Project 6Core
"National IPv6 Core Pakistan"

SANOG XIII

Pakistan IPv6 Task Force [Pkv6TF]

IPv6 PENETRATION in South Asia in 2007

	Visible Prefixes	= 3
	Allocations	= 4
	Visible Percentage	= 75.00%

	Visible Prefixes	= 0
	Allocations	= 0
	Visible Percentage	= 0.00%

	Visible Prefixes	= 2
	Allocations	= 12
	Visible Percentage	= 16.67%

	Visible Prefixes	= 0
	Allocations	= 0
	Visible Percentage	= 0.00%

	Visible Prefixes	= 0
	Allocations	= 1
	Visible Percentage	= 0.00%
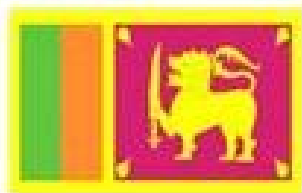
	Visible Prefixes	= 0
	Allocations	= 0
	Visible Percentage	= 0.00%

	Visible Prefixes	= 0
	Allocations	= 0
	Visible Percentage	= 0.00%
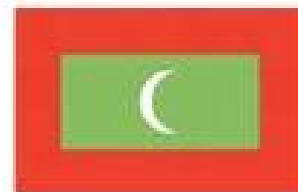
	Visible Prefixes	= 0
	Allocations	= 0
	Visible Percentage	= 0.00%

Source: http://www.sixxs.net/tools/grh/dfp/

IPv6 Pakistan - Today

LG	Prefix	tld	NetName	Owner	AS	S	Allocated	First seen
LG	2001:fe8::/32	☪	SUPER-PK-IPV6-200503...	SUPERNET LIMITED		A	2005-03-29	2006-11-16 10:17:22
LG	2001:4538::/32	☪	CYBERNET-ipv6-200602...	CYBER INTERNET SERVICES (...	9541	A	2006-03-01	2006-09-18 07:17:19
LG	2401::/32	☪	WOLNET	Cybersoft technologies pv...	23966	A	2006-11-03	
LG	2402:e000::/32	☪	TPP-PK-20070913	Telenor Pakistan		A	2007-09-13	2008-11-10 17:32:39
LG	2404:148::/32	☪	DANCOM-V6-20060602	Dancom Online Services	23966	A	2006-06-02	2006-08-22 13:02:21
LG	2404:7000::/32	☪	PKTELECOM-20090120	Pakistan Telecommunicatio...		A	2009-01-20	
LG	2400:7000::/32	☪	worldcall-20080402	WORLDCALL TELECOM LTD		A	2008-04-03	
LG	2407:d000::/32	☪	MICRONET-20080208	Micronet Broadband (Pvt) ...		A	2008-02-08	

IPv6 PENETRATION Pakistan

- IPv6 has been on our radar screen for few years.

- Leading ISPs (CYBERNET, SUPERNET and DOLS) decided to get their v6 prefix from APNIC and get going.

- These ISPs starts initial IPv6 deployment with in their own domain since March, 2006.

- IPv6 Task Force formulated in September 2006 to further increase the pace of v6 activities in Pakistan

IPv6 PENETRATION Limitation

- Three major International transit providers in Pakistan
  - ❖ PTCL / PIE
  - ❖ FLAG Telecom
  - ❖ TW1
- Neither of them ready to support native v6 transit service
- SANOG 8 – Catalyst to Channelize the Activities
  - Project 6 Core

IPv6 PENETRATION Lets Get Going

- At least we have IPv6 Address available.
  - ❖ Cyber Net : 2001:4538::/32   [AS 9541]
  - ❖ DOLS : 2404:148::/32   [AS 23966]
  - ❖ Super Net : 2001:FE8::/32   [AS 24435]
  - ❖ WOL Net : 2401::/32   [AS 9940]

- Solution available:
  - ❖ Go for IPv6 over IPv4 Tunnels

IPv6 PENETRATION-Visibility in IPv6 World

CYBERNET:

AS: 9541, Prefix: 2001:4538::/32

Upstream: Occaid (ASN-30071), LAVANet (ASN-6435), BTExact-UK (ASN-1752)

SUPERNET:

AS: 24435, Prefix: 2001:fe8::/32

Upstream: Occaid (ASN-30071)

DOLS:

AS: 23966, Prefix: 2404:148::/32

Upstream: Fast Lab Network (ASN-41102), Occaid (AS - 30071), BTExact-UK (ASN-1752)

Pakistan IPv6 Task force

- Pkv6TF is the National working body that helps for the facilitation of IPv6 adaptation and penetration in Pakistan.

- Pkv6TF roles include:

  - To support and drive IPv6 deployment in Pakistan.

  - To provide a technical center of expertise for the deployment of IPv6 in Pakistan.

  - To provide briefings, guides and presentations for public consortiums.

 - To work with the IP sector of Pakistan to understand the effects of IPv6 transition within the Market.

Project 6Core

- 6Core – IPv6 National Core of Pakistan.

- Pakistan First IPv6 Nation wide project.

- Initiated by Pkv6TF with CYBERNET, DOLS and SUPERNET.

- OPEN for all to participate.

- Goal of 6Core Test Bed is,

  - To test IPv6 network services in House.

