

# IPv6 Tunneling Over IPV4

A.Sankara Narayanan<sup>1</sup>, M.Syed Khaja Mohideen<sup>2</sup>, M.Chithik Raja<sup>3</sup>

Department of Information Technology  
Salalah College of Technology  
Sultanate of Oman

## ABSTRACT

*Due to the huge growth of the internet users, mobile users using internet connection makes development and implementation of IPv6 as an alternate solution. IPv6 is a long anticipated upgrade to the internet's main communication protocol, which is called IPv4. The current address space provided by IPv4, with only 4, 294, 967, 296 addresses. Nowadays IPv6 tunneling over IPv4 are widely used to form the global IPv6 Internet. The IPv6 128-bit address scheme it should provide enough addresses for everyone's computer. Tunneling provides a path to use an existing IPv4 to IPv6. This paper describes typical IPv6 tunneling and tunnel broker's deployment in real IP networks. In the deployment of IPv6, it is a well adopted practice that IPv6 networks are interconnected via IPv6 over IPv4 (IPv6/IPv4) tunnels*

## Keywords:

IPv6, Tunneling, IPv4

## I.INTRODUCTION

To send and receive information over the Internet, computers and other devices need a unique address called an IP address. The current system that provides addresses is IPv4 (Internet Protocol version 4), and has been in use for the past 30 years. As the Internet has grown, the number of available IPv4 addresses has slowly been exhausted. To accommodate the growing number of Internet users, a new Internet Protocol was required. On February 11, 2011 the Numbering Resource Organization (NRO) announced an important IPv4 to IPv6 milestone. The last public block of IPv4 addresses was assigned and marked the depletion of the IPv4 address pool. Since then, awareness has grown gradually in the enterprise and private sectors around the fact that the Internet and all the devices linked to it will by necessity transition to this new, essentially unlimited

address scheme. On World IPv6 Day (June 8, 2011), major service providers including Google, Yahoo!, and Facebook will turn on Internet Protocol version 6 (IPv6) and for 24 hours they will offer their content over IPv6. While IPv6 implementations started in the 1990s, "World IPv6 Day" is the first global test that is intended to help service providers and vendors prepare for the inevitable migration to IPv6. IPv4 address exhaustion has been a practical problem that providers must face. The reserved addresses of providers will be exhausted in the near future, which may retard the long term development of services. IPv6 is regarded as a complete and thorough solution to IPv4 address exhaustion.

The "tunnel" that is being brokered here is ipv6 traffic encapsulated in ipv4. A machine on your network acts as your local tunnel endpoint, and your tunnel broker has acts as the other end. You only have direct ipv4 connectivity. Your tunnel broker is connected both to ipv4 and ipv6. When a machine on your network desires to reach an ipv6 address, it will send the packet to your local tunnel endpoint. That machine wraps the ipv6 packet in an ipv4 header, and sends it over your ipv4 connection to the tunnel broker's endpoint. There, the ipv6 packet is removed from its wrapper, and sent on its way to the ipv6 destination. Return traffic flows similarly, with the tunnel broker wrapping, and your machine unwrapping. Tunnel Broker model, as defined in RFC3053, is a solution to the automation of IPv6 address assignment and IPv6 over IPv4 tunnel management. A tunnel broker with the Tunnel Setup Protocol (TSP) enables the establishment of tunnels of various inner protocols, such as IPv6 or IPv4, inside various outer protocols packets, such as IPv4, IPv6 or

UDP over IPv4 for IPv4 NAT traversal. The control protocol (TSP) is used by the tunnel client to negotiate the tunnel with the broker.

## II. IPv6 OVER IPv4

IPv4 stands for Internet Protocol version 4. It is the underlying technology that makes it possible for us to connect our devices to the web. Whenever a device access the Internet (whether it's a PC, Mac, Smartphone or other device), it is assigned a unique, numerical IP address such as 8.8.4.4. To send data from one computer to another through the web, a data packet must be transferred across the network containing the IP addresses of both devices. Without IP addresses computers would not be able to communicate and send data to each other. It's essential to the infrastructure of the web.



