TEC
GARR-04-00?

Progetto Servizio IPv6 sulla Rete GARR

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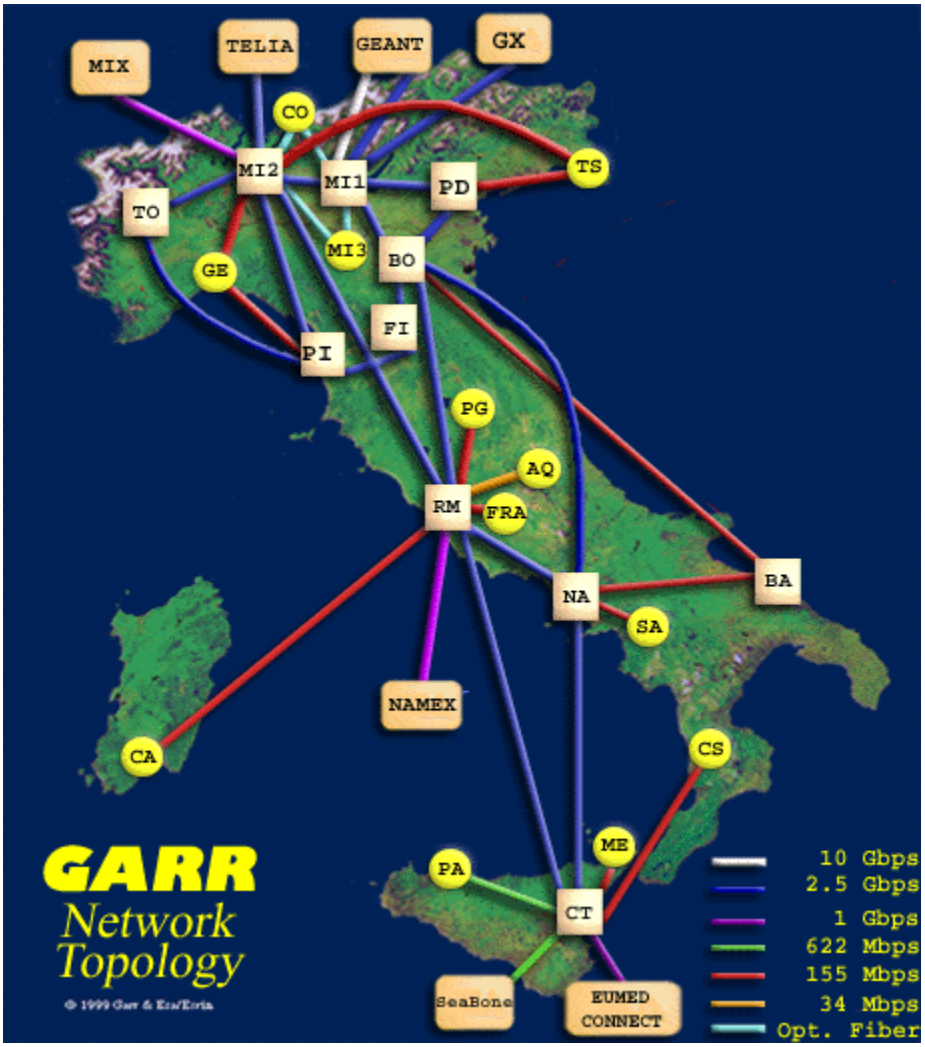
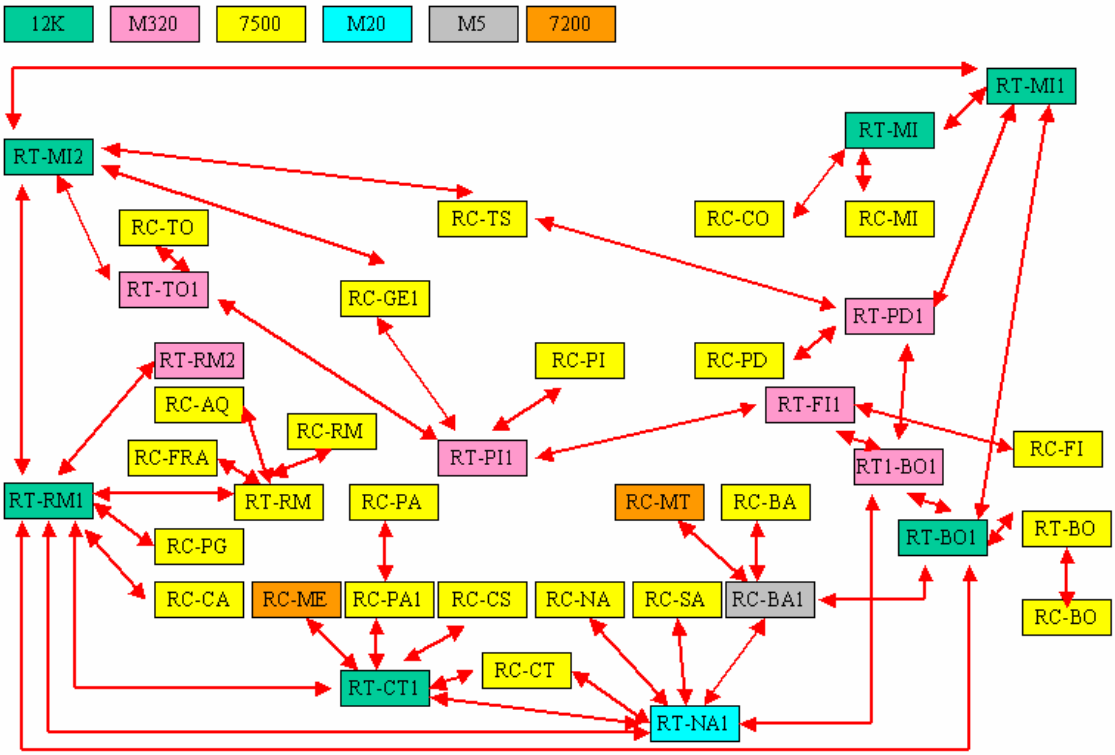
Introduzione