  - Enhance the confidence level of Network Admins

  - Develop SOP for Enterprises that help them to seamlessly migrate to IPv6.
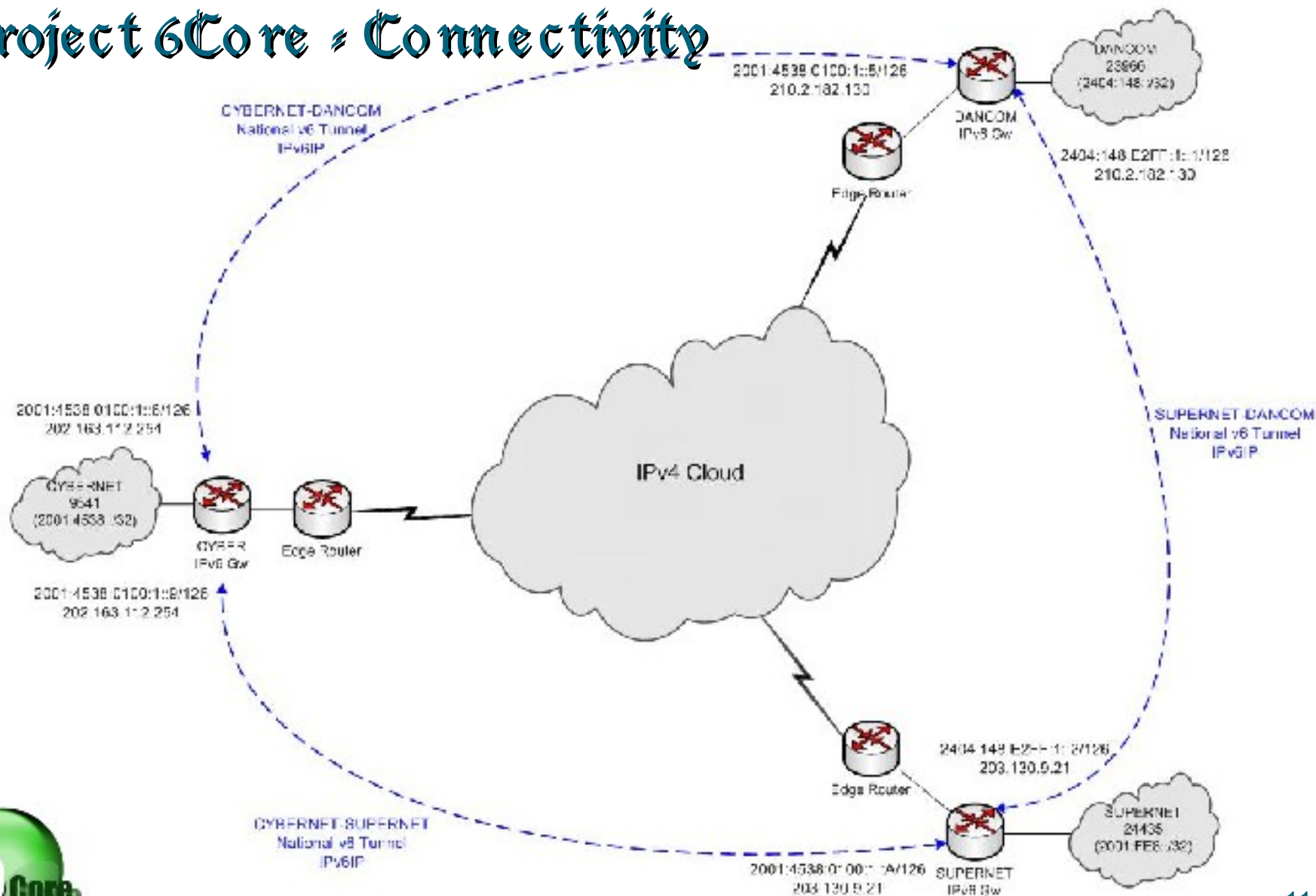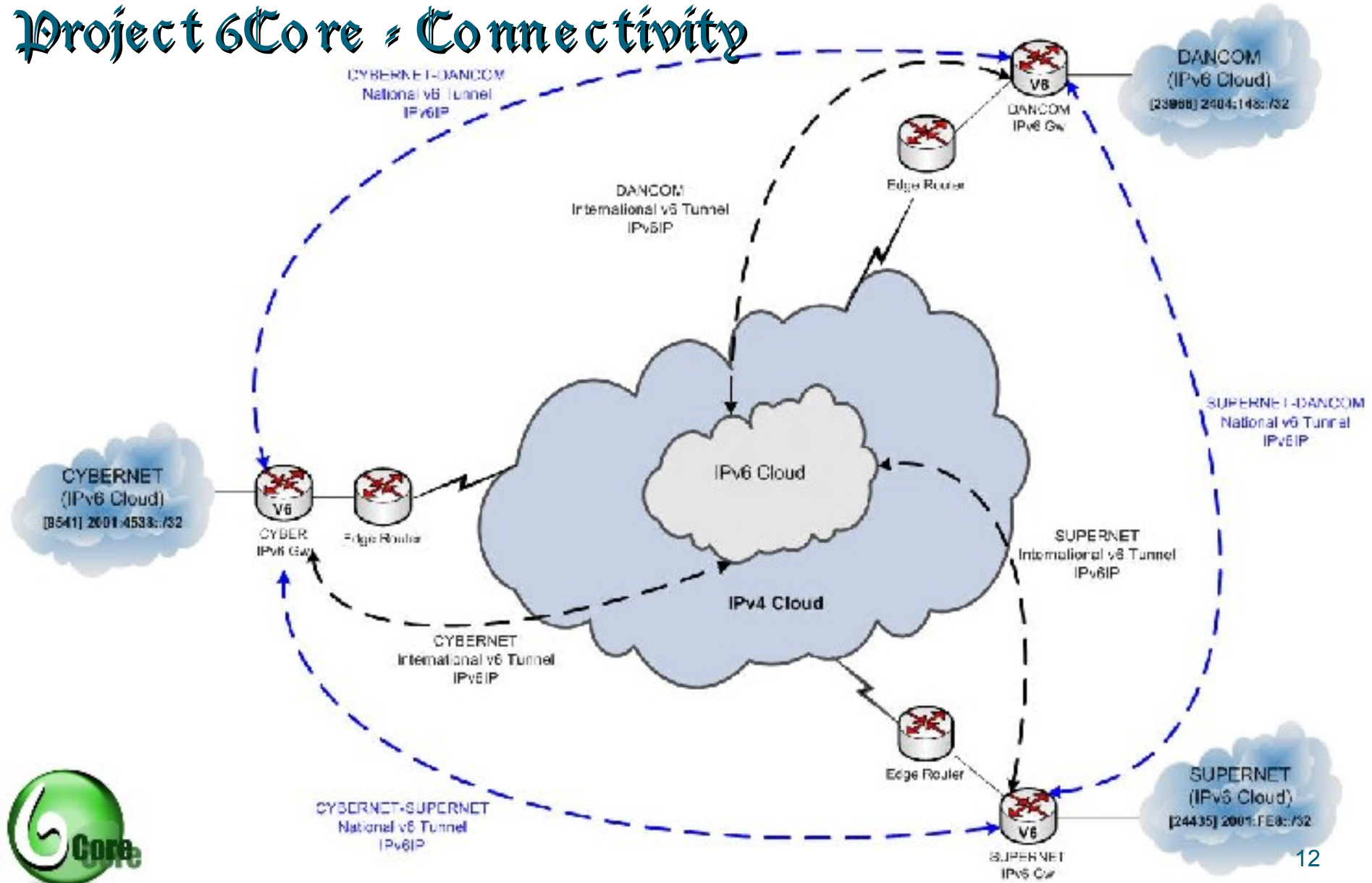
Project 6Core - Topology

