



**ASIA-PACIFIC TELECOMMUNITY**  
**1<sup>st</sup> Meeting of SATRC Working Group on Policy,**  
**Regulation and Services in SAP-IV**  
22 – 23 October 2012, Tehran, Islamic Rep. of Iran

**Document**  
**SAPIV/WGPRS01/INP-06**  
**22 October 2012**

---

**Telecommunication Regulatory Authority of India**

**STRATEGIES FOR MIGRATION TO IPV6**

---

**Contact:** MR. V K AGARWAL  
Telecommunication Regulatory Authority of  
India

Email: [vk.agarwal@traf.gov.in](mailto:vk.agarwal@traf.gov.in)

# Strategies for Migration to IPv6

**V K Agarwal**  
**Dy. Advisor (Networks, Spectrum & Licensing)**  
**Telecom Regulatory Authority of India**

SATRC WG on Policy, Regulation & Services

1

## IP Addresses

### Internet Protocol version 4 (IPv4)

- IPv4 was initially deployed on January 1, 1983 and is still the most commonly used version.
- Uses 32-bit address space (4 byte) often expressed as 4 octets in "dotted decimal" notation (e.g. 192.168.1.152)
- Limits the address space to 4,294,967,296 ( $2^{32}$ ) possible unique addresses.
- IPv4 addresses have already exhausted with Internet Assigned Number Authority (IANA)

### Internet Protocol version 6 (IPv6)

- IPv6 is the new generation of the basic protocol of the Internet. Deployment of the IPv6 protocol began in 1999.
- Uses 128-bit address space (16-byte) and are conventionally expressed using hexadecimal strings (for example, 2001:4490:d9b2:ea38::500).
- Enormous unique addresses to cater the demand as theoretically it can supports 340282366920938 trillion trillion unique addresses.

SATRC WG on Policy, Regulation & Services

2

## Advantages of IPv6

- Larger address space
- Global reachability
- Built-in security, IPSec is a part of the IPv6 protocol.
- Simplification of Header format allows faster and efficient processing at intermediate routers enabling efficient routing
- Better QoS support
- Mobility support across the networks
- Auto-configuration mechanism makes the life of network managers easier and save substantial cost in maintaining IP networks.
- Scalability
- Multi-homing

SATRC WG on Policy, Regulation & Services

3

## IPv6 – New Applications

- Centralized Building Management System
- Smart Grid System
- Intelligent Traffic Management System
- Intelligent Healthcare
- Environmental control applications
- And more ...

SATRC WG on Policy, Regulation & Services

4

## Status of IPv4 Addresses Exhaustion

Organisation	Date of Exhaustion	Remarks
IANA	03/02/2011	Exhausted
APNIC	19/04/2011	Exhausted
RIPE NCC	14/09/2012	Exhausted
ARIN	21/08/2013	Projected
LACNIC	31/05/2015	Projected
AFRINIC	05/11/2019	Projected

Source: IPv4 Address report available at potaroo.net (as on 07/10/2012)

SATRC WG on Policy, Regulation & Services

5

## Status of IPv4 Addresses in SATRC countries

Country	Internet Users	Population	Allocated IPv4 Address /32s	IPv4 Address Allocated /32s per user
Afghanistan	1291708	30754974	108608	0.084
Bangladesh	5691881	162625196	928000	0.163
Bhutan	100018	719557	24576	0.246
India	123407429	1209876759	34798848	0.282
Iran	32111839	68468740	9565184	0.298
Maldives	113875	394032	53760	0.472
Nepal	2062105	29885593	473856	0.23
Pakistan	28420242	183356404	5187328	0.183
Sri Lanka	2588237	21934214	534272	0.206

Source: potaroo.net  
(report generated on 08/10/2012)

SATRC WG on Policy, Regulation & Services

6

## Status of IPv6 Address Allocation

Country	Allocated /64s	/64s per user	Country	Allocated /64s	/64s per user
USA	8.17281E+13	329198	Afghanistan	12884901888	9975
Brazil	2.823E+14	3240324	Bangladesh	1.84684E+11	32446
Germany	4.72146E+13	694788	Bhutan	12884901888	128825
UK	8.37519E+12	161470	India	9.44896E+11	7656
Australia	3.68294E+13	1856827	Iran	3.35008E+11	10432
Russia	2.04011E+12	33394	Maldives	8589934592	75433
Japan	4.81901E+13	477646	Nepal	73015099392	35408
France	3.72889E+13	745064	Pakistan	1.15964E+11	4080
Canada	1.02654E+12	36598	Srilanka	60129607680	23231
China	5.37601E+13	104093			