Dopo una fase di sperimentazione per l'introduzione di IPv6 sulla rete GARR durata circa un anno e portata avanti in collaborazione con la partecipazione italiana al progetto europeo 6NET, il seguente progetto prevede le procedure per il passaggio a servizio del protocollo IPv6.

Struttura della Rete GARR



L'attuale topologia della rete vede attivi 34 PoP, dove sono distribuiti 6 router CISCO 12000, 23 router CISCO 7500, 2 router CISCO 7200, 6 router JUNIPER M320, 1 router JUNIPER M20 e 1 router JUNIPER M5.



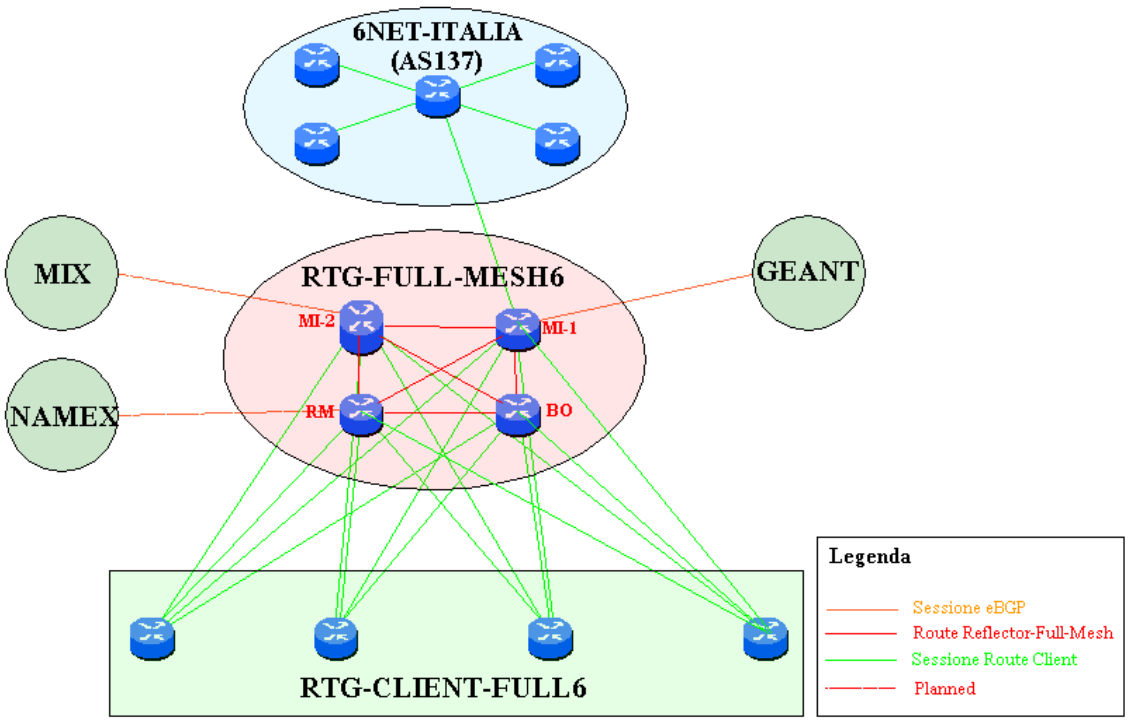
La versione di sistema operativo presente su CISCO 12000 e sui JUNIPER permette di attivare il routing dinamico per IPv6, mentre per i CISCO 7500 e 7200 dovrà essere effettuato un upgrade di IOS, in quanto la versione attuale non supporta completamente IPv6.
Per questo motivo l'attivazione di IPv6 e del routing dinamico IPv6 sulla rete sarà divisa in due parti: nella prima fase sarà configurato ed attivato il routing OSPFv3 e BGP sui router di core, nella seconda fase IPv6 arriverà anche sui router utente, permettendo, ad eccezione di alcuni casi particolari connessi direttamente al core, la possibilità di collegare gli utenti direttamente in dual-stack.