- Three level 6Core hierarchy.
  - TLAs
  - PLAs
  - SLAs
- Current TLAs,
  - CYBERNET
  - DOLS
  - SUPERNET
- Core is established over Tunnels.
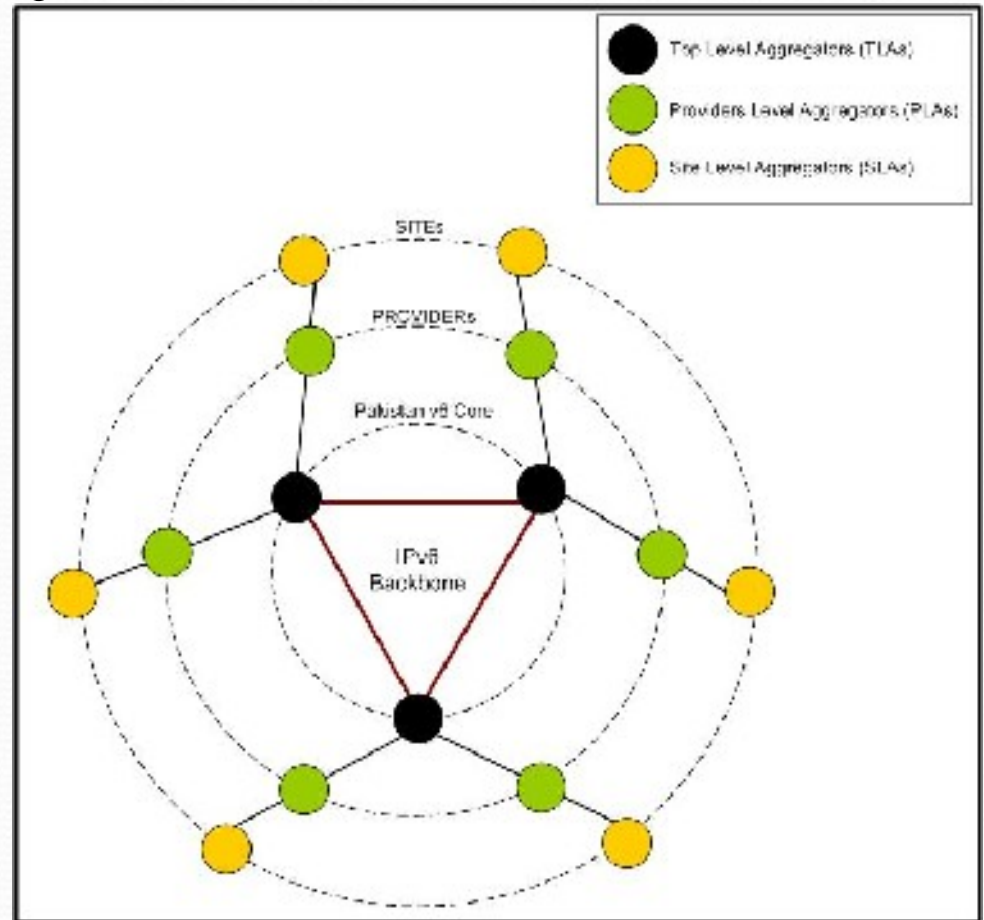
Project 6Core - Connectivity

Project 6Core - Connectivity

Project 6Core – Connected to IPv6 World

- IPv6 Routing Table (Summary)

```
show ipv6 route summary

IPv6 Routing Table Summary - 752 entries
  13 local, 8 connected, 4 static, 0 RIP, 727 BGP 0 IS-IS, 0 OSPF
  Number of prefixes:
   /0: 1, /8: 1, /10: 1, /16: 1, /19: 1, /20: 2, /21: 2, /22: 1
   /24: 1, /26: 2, /27: 2, /28: 5, /29: 1, /30: 2, /31: 1, /32: 583
   /33: 6, /34: 2, /35: 27, /36: 1, /40: 4, /42: 2, /43: 1, /44: 2
   /45: 1, /48: 80, /64: 5, /126: 3, /128: 11
```