Figure 1: Regional Internet Registry's

Internet Assigned Numbers Authority (IANA) is responsible for global coordination of the Internet Protocol addressing systems, as well as the Autonomous System Numbers used for routing Internet traffic. IPv6 is the sixth revision to the Internet Protocol and the successor to IPv4. It functions similarly to IPv4 in that it provides the unique, numerical IP addresses necessary for Internet enabled devices to communicate. However, it does support one major difference it utilizes 128-bit addresses. IPv4 uses 32 bits for its Internet addresses. That means it can support  $2^{32}$  IP addresses in total around 4.29 billion. That may seem like a lot, but all 4.29 billion IP addresses have now been assigned to various institutions, leading to the crisis we face today. Therefore, it can support  $2^{128}$  Internet addresses -- 340,282,366,920,938,000,000,000,000,000,000,000 of them to be exact. That's a lot of addresses, so many that it requires a hexadecimal system to display the addresses. In other words, there are more than enough

IPv6 addresses to keep the Internet operational for a very, very long time.

## III. OVERVIEW OF TUNNEL BROKER SYSTEM

### 1. Tunnel Broker (TB)

Tunnel Broker is the organizer of the Tunnel Broker system. It interacts with the users and sends instructions to the DNS system and the tunnel servers. It monitors the tunnel servers so that if a tunnel server is down it could have other tunnel servers in the same tunnel server group take over the failed tunnel server's attached users.

### 2. Tunnel Server (TS)

Tunnel Server is the point where the users get connected into the IPv6 network. Tunnels are setup between the tunnel servers and the users. Typically each tunnel server will have at least three addresses an IPv6 unicast address for IPv6 routing purpose, an IPv4 unicast address for IPv4 accessibility, and an IPv4 anycast address as the endpoint for the user tunnels. For each of the attached users, the tunnel server will have a tunnel to it with the IPv4 anycast address set as the tunnel's local IPv4 address and a routing entry specifying that the user's IPv6 network is reachable through the tunnel. Each tunnel server monitors its attached users so that if a user is not reachable it will report to the tunnel server.

### 3. Tunnel Server Group (TSG)

Tunnel servers are divided into tunnel server groups by IPv4 anycast addresses all the tunnel servers sharing a single IPv4 anycast address forms a tunnel server group. Whenever a user sends a tunnel activation request to the tunnel broker, it is associated with a tunnel server group and finally it would be attached to the nearest tunnel server in the group. If a user could not reach his upstream tunnel server some time after the tunnel is established, other tunnel servers in the group will try to take over him. If a tunnel server is down, other tunnel servers in the same group will try to take over all of its attached users.

### 4. DNS System (DNS)

The DNS system is responsible for providing mappings from IPv6 addresses to domain names. Typically each user will get a domain name that will resolve to one of his IPv6 addresses.

Some other policies listed below.

- A user has to register first to use the Tunnel Broker system. Registration makes access control relatively easy.
- A user gets a permanent IPv6 address block when registering.
- Each user could only have a single IPv6 address block and a single IPv6/IPv4 tunnel.
- Communication between the users and the tunnel broker is via HTTP. A user could interact with the tunnel broker with a WWW browser. Other ways of communication may be implemented to ease the users operation.