Architettura di routing

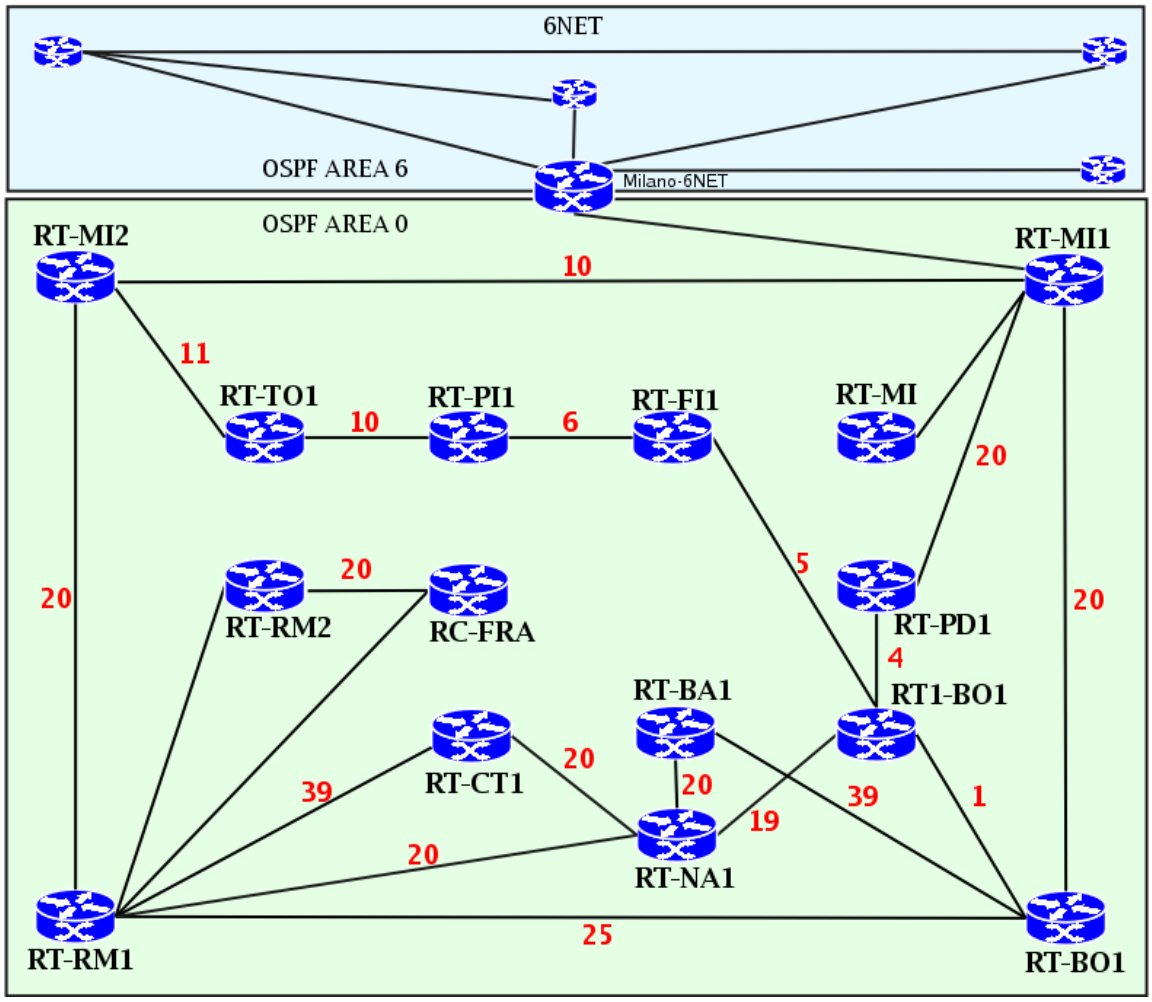
L'architettura di routing dinamico IPv6 rispecchierà completamente la configurazione del routing dinamico IPv4.
La nuova versione di OSPF funziona soltanto con IPv6 e va ad affiancarsi alla versione 2 che funziona solamente con IPv4. Per questo motivo saranno attivati due processi distinti, ma per entrambi sarà utilizzata la stessa politica di configurazione: stesse interfacce attive o passive, stessi costi OSPF impostati.
Le rotte relative alle punto-punto del progetto 6Net verranno propagate all'interno della rete GARR in OSPF. A tale scopo verra' modificato il routing OSPF all'interno di 6Net con la creazione di un'area OSPF separata in modo da separare il routing di produzione

dalla parte sperimentale ed evitare che eventuali flap sulla rete 6Net possano inficiare sulle performance del protocollo di routing.
Per il multiprotocol BGP invece il processo sarà lo stesso, ma con tabelle di routing diverse. Sui router CISCO, dove non già presente dovrà essere attivata l'estensione “multiprotocol BGP” tramite la configurazione delle “address family” Per quanto riguarda i peer group, saranno creati dei peer roup analoghi a quelli utilizzati nella configurazione IPv4.
Questa configurazione e’ necessaria in quanto; sui router CISCO i peer-group non supportano neighbor di address amily differenti, mentre sui router Juniper e’ necessario stabilire un local address Ipv6 per i neighbor della family inet6.
La ristribuzione delle statiche in BGP verrà fatta configurando sui router CISCO una apposita route-map (static6-to-bgp) che utilizzera' una prefix-list IPV6 denominata “novanta”, per continuità con la relativa access-list IPv4, mentre sui router JUNIPER le policy saranno raggruppate sotto il policy-statement “static6-to-bgp”, utilizzando un TERM per ente con le rotte IPv6.

ROUTING BGP – TOPOLOGIA LOGICA



ROUTING OSPF



Rapporti di Peering

E’ al momento attivo soltanto il peering IPv6 con la rete europea GEANT. Una volta configurata la rete saranno attivati i peering IPv6 presso gli Internet Exchange MIX e NAMEX, seguendo le stesse policy, valide per IPv4 e collegando ISP con cui GARR abbia già un peering IPv4. Rientra in questo tipo di attivazioni anche il peering con il name root server F. I peering saranno fatti in modalità dual-stack.
Sarà anche richiesto agli attuali fornitori di connettività verso l’internet commericiale (Global Crossing, Telia, TI Sparkle) di poter attivare anche una sessione di peering IPv6.