- BGP Neighborship (Summary)

```
show bgp ipv6 unicast summary

Neighbor              V   AS     MsgRcvd MsgSent  TblVer     InQ OutQ Up/Down  State/PfxRcd
2001:4538:100:1::5    4 23966  311037  311116   63234769   0   0    4w1d     1  >>> DOLS
2001:4538:100:1::A    4 24435  149962  149983   6143237    0   0    3w5d     1            >>> SUPERNET
2001:4538:100:1::E    4 9541   474256  1729752  634769     0   0    6w11h    710          >>> CYBERNET-
   LHR
2001:4830:E0:11::1    4 30071  735947  1975181  634769     0   0    6w08h    727          >>> Occaid
```

13

Project 6Core – Tunnels Configuration

```
interface Tunnel2
 description < IPV6IP Tunnel to Cybernet Karachi >
 no ip address
 ipv6 address 2001:4538:100:1::A/126
 keepalive 5 2
 tunnel source 203.130.9.21
 tunnel destination 202.163.112.254
 tunnel mode ipv6ip
!
interface Tunnel3
 description < IPV6IP Tunnel to DOLS Lahore>
 no ip address
 ipv6 address 2404:148:E2FF:1::2/126
 keepalive 5 2
 tunnel source 203.130.9.21
 tunnel destination 210.2.182.130
 tunnel mode ipv6ip
!
interface Tunnel4
 description < IPV6IP Tunnel to Occaid Spain Ckt. ID: 10EGTX125725.UK1>
 no ip address
 ipv6 address 2001:4830:D1:E::2/64
 keepalive 5 2
 tunnel source 203.130.9.21
 tunnel destination 85.116.11.4
 tunnel mode ipv6ip
!
```

Project 6Core – BGP Configuration

```
router bgp 24435
 neighbor 2001:4538:100:1::9 remote-as 9541
 neighbor 2001:4538:100:1::9 description "=== eBGP with Cybernet IPv6 ==="
 neighbor 2001:4538:100:1::9 password 7 082242585F0A0B
 neighbor 2001:4538:100:1::9 update-source Tunnel2
 neighbor 2001:4830:D1:E::1 remote-as 30071
 neighbor 2001:4830:D1:E::1 description "=== eBGP with Occaid IPv6 ==="
 neighbor 2001:4830:D1:E::1 update-source Tunnel4
 neighbor 2404:148:E2FF:1::1 remote-as 23966
 neighbor 2404:148:E2FF:1::1 description "=== eBGP with DOLS IPv6 ==="
 neighbor 2404:148:E2FF:1::1 update-source Tunnel3
!
 address-family ipv6
 neighbor 2001:4538:100:1::9 activate
 neighbor 2001:4538:100:1::9 prefix-list in-peer-Cyber in
 neighbor 2001:4538:100:1::9 prefix-list out-peer-v6 out
 neighbor 2001:4830:D1:E::1 activate
 neighbor 2001:4830:D1:E::1 prefix-list in-peer-Occaid in
 neighbor 2001:4830:D1:E::1 prefix-list out-peer-v6 out
 neighbor 2404:148:E2FF:1::1 activate
 neighbor 2404:148:E2FF:1::1 prefix-list in-peer-Dancom in
 neighbor 2404:148:E2FF:1::1 prefix-list out-peer-v6 out
 network 2001:FE8::/32
 exit-address-family
```

Project 6Core – BGP Prefix Lists

```
ipv6 prefix-list in-peer-Cyber seq 5 permit 2001:4538::/32
ipv6 prefix-list in-peer-Cyber seq 10 deny ::/0 le 128
!
ipv6 prefix-list in-peer-DOLS seq 5 permit 2404:148::/32
ipv6 prefix-list in-peer-DOLS seq 10 deny ::/0 le 128
!
ipv6 prefix-list in-peer-Occaid seq 5 permit 2001:4830::/32
ipv6 prefix-list in-peer-Occaid seq 10 deny ::/0 le 128
!
ipv6 prefix-list out-peer-v6 seq 5 permit 2001:FE8::/32
ipv6 prefix-list out-peer-v6 seq 10 deny ::/0 le 128
!
ipv6 prefix-list ipv6-ebgp-relaxed seq 5 deny 3FFE::/16 le 128
ipv6 prefix-list ipv6-ebgp-relaxed seq 10 deny 2001:DB8::/32 le 128
ipv6 prefix-list ipv6-ebgp-relaxed seq 15 permit 2001::/32
ipv6 prefix-list ipv6-ebgp-relaxed seq 20 deny 2001::/32 le 128
ipv6 prefix-list ipv6-ebgp-relaxed seq 25 permit 2002::/16
ipv6 prefix-list ipv6-ebgp-relaxed seq 30 deny 2002::/16 le 128
ipv6 prefix-list ipv6-ebgp-relaxed seq 35 deny ::/8 le 128
ipv6 prefix-list ipv6-ebgp-relaxed seq 40 deny FE00::/9 le 128
ipv6 prefix-list ipv6-ebgp-relaxed seq 45 deny FF00::/8 le 128
ipv6 prefix-list ipv6-ebgp-relaxed seq 50 permit ::/0 le 48
ipv6 prefix-list ipv6-ebgp-relaxed seq 55 deny ::/0 le 128
```