## IV.IPv6 OVER IPv4 TUNNELING

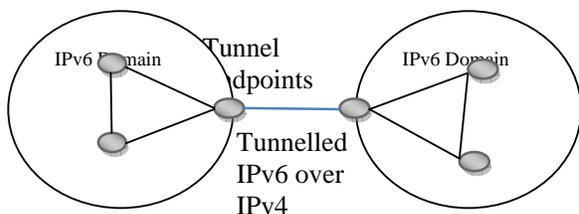


Figure 2: IPv4 Network

Tunneling is a mechanism to allow IPv6 domains that are connected via IPv4 networks to communicate with each other, or to allow isolated IPv6 hosts that are not directly connected to an IPv6 router but only to IPv4 machines to reach the wider IPv6 network. Naturally, to use tunneling a host must have a dual IP stack in order to send and receive IPv4 datagrams. In most cases, however, this won't apply to large numbers of machines just some routers and isolated IPv6 machines on IPv4 networks. Tunneling IPv6 packets over IPv4 network infrastructure is simple in theory just prep end an IPv4 header and sends them via the normal IPv4 mechanisms to a router with a dual IP stack. There are also issues about dealing with IPv4 ICMP errors, which are reported to the encapsulating node rather than the original sender, and to do with fragmenting IPv6 packets, but these can be dealt with. However, the straightforward approach involves network managers configuring information about tunnel endpoints into the encapsulating node this is time consuming and non scalable. It is also impossible to expect single isolated users who may be dialing into the IPv4 network through their ISP to configure tunnels. Therefore a dynamic solution is required.

## A.TUNNEL BROKERS

There are a variety of tunnel brokers that provide their own implementations based on different business goals. For example, one tunnel broker product on the market is called gogo server (formerly Gateway6).It's free client utility tunnel broker.

### 1) GOGO CLIENT IPv6 CONNECTIVITY

Go to <http://gogo6.com/>. At the upper right of the page, click "Freenet6". On the next page, click Sign Up. Fill in the form to create an account. You will have to read your email and click a link to verify your account, and also fill out a profile form. Go to <http://gogo6.com/> and, at the top of the page, click "Freenet6". Your name should appear at the upper right of the page Freenet has recorded your ID with a cookie. In the "Freenet Services" section, click the Download button. The next page offers several versions to download. Download the "gogoCLIENT - Basic version" and install it with the default options. Now you need to create a Freenet6 Tunnel account. In your browser, on the "Download" page, at the top, click the "Freenet6" link. Scroll down to the "Freenet6" section and click the "Learn more" link, as shown below on this page.

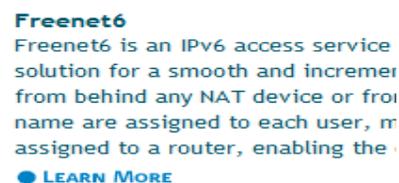


Figure 3: Freenet6

On the next page, scroll down to the "Getting started" section, and click the "here" link, as shown below on this page. Fill out the form to get a Freenet6 account.



Figure 4: gogo client download page

When the gogoCLIENT is installed and running, click the "Advanced" tab, and select a "Tunnel Mode" of "IPv6-in-UDP-IPv4 Tunnel (NAT Traversal)" as shown below on this page. Click "Apply".

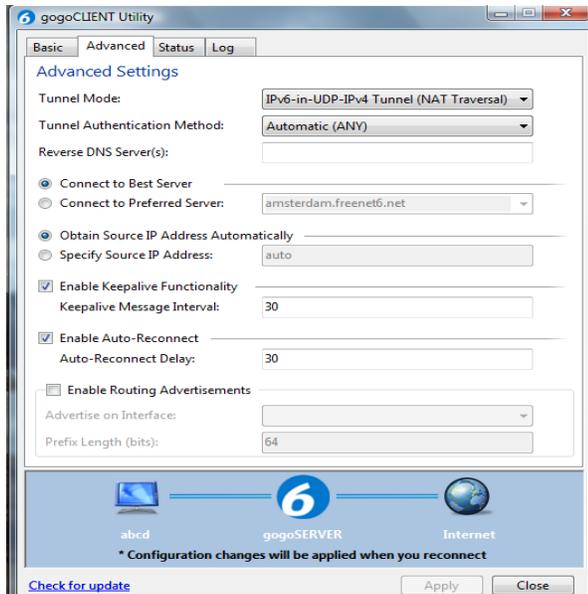


Figure 5: gogo client tunnel mode setup

In the gogoCLIENT window, click the "Basic" tab. Change the "Server Address" to authenticated.freenet6.net. In the middle of the window, click the "Connect Using the Following Credentials" button. Enter your Freenet6 username and password. Click the "Connect" button. A box will pop up asking "Save changes before connecting?" Click Save.