Supporto ai Progetti di Ricerca

Fino al 30 giugno 2005, data di chiusura del progetto europeo 6NET, sarà garantita l'interoperabilità fra la rete italiana di 6NET e la rete di produzione IPv6 attraverso il collegamento fra il router di trasporto di Milano Lancetti e il router GARR di 6NET, sempre presso COLT Lancetti.

Piano di Indirizzamento

Ad ogni router e' assegnata una **/64** del relativo **gruppo di /56 del PoP** principale **a cui e' connesso**.
Ad ogni utente e' assegnata una **/48** del relativo **gruppo di /40 del PoP a cui e' connesso**.

Indirizzamento router: 2001:760:FFFF::/48
Indirizzamento punto-punto di backbone: 2001:760:FFFF:FFFF::/64
Indirizzamento utenti: 2001:760:1000::/36

Indirizzamento punto-punto backbone

2001:0760:FFFF:FFFF::36/126	rt-bo1-rc-ba1-ba1.garr.net	Ba1
2001:0760:FFFF:FFFF::42/126	rt-na1-rc-ba1.ba1.garr.net	Ba1
2001:0760:FFFF:FFFF::1/126	rt-fi1-rt-bo1.bo1.garr.net	Bo1
2001:0760:FFFF:FFFF::12/126	rt-mi1-rt-bo1.bo1.garr.net	Bo1
2001:0760:FFFF:FFFF::25/126	rt-pd1-rt1-bo1.bo1.garr.net	Bo1
2001:0760:FFFF:FFFF::31/126	rt1-bo1-rt-bo1.bo1.garr.net	Bo1
2001:0760:FFFF:FFFF::32/126	rt-no1-rt1-bo1.bo1.garr.net	Bo1
2001:0760:FFFF:FFFF::35/126	rc-ba1-rt-bo1.bo1.garr.net	Bo1
2001:0760:FFFF:FFFF::39/126	rt-na1-rt1-bo1.bo1.garr.net	Bo1
2001:0760:FFFF:FFFF::A/126	rt-rm1-rt-bo1.bo1.garr.net	Bo1
2001:0760:FFFF:FFFF::2A/126	rt-rm1-rt-ct1.ct1.garr.net	Ct1
2001:0760:FFFF:FFFF::3E/126	rt-na1-rt-ct1.ct1.garr.net	Ct1
2001:0760:FFFF:FFFF::2/126	rt-bo1-rt-fi1.fi1.garr.net	Fi1
2001:0760:FFFF:FFFF::4A/126	rt-pi1-rt-fi1.fi1.garr.net	Fi1
2001:0760:FFFF:FFFF::11/126	rt-bo1-rt-mi1.mi1.garr.net	Mi1
2001:0760:FFFF:FFFF::15/126	rt-mi-rt-mi1.mi1.garr.net	Mi1
2001:0760:FFFF:FFFF::16/126	rt-mi1-rt-mi.mi.garr.net	Mi
2001:0760:FFFF:FFFF::1D/126	rt-mi2-rt-mi1.mi1.garr.net	Mi1
2001:0760:FFFF:FFFF::21/126	rt-pd1-rt-mi1.mi1.garr.net	Mi1

2001:0760:FFFF:FFFF::19/126	rt-to1-rt-mi2.mi2.garr.net	Mi2
2001:0760:FFFF:FFFF::1E/126	rt-mi1-rt-mi2.mi2.garr.net	Mi2
2001:0760:FFFF:FFFF::6/126	rt-rm1-rt-mi2.mi2.garr.net	Mi2
2001:0760:FFFF:FFFF::3A/126	rt1-bo1-rt-na1.na1.garr.net	Na1
2001:0760:FFFF:FFFF::3D/126	rt-ct1-rt-na1.na1.garr.net	Na1
2001:0760:FFFF:FFFF::41/126	rc-ba1-rt-na1.na1.garr.net	Na1
2001:0760:FFFF:FFFF::E/126	rt-rm1-rt-na1.na1.garr.net	Na1
2001:0760:FFFF:FFFF::22/126	rt-mi1-rt-pd1.pd1.garr.net	Pd1
2001:0760:FFFF:FFFF::26/126	rt1-bo1-rt-pd1.pd1.garr.net	Pd1
2001:0760:FFFF:FFFF::45/126	rt-to1-rt-pi1.pi1.garr.net	Pi1
2001:0760:FFFF:FFFF::49/126	rt-fi1-rt-pi1.pi1.garr.net	Pi1
2001:0760:FFFF:FFFF::29/126	rt-ct1-rt-rm1.rm1.garr.net	Rm1
2001:0760:FFFF:FFFF::2D/126	rt-rm2-rt-rm1.rm1.garr.net	Rm1
2001:0760:FFFF:FFFF::5/126	rt-mi2-rt-rm1.rm1.garr.net	Rm1
2001:0760:FFFF:FFFF::9/126	rt-bo1-rt-rm1.rm1.garr.net	Rm1
2001:0760:FFFF:FFFF::D/126	rt-na1-rt-rm1.rm1.garr.net	Rm1
2001:0760:FFFF:FFFF::4D/126	rc-fra-rt-rm1.rm1.garr.net	Rm1
2001:0760:FFFF:FFFF::2E/126	rt-rm1-rt-rm2.rm2.garr.net	Rm2
2001:0760:FFFF:FFFF::51/126	rc-fra-rt-rm2.rm2.garr.net	
2001:0760:FFFF:FFFF::1A/126	rt-mi2-rt-to1.to1.garr.net	To1
2001:0760:FFFF:FFFF::46/126	rt-pi1-rt-to1.to1.garr.net	To1
2001:0760:FFFF:FFFF::4E/126	rc-rm1-rc-fra.fra.garr.net	Fra
2001:0760:FFFF:FFFF::52/126	rc-rm2-rc-fra.fra.garr.net	Fra