Project 6Core – IPv6 Enabled in Pakistan

rviews@zelie.opentransit.net> traceroute www.ipv6tf.org.pk
traceroute6 to www.ipv6tf.org.pk (2001:4538:100::2) from 2001:688:0:3:4::5, 30 hops max, 12 byte packets
 2001:688:0:4::62 (2001:688:0:4::62) 27.099 ms 27.160 ms 27.129 ms
 10.ge0-0.cr1.atl1.us.occaid.net (2001:4830:ff:e300::1) 39.069 ms 38.987 ms 38.951 ms
 v3327-mpd.cr1.lax1.us.occaid.net (2001:4830:ff:a110::2) 159.519 ms 159.515 ms 159.436 ms
 so-1-0-0.cr1.sjc2.us.occaid.net (2001:4830:ff:1201::1) 168.505 ms 168.571 ms 168.410 ms
 38.fe0-0.cr1.sfo2.us.occaid.net (2001:4830:ff:12ea::1) 171.830 ms 171.402 ms 171.474 ms
 cybernet-gw.customer.occaid.net (2001:4830:e0:11::2) 469.982 ms 469.176 ms 468.937 ms
 cybernet-ipv6-gw (2001:4830:e0:11::2) 470.543 ms 470.626 ms
 www.ipv6tf.org.pk(2001:4538:100::2) 470.543 ms 470.626 ms

rviews@zelie.opentransit.net> ping inet6 www.ipv6tf.org.pk
PING6(56=40+8+8 bytes) 2001:688:0:3:4::5 --> 2001:4538:100::2
16 bytes from 2001:4538:100::2, icmp_seq=0 hlim=53 time=477.248 ms
16 bytes from 2001:4538:100::2, icmp_seq=1 hlim=53 time=468.991 ms
16 bytes from 2001:4538:100::2, icmp_seq=2 hlim=53 time=474.265 ms
16 bytes from 2001:4538:100::2, icmp_seq=3 hlim=53 time=477.434 ms

4 packets transmitted, 4 packets received, 0% packet loss
round-trip min/avg/max/std-dev = 468.991/474.484/477.434/3.412 ms

IPv6 Enabled Services

Pakistan IPv6 Task Force Website

- www.ipv6tf.org.pk [AAAA IPv6 address = 2001:4538:100::2]

CYBERNET IPv6 Enabled Media Server

- mms://radio.ipv6.cyber.net.pk/quran
- mms://radio.ipv6.cyber.net.pk/urdu
- mms://radio.ipv6.cyber.net.pk/english
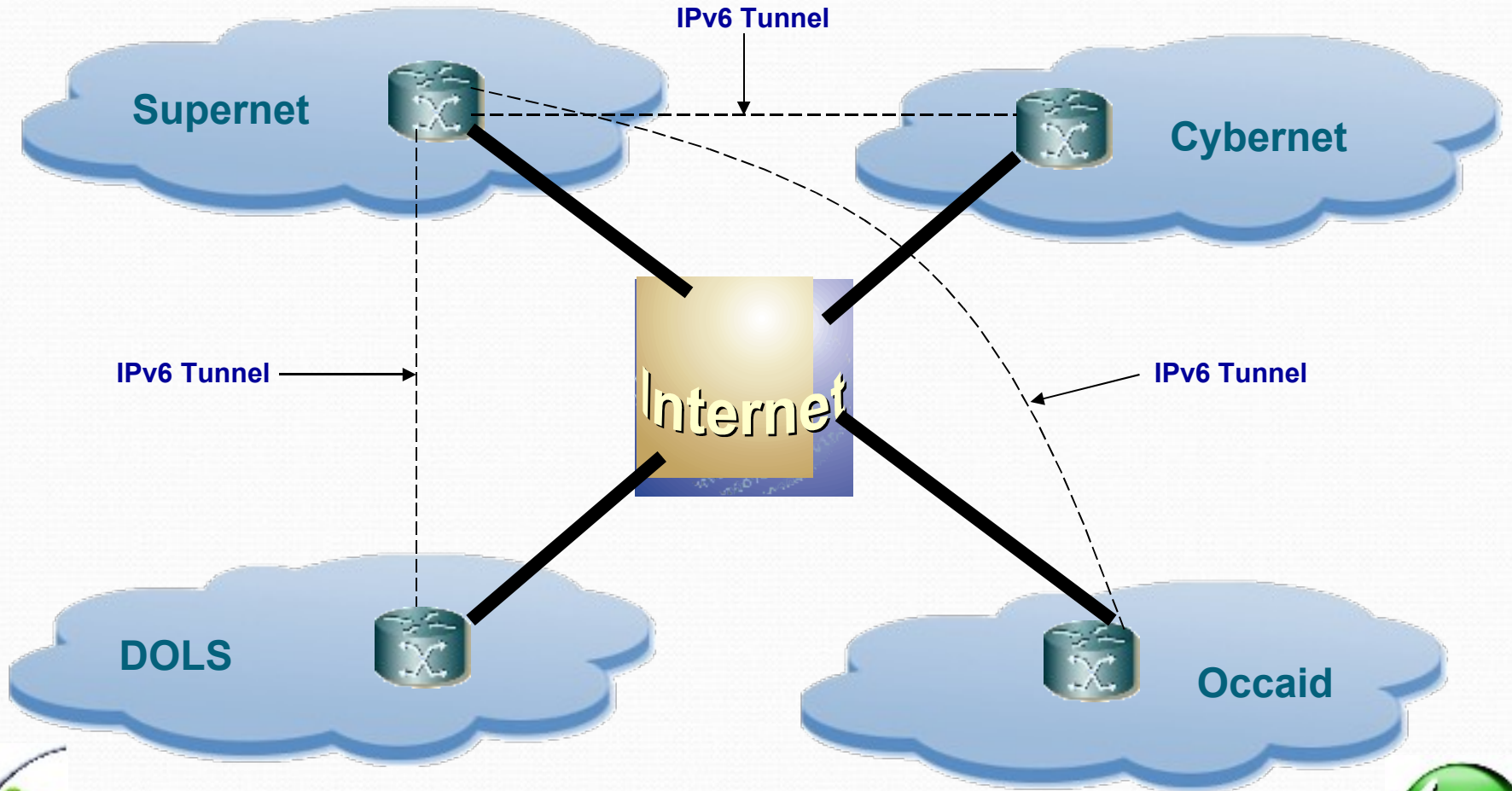- [AAA IPv6 address = 2001:4538::2]

