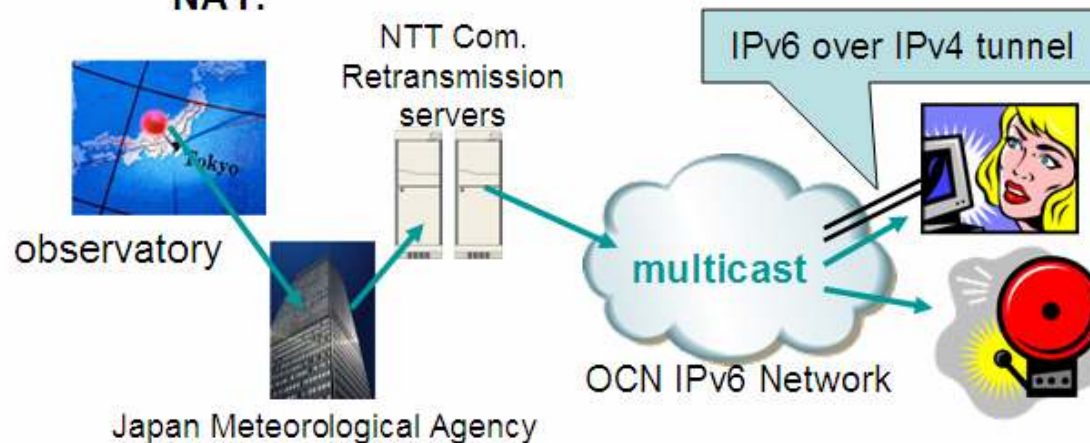
- IPv4もIPv6も同じOSライセンスフィーで
- Security、NMS、冗長性能、関係サーバ、全部v6対応
- IPv6動かしてもパフォーマンスダウンなしで！
-

Emergency Alert

NTT Com. “Earthquake alert service”

NTT Information Sharing Platform Laboratories

- **Earthquake emergency alert service**
 - On detecting P-wave, S-wave alert is delivered.
 - Dedicated terminal/software receives an alert.
 - **IPv6 multicast is adopted**
 - **Lower-delay delivery** is achieved.
 - IPv4 isn't suitable for such a push-type service due to NAT.



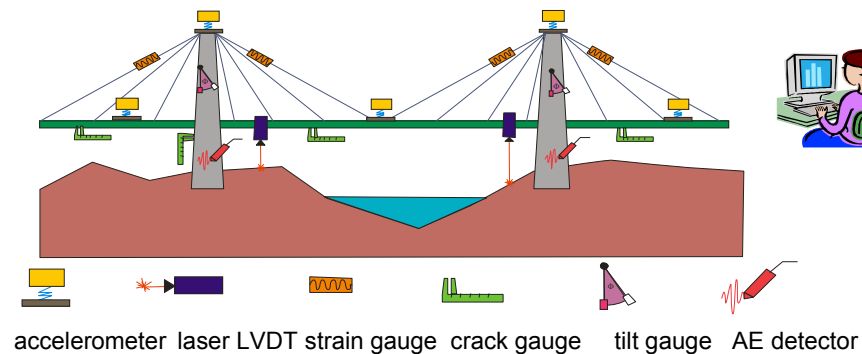
Copyright(C) NTT Information Sharing Platform Laboratories.

Sensor arrays

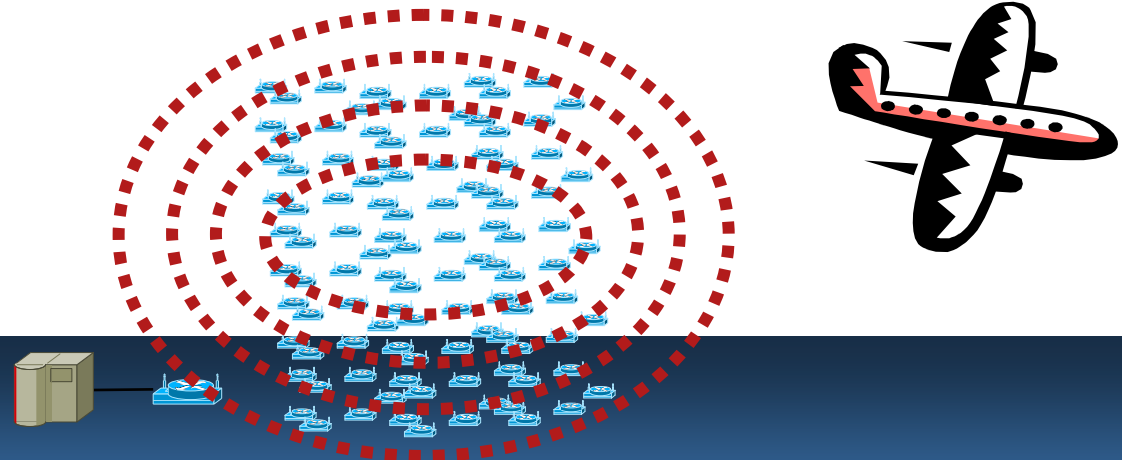
6LoWPAN (RFC 4919 & 4944) based networks

Routing Over Low power and Lossy networks <http://www.ietf.org/html.charters/roll-charter.html>

- Sensors on aging infrastructure.



- Adhoc networks of fire sensors.



Innovative Opportunity – Agriculture

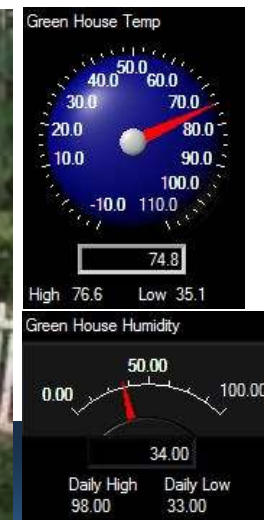
- Wireless Sensor Network Research Group, Institute of Computing Technology, Chinese Academy of Sciences

CNGI: IPv6 Based Sensor network Application Demonstration By cooperating with Chinese University of Sciences and Technology, we are going to develop a sensor application system by integrating wireless sensor network technology, control technology and precision agriculture technology. The applications of the integrated system are two-folded: accurate watering of farmland and water/soil pollution monitoring.

Opportunities exist beyond farming in smaller scale uses.



<http://www.sixxs.net/misc/toys/>



IPv6有効？利用

- IPv4枯渇と原油枯渇は違う。でもすぐにやってくる。
 - 現在アサインされているIPv4アドレスがなくなるわけではない
 - 新規アサインができないのが問題
 - 本当にGlobalな必要ある？(BBR)
 - Y2kを思い出させる状態、IPv4が枯渇する直前にパニックになるのは？
- IPv6って、IPv4の上位プロトコル？
 - IP/IPX/DECnetの共存時代と何が違うの？
 - 現在のIPv4環境を、すぐに&すべてIPv6で実現？
- YellowCable時代から引きずっているIPv4アドレス設計
 - UCやDCなど、現状のIPv4アドレス設計では追加できないアプリケーションの導入
 - Vmwareでバーチャル化の前にデザイン変更？
- ユーザがIPv6になじめば接続要求も上がる？
- ユーザがほしいのはサービスで、プロトコルじゃない