Indirizzamento Punto-Punto Utenti e Loopback

PoP	Indirizzamento	RT	RC	GESTIONE
aq.garr.net	2001:760:FFFF:0600::/56		2001:760:FFFF:0600::/64	2001:760:FFFF:060F::/64
ba.garr.net	2001:760:FFFF:1300::/56		2001:760:FFFF:1300::/64	2001:760:FFFF:130F::/64
ba1.garr.net	2001:760:FFFF:0700::/56	2001:760:FFFF:0700::/64		2001:760:FFFF:070F::/64
bo.garr.net	2001:760:FFFF:2100::/56	2001:760:FFFF:2100::/64	2001:760:FFFF:2101::/64	2001:760:FFFF:210F::/64
bo1.garr.net	2001:760:FFFF:0200::/56	2001:760:FFFF:0200::/64 2001:760:FFFF:0201::/64		2001:760:FFFF:020F::/64
ca.garr.net	2001:760:FFFF:0800::/56		2001:760:FFFF:0800::/64	2001:760:FFFF:080F::/64
co.garr.net	2001:760:FFFF:1400::/56		2001:760:FFFF:1400::/64	2001:760:FFFF:140F::/64
cs.garr.net	2001:760:FFFF:0A00::/56		2001:760:FFFF:0A00::/64	2001:760:FFFF:0A0F::/64
ct.garr.net	2001:760:FFFF:1E00::/56		2001:760:FFFF:1E00::/64	2001:760:FFFF:1E0F::/64
ct1.garr.net	2001:760:FFFF:0900::/56	2001:760:FFFF:0900::/64		2001:760:FFFF:090F::/64
fi.garr.net	2001:760:FFFF:1500::/56		2001:760:FFFF:1500::/64	2001:760:FFFF:150F::/64
fi1.garr.net	2001:760:FFFF:0B00::/56	2001:760:FFFF:0B00::/64		2001:760:FFFF:0B0F::/64
fra.garr.net	2001:760:FFFF:0C00::/56		2001:760:FFFF:0C00::/64	2001:760:FFFF:0C0F::/64

ge1.garr.net	2001:760:FFFF:0D00::/56		2001:760:FFFF:0D00::/64	2001:760:FFFF:0D0F::/64
me.garr.net	2001:760:FFFF:1600::/56		2001:760:FFFF:1600::/64	2001:760:FFFF:160F::/64
mi.garr.net	2001:760:FFFF:0500::/56	2001:760:FFFF:0500::/64	2001:760:FFFF:0501::/64	2001:760:FFFF:050F::/64
mi1.garr.net	2001:760:FFFF:0100::/56	2001:760:FFFF:0100::/64		2001:760:FFFF:010F::/64
mi2.garr.net	2001:760:FFFF:1700::/56	2001:760:FFFF:1700::/64		2001:760:FFFF:170F::/64
mi3.garr.net	2001:760:FFFF:1800::/56	2001:760:FFFF:1800::/64		2001:760:FFFF:180F::/64
mt.garr.net	2001:760:FFFF:1900::/56		2001:760:FFFF:1900::/64	2001:760:FFFF:190F::/64
na.garr.net	2001:760:FFFF:1A00::/56		2001:760:FFFF:1A00::/64	2001:760:FFFF:1A0F::/64
na1.garr.net	2001:760:FFFF:0300::/56	2001:760:FFFF:0300::/64		2001:760:FFFF:030F::/64
pa1.garr.net	2001:760:FFFF:0F00::/56		2001:760:FFFF:0F00::/64	2001:760:FFFF:0F0F::/64
pd.garr.net	2001:760:FFFF:2200::/56		2001:760:FFFF:2200::/64	2001:760:FFFF:220F::/64
pd1.garr.net	2001:760:FFFF:0E00::/56	2001:760:FFFF:0E00::/64		2001:760:FFFF:0E0F::/64
pg.garr.net	2001:760:FFFF:1000::/56		2001:760:FFFF:1000::/64	2001:760:FFFF:100F::/64
pi.garr.net	2001:760:FFFF:1F00::/56		2001:760:FFFF:1F00::/64	2001:760:FFFF:1F0F::/64
pi1.garr.net	2001:760:FFFF:0400::/56	2001:760:FFFF:0400::/64		2001:760:FFFF:040F::/64
rm.garr.net	2001:760:FFFF:1B00::/56	2001:760:FFFF:1B00::/64	2001:760:FFFF:1B01::/64	2001:760:FFFF:1B0F::/64
rm1.garr.net	2001:760:FFFF:0000::/56	2001:760:FFFF:0000::/64		2001:760:FFFF:000F::/64
rm2.garr.net	2001:760:FFFF:1C00::/56	2001:760:FFFF:1C00::/64		2001:760:FFFF:1C0F::/64
sa.garr.net	2001:760:FFFF:1D00::/56		2001:760:FFFF:1D00::/64	2001:760:FFFF:1D0F::/64
to.garr.net	2001:760:FFFF:2000::/56		2001:760:FFFF:2000::/64	2001:760:FFFF:200F::/64
to1.garr.net	2001:760:FFFF:1100::/56	2001:760:FFFF:1100::/64		2001:760:FFFF:110F::/64
ts.garr.net	2001:760:FFFF:1200::/56		2001:760:FFFF:1200::/64	2001:760:FFFF:120F::/64