DOLS IPv6 Enabled Web Server

- www.ipv6.net.pk   [AAAA IPv6 address = 2404:148:e202::3]

CYBERNET IPv6 Testbed

- IPv6 enabled in all three region of Pakistan.

- CYBERNET IPv6 Core based on IPv6 over v4 Tunnels.

- LAB consist of different vendors devices are placed to TEST,

- ❖ IPv6 Services.

- ❖ Interoperability Issues.
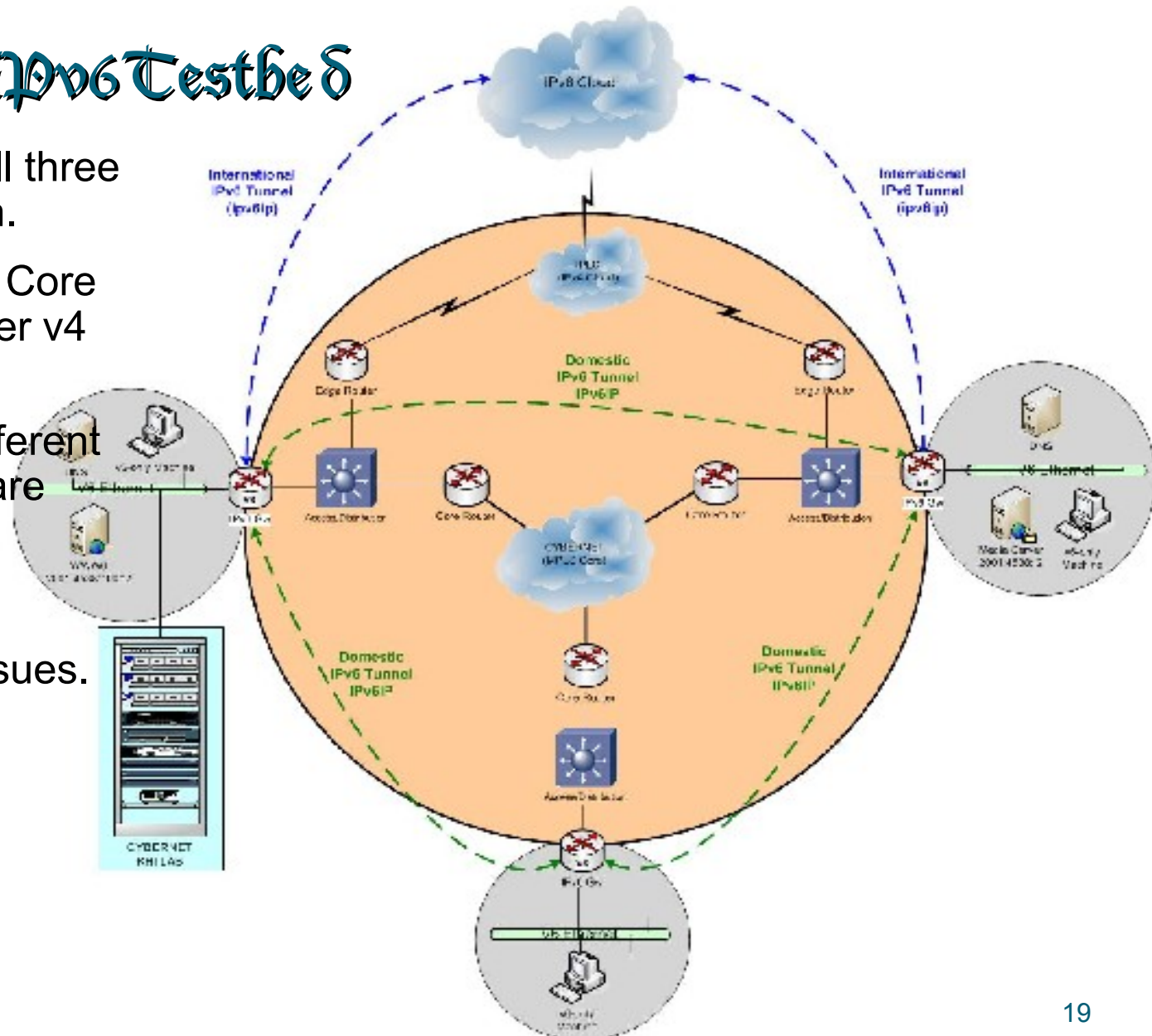
SUPERNET IPv6 Testbed