Click the "Status" tab. When it connects, you should see a long IPv6 "Local Endpoint Address", as shown below on this page. If you cannot connect, you may have to adjust your router or firewall to allow UDP port 3653.

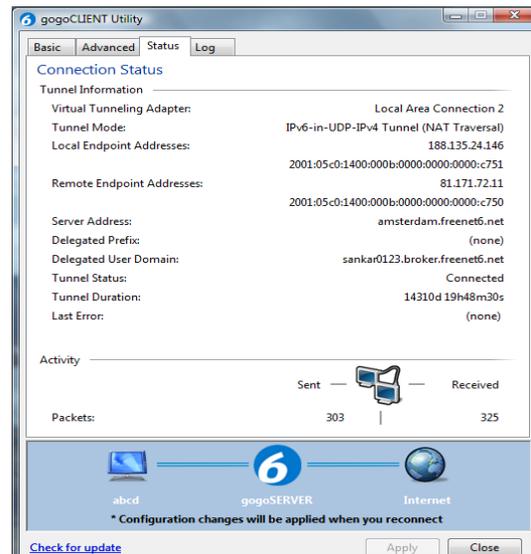


Figure 6: gogo client connection status

Effectively, you load on a driver on your client system, and you establish a tunnel from your system, through the Tunnel Broker's network to access servers and services, things like <http://ipv6.google.com> over IPv6.

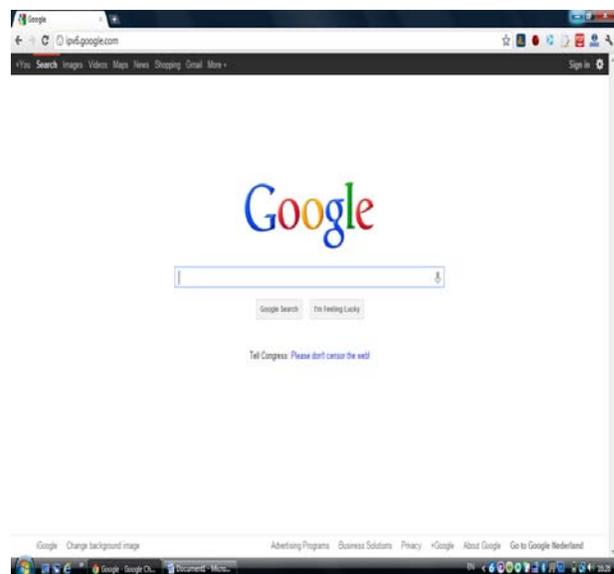


Figure 7: ipv6.google.com

For the individual or small business that doesn't want to setup its own DirectAccess server and relay or routing setup, the Tunnel Broker can drastically simplify the process. Say for example you want to access the latest IPv6 Facebook site from your home office, but your DSL provider doesn't have IPv6 support yet and your company hasn't setup IPv6 routing on their end, you can simply download the Tunnel Broker drivers, install them on your home system, and within about 10 minutes, your

home system is now configured using IPv6 through  
Facebook's IPv6 site.