Indirizzamento Utenti

Aquila	2001:760:4200::/40
Bari	2001:760:3200::/40
Bologna	2001:760:2E00::/40
Cagliari	2001:760:4800::/40
Catania	2001:760:3400::/40
Cosenza	2001:760:3600::/40
Firenze	2001:760:2A00::/40
Frascati	2001:760:4400::/40
Genova	2001:760:2400::/40
Matera	2001:760:3C00::/40
Messina	2001:760:3A00::/40
Milano+Como	2001:760:2000::/40
Napoli	2001:760:3000::/40
Padova	2001:760:2200::/40

Palermo	2001:760:3800::/40
Perugia	2001:760:4600::/40
Pisa	2001:760:2C00::/40
Roma	2001:760:4000::/40
Salerno	2001:760:3E00::/40
Torino	2001:760:2600::/40
Trieste	2001:760:2800::/40

Collegamento degli Utenti

Gli utenti già connessi alla sperimentazione rimarranno attivi sia durante la prima fase, che alla conclusione della seconda, quando potranno decidere se mantenere l'attuale collegamento in tunnel oppure passare ad un collegamento nativo in dual-stack.
L'attivazione di Ipv6 per nuovi utenti verrà effettuata preferenzialmente in dual-stack sul link di produzione.

Configurazione standard per i router CISCO

```
ipv6 unicast-routing
!ipv6 multicast-routing # se necessario
!
interface Loopback0
 ipv6 address 2001:760:FFFF:xxxx::/128
 ipv6 enable
!
interface POSx/y
 description RT.XX - RT.YY (ID: ...../..)
 ipv6 address 2001:760:FFFF:FFFF::nnnn/126 #ptop backbone
 ipv6 enable
 ipv6 ospf 137 area 0
!
interface ATMa/b
 description Ente Sede: Sede-ente
 ipv6 address 2001:760:FFFF:xxxx::11/126 # ptop utente
 ipv6 enable
```

```
 ipv6 ospf 137 area 0
!
router bgp 137
 no bgp default ipv4-unicast
 !
  neighbor RTG-FULLMESH6 peer-group
  neighbor RTG-FULLMESH6 remote-as 137
  neighbor RTG-FULLMESH6 update-source Loopback0
  neighbor RTG-CLIENTS6 peer-group
  neighbor RTG-CLIENTS6 remote-as 137
  neighbor RTG-CLIENTS6 update-source Loopback0
  neighbor RTG-CLIENTS-FULL6 peer-group
  neighbor RTG-CLIENTS-FULL6 remote-as 137
  neighbor RTG-CLIENTS-FULL6 update-source Loopback0
 !
 neighbor 2001:760:FFFF:yyyy:: description rt.yy.garr.net
 neighbor 2001:760:FFFF:yyyy:: peer-group RTG-FULLMESH6
 neighbor 2001:760:FFFF:zzzz:: description rt.zz.garr.net
 neighbor 2001:760:FFFF:zzzz:: peer-group RTG-CLIENTS-FULL6
 neighbor 2001:760:FFFF:kkkk:: description rc.kk.garr.net
 neighbor 2001:760:FFFF:kkkk:: peer-group RTG-CLIENTS6
!
address-family ipv6
 neighbor RTG-FULLMESH6 activate
 neighbor RTG-FULLMESH6 soft-reconfiguration inbound
 neighbor RTG-CLIENTS-FULL6 activate
 neighbor RTG-CLIENTS-FULL6 route-reflector-client
 neighbor RTG-CLIENTS-FULL6 send-community
 neighbor RTG-CLIENTS-FULL6 soft-reconfiguration inbound
 neighbor RTG-CLIENTS6 activate
 neighbor RTG-CLIENTS6 route-reflector-client
 neighbor RTG-CLIENTS6 default-originate
 neighbor RTG-CLIENTS6 soft-reconfiguration inbound
 neighbor RTG-CLIENTS6 route-map AS137-out out # la stessa route-map ipv4
 network 2001:760:XXXX::/40 # network utenti
 redistribute static route-map static6-to-bgp
exit-address-family
!
ipv6 route 2001:760:XXX2::/48 2001:760:FFFF:xxxx::12 # route per utente
ipv6 route 2001:760:XXXX::/40 Null0
!
ipv6 router ospf 6
 log-adjacency-changes
 passive-interface ATMa/b
!
!route-map AS137-out permit 10
! match as-path 51
!
```

```
route-map static6-to-bgp permit 10
 match ipv6 address prefix-list novanta
!
ipv6 prefix-list novanta seq 5 permit ipv6 2001:760:XXX2::/48
```

Configurazione standard per i router JUNIPER

* Configurazione IPv6
set interfaces lo0 unit 0 family inet6 address ipv6_address/128
set interfaces so-0/0/0 unit 0 family inet6 address ipv6_address/126

*Configurazione OSPFv3
set protocols ospf3 area 0 interface interface_name
set protocols ospf3 area 0 interface interface_name passive