DOLS: IPv6 Testbed

DANCOM v6 Network Topology
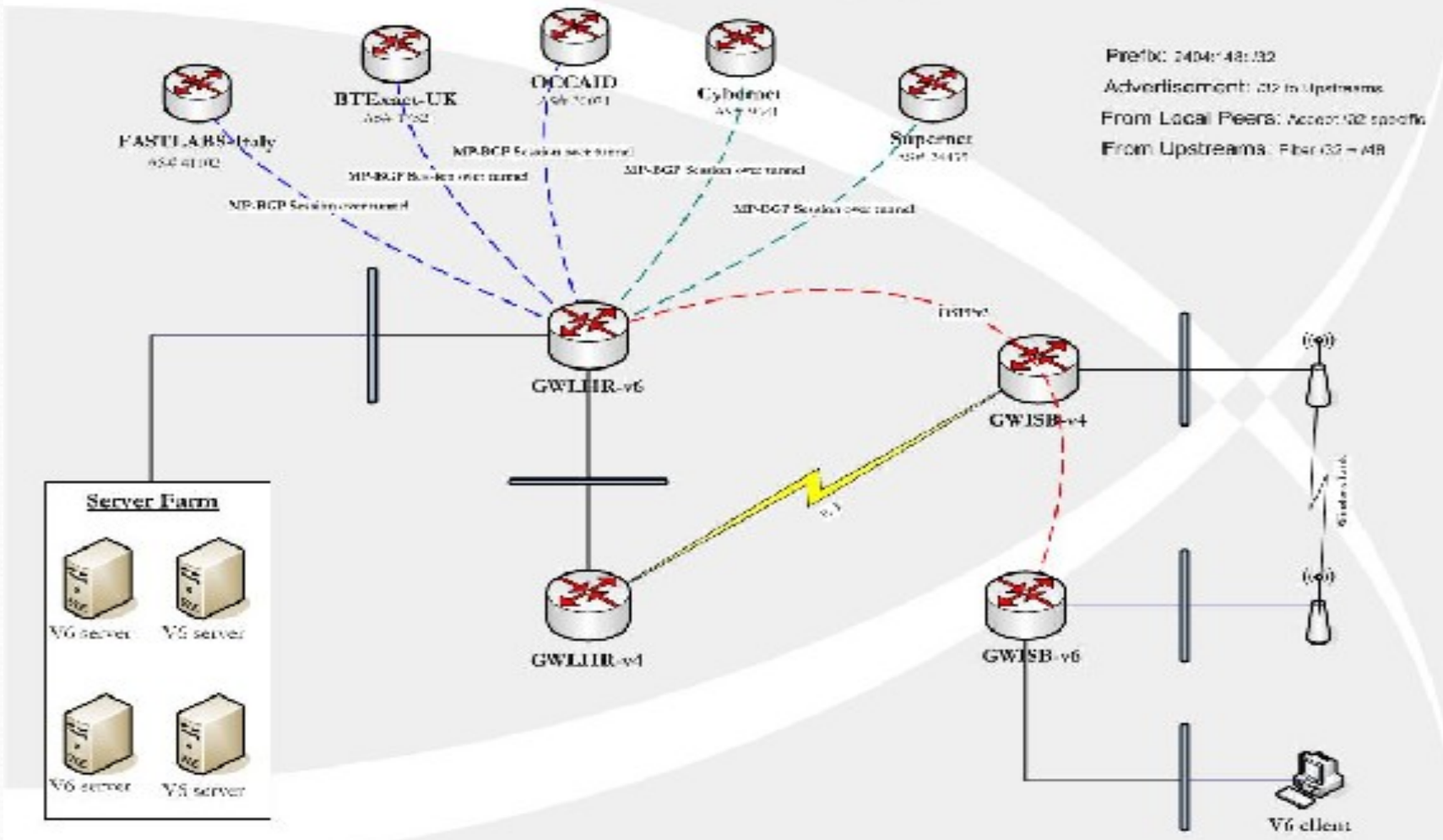
DOLS: IPv6Specific Configs

- Accept and advertise APNIC assigned /32 from our local peers.

- Anything above a /48 is filtered from our up-streams.

- Planning to do some interesting things with RH0.

- Enable tcp-path-mtu discovery for your sanity :)

Services - IPv6 DNS

- What do you need for running IPv6 DNS?
  - IPv6 enabled DNS server
  - IPv6 connectivity to the DNS server.

- IPv6 Resource records
  - AAAA records; covered in RFC 1886.
  - Reverse records are now being looked up using IP6.arpa.
  - IP6.int is deprecated.

Services - IPv6 DNS Notes

- Be aware of the packet size.

  - Make sure your DNS software support EDNS0. Otherwise the 512 bytes limit will hit you hard.

- TCP/53 should NOT be filtered.

- Have dual-stack servers. Makes for easy migration.

- Have at least one IPv4 reachable server in your pure IPv6 domain.

Services – IPv6 DNS

- Currently, the root servers are still running on IPv4.

- Some local domain registrars have started to support IPv6 glue records.

- When will PKNIC do it?? :)

Services – Is my Infrastructure Ready?

- Ask yourself twice. DNS connects humans to the dry world of IP. :)

- Watch out for DSL CPEs, old router software, packet firewalls, IDS devices.

- Use latest application and software.

- Stay up-to-date on IPv6. Operational issues are being highlighted every day.

- Recent example being the RH0.

How to Enable IPv6 on HOST?

- IPv6 can be installed on Windows2000/XP/2003 machine by running command ipv6 install on command prompt.

```
C:\WINDOWS\system32\cmd.exe

C:\Documents and Settings\Administrator>ipv6 install
Installing...
Succeeded.

C:\Documents and Settings\Administrator>ipconfig
```

- Unix Platforms and Microsoft Vista has IPv6 Install by default.

IPv6 Enable HOST

- After enabling IPv6 Windows will automatically connected to IPv6 Cloud using Tunnel.

- You are now in IPv6 World……..!

- Manual Tunnels can also be created.