Source: potaroo.net (report generated on 08/10/2012)

SATRC WG on Policy, Regulation & Services

7

## Deployment status of IPv6

Country	Number of prefixes Allocated	Number of prefixes Visible	Country	Number of prefixes Allocated	Number of prefixes Visible
USA	2961	1195	Afghanistan	3	0
Brazil	905	140	Bangladesh	51	11
Germany	738	436	Bhutan	3	2
UK	619	289	India	187	27
Australia	535	151	Iran	63	19
Russia	476	223	Maldives	2	1
Japan	373	182	Nepal	22	6
France	335	182	Pakistan	31	8
Canada	284	140	Srilanka	16	11
China	215	32			

Source: www.sixxs.net (report generated on 08/10/2012)

SATRC WG on Policy, Regulation & Services

8

## IPv6 Need to be adopted NOW

- Progressive changeover to IPv6 is cost effective and can be better planned.
- Planned upgrade of software to IPv6 can be done with minimal expenditure and in some cases without any expenditure.
- Chaotic changeover to IPv6 may require cost multiple times compared to planned migration and may degrade performance of network.
- If not acted now the migration of IPv6 may be equally critical as the Y2K scenario threatening IT network to breakdown if not acted in time.

SATRC WG on Policy, Regulation & Services

9

## IPv4 to IPv6 Migration

- Migration Plan
- Migration Options
- Pilot Implementation
- IPv6 Test bed for large organization
- IPv6 Training
- IPv6 Compliance and Certification
- IPv6 Auditing

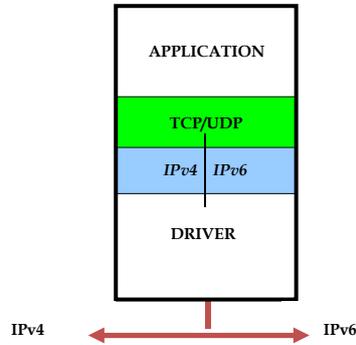
SATRC WG on Policy, Regulation & Services

10

## IPv6 Transition Mechanisms

### Dual Stack

- Need v4/v6 communication support
- Basis for other transition mechanisms.
- Make security more complex as it requires separate security concepts and firewall rules for each protocol (i.e. IPv4 and IPv6).



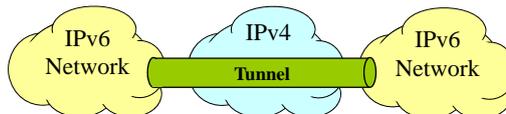
SATRC WG on Policy, Regulation & Services

11

## IPv6 Transition Mechanisms

### Tunneling

- Flexible and easy method for migration.
- The tunnel entry and exit points need time and CPU power for encapsulating and decapsulating packets.
- They also represent single points of failure. Troubleshooting gets more complex.
- Management of traffic is more difficult.
- Tunnels offer points for security attack.



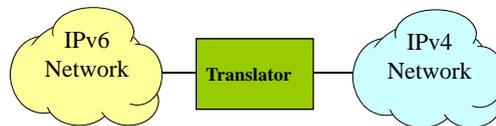
SATRC WG on Policy, Regulation & Services

12

## IPv6 Transition Mechanisms

### Address and Protocol Translation

- Temporary solution for short time.
- It does not support the advanced features of IPv6, such as end-to-end security
- Allows IPv6 hosts to communicate directly with IPv4 hosts and vice versa.



SATRC WG on Policy, Regulation & Services

13

## Challenges for IPv6 Deployment

- Large Investments in current IPv4 Infrastructure
- IPv4 still work, NAT reduces IPv4 address requirement.
- Uncertainty of Market Demand
- No clear IPv6 business model : Cost or Quality ?
- IPv4 and IPv6 will co-exist for long time
- Non compatible end user equipment
- Interoperability with IPv4 as IPv6 is not back compatible with IPv4

SATRC WG on Policy, Regulation & Services

14

## Challenges for IPv6 Deployment contd. ..

- IPv6 deployment lack motivation
- Lack of consumer push as IPv6 does not give users new experiences.
- Non availability of real IPv6 content and application
- Lack of IPv6 Skills
- Non availability of IPv6 Test Beds for end to end testing
- Lack of Government incentives

SATRC WG on Policy, Regulation & Services

15

## Need for Strategies that:

- Build confidence in IPv6 as a technology – Showcase IPv6 ready products and solutions
- Showcase ROI on IPv6 investments .
- Showcase application of IPv6 in e-governance/citizen services – *Create market demand*
- Showcase that IPv6 applications can impact/enhance the lives of our citizens – *Create market demand*
- can be adopted and replicated across the country
- Include creation of National Task force and pilot projects
- include creation of IPv6 test beds
- Include awareness and training programs