*Configurazione BGP usando la stessa struttura v4
set protocols bgp group iBGP-6 type internal
set protocols bgp group iBGP-6 local-address ipv6_loopback_address
set protocols bgp group iBGP-6 family inet6 any
set protocols bgp group iBGP-6 export static6-to-bgp peer-as 137
set protocols bgp group iBGP-6 neighbor 2001:760:xxxx:xxxx description RTMI1_IPv6

*Configurazione statiche utente
set routing-options rib inet6.0 static route 2001:760:: next-hop 2001:760:ffff:ffff::21

*Ridistribuzione statiche utente
set policy-options policy-statement static6-to-bgp term UTENTE-IPv6 from family inet6
protocol static route-filter 2001:760:xxxx:xxxx/48 exact
set policy-options policy-statement static6-to-bgp term UTENTE-IPv6 then accept

Gestione Troubleshooting

La gestione del troubleshooting da parte del NOC non prevede utilizzo di tool diversi da quelli esistenti, in quanto la funzionalità del link resta indipendente dal tipo di protocollo utilizzato. Sarà invece necessario monitorare qualche indirizzo IPv6 e i peering IPV6 in modo da avere sempre sottocontrollo la raggiungibilità IPv6.
Appositi tool, o plug-in ai tool esistenti, dovranno eventualmente essere sviluppati per il monitoraggio di link nativi IPv6 in assenza del dual-stack.
Non potrà essere effettuato accounting separato per il traffico IPv6 sui router CISCO in quanto le versioni di IOS in uso non consentiranno l'interrogazione di specifiche MIB SNMP.

Gestione Incidenti di Sicurezza

Potrebbero presentarsi con l'attivazione del servizio IPv6 problematiche relative a incidenti di sicurezza con indirizzi IPv6. Il CERT, supportato dal NOC, deve essere in grado di individuare l'utilizzatore degli indirizzi attraverso il database di RIPE, che dovrà essere sempre aggiornato.

Piano e tempi di realizzazione

3-9/11/04	Preparazione configurazioni 12K e JUNIPER
11/11/04 ore 20.00	Attivazione su core del routing dinamico IPv6
-	Acquisto Flash Card per CISCO 7500 e 7200
-	Configurazione Flash Card con relativo IOS presso GARR
-	Installazione Flash Card presso PoP
-	Preparazione configurazioni CISCO 7500 e 7200
-	Attivazione su accesso del routing dinamico IPv6
-	Comunicazione ufficiale dell'attivazione del servizio

Appendice 1: Comandi utili

Router CISCO – Comandi troubleshoting di interfaccia

```
RTG_ROMA>show ipv6 interface brief

GigabitEthernet0/0/0       [up/up]
    unassigned
GigabitEthernet0/0/1       [up/up]
    unassigned
GigabitEthernet0/0/2       [up/up]
    unassigned
GigabitEthernet0/1/0       [up/up]
    FE80::209:7BFF:FE4A:F403
    2001:760:FFFF::11
…….

-------------------------------------------------------------------------

RTG_ROMA> show ipv6 interface GigabitEthernet0/1/0
GigabitEthernet0/1/0 is up, line protocol is up
  IPv6 is enabled, link-local address is FE80::209:7BFF:FE4A:F403
  Description: macchina servizi 6net
  Global unicast address(es):
    2001:760:FFFF::11, subnet is 2001:760:FFFF::10/126
  Joined group address(es):
    FF02::1
    FF02::2
    FF02::1:FF4A:F403
    FF02::1:FF00:11
    FF02::5
    FF02::6
  MTU is 1500 bytes
  ICMP error messages limited to one every 100 milliseconds
```

```
  ICMP redirects are enabled
  ND DAD is enabled, number of DAD attempts: 1
  ND reachable time is 30000 milliseconds
  ND advertised reachable time is 0 milliseconds
  ND advertised retransmit interval is 0 milliseconds
  ND router advertisements are sent every 200 seconds
  ND router advertisements live for 1800 seconds
  Hosts use stateless autoconfig for addresses.
```

Router CISCO – Comandi troubleshoting Routing

```
RTG_ROMA>show ipv6 route
IPv6 Routing Table - 725 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
       I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea
       O - OSPF intra, OI - OSPF inter, OE1 - OSPF ext 1, OE2 - OSPF ext
2
B   2001:200::/32 [200/0]
     via 2001:798:2020:10AA::9, Null, 10:29:16
B   2001:200:12D::/48 [200/0]
     via 2001:760:FFF::, Null, 05:21:40
……….
--------------------------------------------------------------------------

RTG_ROMA>show ipv6 route 2001:760:FFFF:FFFF::11/126
IPv6 Routing Table - 725 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
       I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea
       O - OSPF intra, OI - OSPF inter, OE1 - OSPF ext 1, OE2 - OSPF ext
2
O   2001:760:FFFF:FFFF::10/126 [110/45]
     via FE80::209:7BFF:FE4C:132, POS11/0, 01:25:17
```