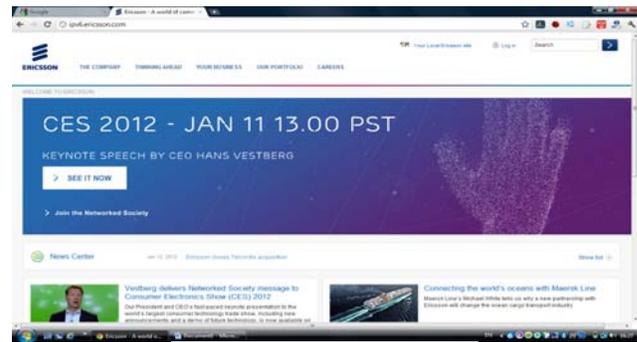
## 2) HURRICANE ELECTRIC IPv6 CONNECTIVITY

This is also one of the free IPv6 tunnel broker. Go to <http://tunnelbroker.net>. At the left corner of the page, click register. On the next page fill the form to create an account. Your new login username and password will be sent to your registered email address. After login the user account click "Create regular tunnel" IPv4 endpoint enter your viewing IP, select anyone server closest to you? Click Submit. On the next page will show tunnel detail.



Figure 8: tunnel details

Now establish a tunnel from your system, through the Tunnel Broker's network to access servers and services, things like <http://ipv6.ericsson.com>



## V.CONCLUSION

Network industry expects a gradual transition to IPv6 in near future. The IPv6 addressing protocol solves the problem of IP address exhaustion, because IPv4 and IPv6 are incompatible, the general public, businesses of all size and federal agencies will eventually need to replace or upgrade every element in their communications scheme. The adoption of IPv6 will occur over several years; precisely how long remains unpredictable. This paper designed to describe how the client (end) user can update IPv4 to IPv6 without any charges, using tunnel brokers. The transition mechanisms focused in this document are useful in the current stage of global IPv6 deployment in real IP networks. The works related to this paper are to do such experiments. These experiments will present more clearly and comprehensively meet the guidelines.

## VI.REFERENCES

- [1] <http://www.polycom.com/global/documents/whitepapers/ipv4-to-ipv6-migration-whietpaper.pdf>
- [2] [http://www.eurojournals.com/ejsr\\_34\\_1\\_12.pdf](http://www.eurojournals.com/ejsr_34_1_12.pdf)
- [3] [http://cdn1.cust.footprint.net/prod/App\\_Data/Replicated/MediaFiles/1/2/6/%7B12683971-2955-444E-AC64-6159E46A8B91%7Dipv6\\_white\\_paper.pdf](http://cdn1.cust.footprint.net/prod/App_Data/Replicated/MediaFiles/1/2/6/%7B12683971-2955-444E-AC64-6159E46A8B91%7Dipv6_white_paper.pdf)
- [4] <http://www.worldip6launch.org/>
- [5] <http://www.networkworld.com/community/blog/configuring-ipv6-routing-through-ipv4-microso>

- [6] <http://www.ipv6.com/gctcms/Editor/files/ipv6%20white%20paper%20by%20Allied%20Telesis.pdf>
- [7] <http://searchtelecom.techtarget.com/tip/IPv6-security-issues-Fixing-implementation-problems>[http://www.cs.duke.edu/~angl/papers/v4over6\\_noms06.pdf](http://www.cs.duke.edu/~angl/papers/v4over6_noms06.pdf)
- [8] <http://www.cs.princeton.edu/~yiwang/papers/iscc05.pdf>
- [9] [http://www.brocade.com/downloads/documents/technical\\_briefs/Transitioning-to-IPv6-for-SP\\_GA-TB-380-00.pdf](http://www.brocade.com/downloads/documents/technical_briefs/Transitioning-to-IPv6-for-SP_GA-TB-380-00.pdf)
- [10] <http://www.huawei.com/en/static/hw-092945.pdf>
- [11] <http://www.iana.org/numbers>

## Authors

1. A. Sankara Narayanan ,MCA.,MCP,CCNA,CCNA Security,CEH. Technical Support –Salalah College of Technology.Sultanate of Oman.
2. M.Syed Khaja Mohideen , MSc.,MPhil.,PGDAS., Lecturer – Salalah College of Technology.Sultanate of Oman.
3. M.Chithik Raja , MSc.,M.E., Lecturer – Salalah College of Technology. Sultanate of Oman.