SATRC WG on Policy, Regulation & Services

16

## IPv6 Pilot Project - Goals

- Technology demonstration – Build confidence in IPv6 as a technology
- Showcase solutions – which result in RoI
- Social benefits – Impacting common masses
- Innovation – Entrepreneurship, New ideas and solutions

SATRC WG on Policy, Regulation & Services

17

## IPv6 pilot projects

Sector	Pilot project
Healthcare	IPv6 based Healthcare/tele-medicine <ul style="list-style-type: none"> <li>•Electronic Health records linked to Adhaar and stored centrally</li> <li>•Providing health based benefits to beneficiaries using IPv6 enabled devices and authentication based on Adhaar</li> </ul>
Education	IPv6 based e-learning system <ul style="list-style-type: none"> <li>•Learning system pervading across multiple technologies, mobile, handheld device, TV and other means</li> <li>•Adhaar based system for individual specific learning courses and methods</li> </ul>
Citizen services	Delivery of Citizen Services over IPv6 enabled SDG (issuance of Income Certificate, Child School performance monitoring System)
Agriculture	IPv6 enablement of Wireless Sensors for Agriculture use (Example in a greenhouse to monitor temperature and moisture and turn on relevant devices to control these parameters)
Smart-Grid	IPv6 based electricity Smart-Grid, to monitor, measure and manage electricity networks

SATRC WG on Policy, Regulation & Services

18

## International Scenario: Policy Initiatives for deployment of IPv6

### Malaysia

- National IPv6 Council was set up to provide leadership and the strategic planning for IPv6 implementation in Malaysia
- A study was conducted to reach the national IPv6 implementation target as set by National IPv6 Council.
- Preparation of National Strategic IPv6 Roadmap (Roadmap);
- implementation of Migration from IPv4 to IPv6 Pilot Project; and
- promotion and awareness programs
- National Advanced IPv6 Centre of Excellence (NAv6) was established.
  - The functions of NAv6 are to conduct IPv6 research, human resource development and monitoring of IPv6 development
  - Providing IPv6 training and consultancy services to the Government
  - Spearheading promotion and awareness program

SATRC WG on Policy, Regulation & Services

19

## International Scenario: Policy Initiatives for deployment of IPv6

### Singapore

- Inclusion of IPv6 elements in the Next Generation National Infocomm Infrastructure (“Next Gen NII”) which is capable of supporting emerging Next Generation Services.
- A progressive replacement of public sector equipment with IPv6 capable equipment with a deadline of end of 2010 for full public sector IPv6 transition.
- Formation of National Task Force for IPv6
  - Guidelines for government for IPv6 transition
  - Setting up IPv6 test bed
  - Seminars to deepen industries knowledge and expertise in deploying IPv6

SATRC WG on Policy, Regulation & Services

20

### International Scenario: Policy Initiatives for deployment of IPv6

Country	IPv6 adoption In Govt.	Awareness building efforts	Initiatives
Australia	yes	yes	The Australian Government Information Management Office (AGIMO) is coordinating the transition of Australian Government agencies to IPv6, and has developed "A Strategy for the Implementation of IPv6 in Australian Government Agencies", that aims for Australian Government networks to be IPv6-enabled by the end of 2012
Canada	No	yes	Canada does not currently plan to use legislation or other government-led measures, such as target setting for industry, to influence the introduction of IPv6. The American Registry for Internet Numbers (ARIN) has assisted with awareness-raising efforts within the Canadian government

SATRC WG on Policy, Regulation & Services

21

### International Scenario: Policy Initiatives for deployment of IPv6

Country	IPv6 adoption In Govt.	Awareness building efforts	Initiatives
Germany	yes	yes	<p>German IPv6 Roadmap was launched in 2009. The objective is a complete technical and organisational setup for a centralised IPv6 public administration in Germany as of 2011.</p> <p>The German Federal Ministry of the Interior was allocated and administers a /26 IPv6 address block for all federal, state and local public administration in Germany at the end of 2009. In 2008, two large programmes were launched to modernize the communication infrastructure of the public administration based on IPv6.</p> <p>In addition, IPv6 is being introduced through a variety of IPv6 projects and initiatives at different policy, organizational and technical levels, with numerous IPv6 pilot projects, working groups and activities at state and local level</p>

SATRC WG on Policy, Regulation & Services

22

### International Scenario: Policy Initiatives for deployment of IPv6

Country	IPv6 adoption In Govt.	Awareness building efforts	Initiatives
Japan	no	yes	In February 2009, MIC convened a "Study Group Concerning the Improved Use of IPv6 on the Internet". The MIC has developed an IPv6 testing platform to build IPv6 expertise. The "Task Force on IPv4 Addresses Exhaustion, Japan", launched by MIC and industry associations in September 2008 helps interested Internet operators to build action plans, publicise IPv6 activities, and develop IPv6 educational programmes.
US	Yes	yes	The United States has set a timeline for adopting IPv6 for use on public servers by the end of 2012.