Router CISCO – Comandi troubleshoting OSPF

```
RTG_ROMA>show ipv6 ospf neighbor

Neighbor ID       Pri    State           Dead Time    Interface ID
Interface
193.206.136.253  128      FULL/    -                00:00:38        2
POS11/3
193.206.137.189      1      FULL/    -                00:00:37        7
POS11/1
193.206.128.251      1      FULL/    -                00:00:39        4
POS11/0
193.206.131.249 128   FULL/  -        00:00:38    2               POS4/2
193.206.130.254 128   FULL/  -        00:00:38    5               POS4/1
193.206.129.1     1   FULL/  -        00:00:39    10              POS4/0

--------------------------------------------------------------------------

RTG_ROMA>show ipv6 ospf database prefix internal

            OSPFv3 Router with ID (193.206.131.251) (Process ID 137)

                Intra Area Prefix Link States (Area 0)

  Routing Bit Set on this LSA
  Now in min table
```

```
  Table index: 52 min 0 sec
  LS age: 746
  LS Type: Intra-Area-Prefix-LSA
  Link State ID: 1004
  Advertising Router: 0.0.0.2
  LS Seq Number: 800000A0
  Checksum: 0x2832
  Length: 52
  Referenced LSA Type: 2002
  Referenced Link State ID: 4
  Referenced Advertising Router: 0.0.0.2
  Number of Prefixes: 1
  Prefix Address: 2001:760:FFFF:100::4
  Prefix Length: 126, Options: None, Metric: 0

 --More—
  Routing Bit Set on this LSA
  Now in min table
  Table index: 59 min 51 sec
  LS age: 648
  LS Type: Intra-Area-Prefix-LSA
  Link State ID: 0
  Advertising Router: 193.206.128.251
  LS Seq Number: 800000B6
  Checksum: 0xE0FE
  Length: 132
  Referenced LSA Type: 2001
  Referenced Link State ID: 0
  Referenced Advertising Router: 193.206.128.251
  Number of Prefixes: 5
  Prefix Address: 2001:760:FFFF:200::
  Prefix Length: 128, Options: LA , Metric: 0
  Prefix Address: 2001:760:FFFF:FFFF::34
  Prefix Length: 126, Options: None, Metric: 39
  Prefix Address: 2001:760:FFFF:FFFF::10
  Prefix Length: 126, Options: None, Metric: 20
  Prefix Address: 2001:760:FFFF:FFFF::30
  Prefix Length: 126, Options: None, Metric: 1
  Prefix Address: 2001:760:FFFF:FFFF::8
……
```

Router CISCO – Comandi troubleshoting BGP

```
RTG_ROMA>show bgp ipv6 unicast summary
BGP router identifier 193.206.131.251, local AS number 137
BGP table version is 37270, main routing table version 37270
635 network entries using 92075 bytes of memory
636 path entries using 45792 bytes of memory
57796/532 BGP path/bestpath attribute entries using 6241968 bytes of
memory
57 BGP rrinfo entries using 1368 bytes of memory
50422 BGP AS-PATH entries using 1276982 bytes of memory
522 BGP community entries using 21436 bytes of memory
0 BGP route-map cache entries using 0 bytes of memory
0 BGP filter-list cache entries using 0 bytes of memory
BGP using 7679621 total bytes of memory
BGP activity 2612138/2310561 prefixes, 40963051/40325180 paths, scan
interval 60 secs

Neighbor          V     AS MsgRcvd MsgSent    TblVer   InQ OutQ Up/Down
State/PfxRcd
2001:760:FFFF:100::
```

```
                4     137     23425      6677      37270      0      0 4d15h
632
2001:760:FFFF:200::
                4     137      6314      6317      37270      0      0 3d19h
1
2001:760:FFFF:201::
                4     137     11100     21643      37270      0      0 3d19h
0
……….
```

```
RTG_ROMA>show bgp ipv6 unicast neighbors 2001:760:FFFF:200:: received-
routes
BGP table version is 37270, local router ID is 193.206.131.251
Status codes: s suppressed, d damped, h history, * valid, > best, i -
internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
*>i2001:760:FFF:4::/64
                    2001:760:FFFF:200::6
                                             0    100      0 ?

Total number of prefixes 1
```

Router Juniper: Comandi troubleshoting di interfaccia

Stessi comandi IPv4.

Router Juniper: Comandi troubleshoting di routine

```
nocview@RT-PI1-RE0> show route table inet6

inet6.0: 720 destinations, 1358 routes (720 active, 0 holddown, 0
hidden)
+ = Active Route, - = Last Active, * = Both

2001:200::/32         *[BGP/170] 10:39:24, MED 0, localpref 200, from
2001:760:ffff:100::
                       AS path: 20965 11537 7660 2500 I
                     > via so-0/0/0.0
                     [BGP/170] 10:39:19, MED 0, localpref 200, from
2001:760:ffff::
                       AS path: 20965 11537 7660 2500 I
                     > via so-0/0/0.0
```

Router Juniper – Comandi troubleshoting OSPF

```
nocview@RT-PI1-RE0> show ospf3 neighbor
ID               Interface              State     Pri   Dead
193.206.132.188  so-0/0/0.0             Full      128   36
```

```
  Neighbor-address fe80::280:42ff:fe14:568a
193.206.136.125  so-1/0/0.0             Full      128   39
  Neighbor-address fe80::280:42ff:fe14:5623

------------------------------------------------------------------------

nocview@RT-PI1-RE0> show ospf3 route
Prefix                                         Path    Route        NH
Metric
                                              type   type        type
0.0.0.1                                            Inter  AS BR       IP
11139
  NH-interface so-0/0/0.0
0.0.0.2                                       Intra  Area/AS BR  IP   28
  NH-interface so-0/0/0.0
……..
2001:798:2020:10aa::8/126                     Intra  Network     IP   28
  NH-interface so-0/0/0.0
3ffe:2000:0:41a::/64                               Inter  Network      IP
11139
  NH-interface so-0/0/0.0
```

Router Juniper – Comandi troubleshoting BGP

Stessi comandi IPv4.