Do Visit

- Further information can be collected using CYBERNET IPv6 LG:

  http://seraph.cyber.net.pk/cgi-bin/lg-cisco/index.cgi

- For Visibility of Pakistan IPv6 CIDRs in IPv6 Cloud, refer:
  http://www.sixxs.net/tools/grh/dfp/all/?country=pk

- For Pakistan IPv6 Task Force Website, refer:
  http://www.ipv6tf.org.pk

- For Project 6Core and its Documentation, refer:
  http://www.ipv6tf.org.pk:8080/ipv6/6Core

6Core Phases

6Core START

Phase : I

- Every TLA ISP will initiate single IPv6 Tunnel with all other TLA ISPs in Pakistan is establish IPv6 tunnel ring.
- Every TLA will advertise its /32 CIDR only (No v6 Transit services will be offered between TLAs).
- IPv6 Tunnel will be used only for IPv6 traffic (unicast/multicast) only.
- BGP4 neighborship will be created over National IPv6 tunnels.
- For International IPv6 traffic every TLA will forward it to their International IPv6 Tunnel provider.

Phase : II

- Every ISP will launch wwwv6, DNS and FTP services over IPv6 in their Testbeds.
- Services like HTTP, Telnet and SSH, will be tested.
- ICMPv6 functions verification i.e. ICMPv6 Echo Request, Reply and Redirect, DMP Hop limit exceeded.", Neighbor Unreachability Detection, Path MTU Detection and Fragmentation/Reassembly, Address Autoconfiguration, Duplicate Address Detection, Multiple Prefixes, and Network Renumbering.

Phase : III

- Multiple v6 Tunnel between the ISP (base on major regions KHI/LHR/ISB only).
- Every ISP will relax the prefix filter policy to /32 upto /48 to implement BGP4 Multi-homed Traffic Engineering.
- Routing Protocol performance "OSPFv3, ISIS and BGP4+" will be tested.
- Different Tunnel scenarios i.e. static tunnels, 6to4, ISATAP, Teredo and Tunnel Broker will be tested.
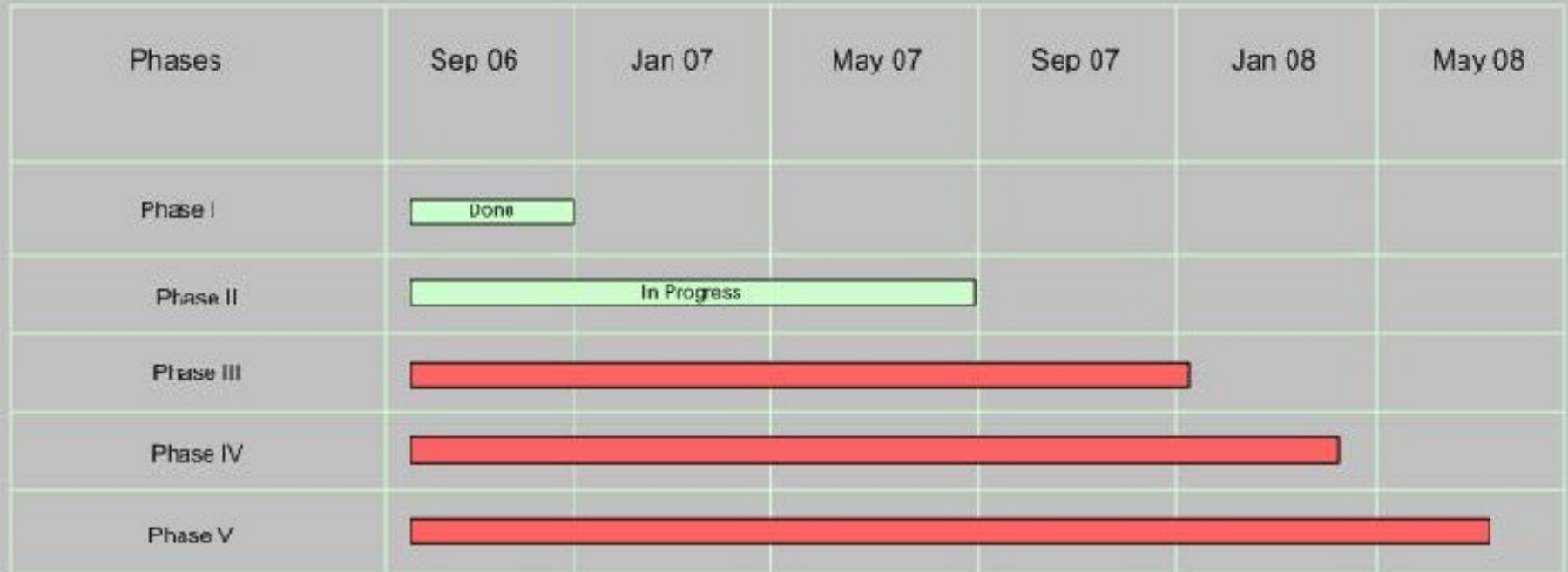
Phase : IV

- IPv6 over DSL (IPoA/PPPoE) will be test.
- IPv6 over WiFi will be test.
- IPv6 over dialup/ISDN/Ethernet and other Technologies with different Layer 2 Encapsulation will be test.
- Different client scenarios will be implemented over Native IPv6 links between providers and Sites.

Phase : V

- QoS implementation will be test.
- CPE and CVPE will be test.
- Voice over IPv6 will be test.
- Firewall and other security features will be test.

30

6Core Deployment Roadmap

6Core IPv6 deployment Roadmap

Phases	Sep 06	Jan 07	May 07	Sep 07	Jan 08	May 08
Phase I	Done					
Phase II	In Progress					
Phase III						
Phase IV						
Phase V						

Questions?