SATRC WG on Policy, Regulation & Services

23

### International Scenario: Policy Initiatives for deployment of IPv6

Country	IPv6 adoption In Govt.	Awareness building efforts	Initiatives
Korea	yes	yes	In order to encourage the voluntary adoption of IPv6 by Internet stakeholders such as ISPs and Web portals, the KCC created a public-private consultative body and is providing systematic support for the deployment of IPv6 in Korea through pilot projects, offering training, conducting promotional activities, and operating IPv6 interconnection networks. The Ministry of Strategy and Finance stipulates in its "2010 Guidelines for the Execution of Budget and Fund Operation Plan" that all of its network infrastructure should support both IPv4 and IPv6. The Ministry of Public Administration and Security also issued a government notification that applies the same principle to public administrative organizations

SATRC WG on Policy, Regulation & Services

## International Scenario: Policy Initiatives for deployment of IPv6

Country	IPv6 adoption In Govt.	Awareness building efforts	Initiatives
Switzerland	yes	yes	Switzerland does not have an active policy to encourage IPv6 deployment. However, IPv6 support is a requirement for public procurement contracts
UK	no	yes	The UK encourages a market-led, needs-driven approach. Encourage stakeholders to be proactive in adopting IPv6, while being mindful of their commercial needs and costs. The UK has set up 6UK, a not-for-profit membership organisation founded in April 2010 to help the UK and UK organisations secure every competitive advantage available from the rapid adoption of the new protocol, and otherwise to make sure no segment of UK industry and wider society gets left behind..

SATRC WG on Policy, Regulation & Services

25

## Indian Initiatives for IPv6 deployment

### Initiatives by the Govt.

- National IPv6 Deployment Roadmap released in July 2012
- Key Policy guidelines
  - All major service providers (having at least 10000 Internet customers or STM-1 bandwidth) to be able to handle IPv6 traffic and offer IPv6 services by December, 2011
  - All Central and State government ministries and departments, including its PSUs, shall start using IPv6 services by March 2012
  - Establishment of IPv6 Task Force
- IPv6 Task Force comprising of 2 committees and 10 working groups came into existence in December 2010.

SATRC WG on Policy, Regulation & Services

26

## Indian Initiatives for IPv6 deployment

### Initiatives by the Govt.

- **Oversight committee** – apex body for making policy decisions and responsible for guiding the task force by taking strategic decisions
- **Steering committee** – for coordinating the activities of the Task force and oversee the activities of different working groups
- **Working groups:**

Training and awareness	IPv6 implementation in government sectors
IPv6 network implementations	Pilot projects
Standards and specifications	Application support
India6 network	Knowledge resource development
Experimental IPv6	Security

SATRC WG on Policy, Regulation & Services

27

## Indian Initiatives for IPv6 deployment

### Initiatives by the Govt.

- Several workshops were organised by DoT/ BSNL across the country .
- Telecommunications Engineering Centre (TEC) has been entrusted the task of standardisation & specifications and creation of IPv6 test bed.
- Center for Development of Telematics (C-DoT) is developing Lawful Interception and Monitoring System for IPv6.
- National Knowledge Network (NKN), National Informatics Center (NIC), Educational & Research Network (ERNET) and Internet Service Providers Association of India (ISPAI) are working for promotion of IP6 in educational institutions
- Some IPv6 ready websites :
  - Bharat Heavy Electricals Limited (BHEL) ,
  - National Knowledge Network,
  - TATA Communications,
  - Honesty Net Solutions (I) Ltd.,

SATRC WG on Policy, Regulation & Services

28

## Indian Initiatives for IPv6 deployment

### Key Initiatives proposed for 2012-13

- To release IPv6 Deployment Roadmap version-2.
- To have all the government websites on dual stack.
- Adoption of IPv6 based Pilot projects in government sectors.
- IPv6 Ready Logo Certification from TEC test bed

SATRC WG on Policy, Regulation & Services

29

## Way Forward

**An integrated efforts from Government, service providers, vendors and end users are required for timely and smooth deployment of IPv6.**

SATRC WG on Policy, Regulation & Services

30

# Thank You

e-mail: [vk.agarwal@traf.gov.in](mailto:vk.agarwal@traf.gov.in)