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## OPERATION OF A NODE IN THE EXPERIMENTAL IPV6 MULTICAST NETWORK “M6BONE”

Christian Lazo R.<sup>1</sup> Roland Glöckler<sup>2</sup>

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### RESUMEN

Este trabajo describe la participación y experiencia de la Universidad Austral de Chile (UACH) en la red experimental M6Bone o red multicast sobre IPv6. Actualmente la red M6Bone está en funcionamiento distribuido, dando soporte a conexiones a escala mundial. Su administración es coordinada desde la Red Francesa de Investigación y Desarrollo RENATER. Muchos proyectos de investigación hacen uso de esta estructura mundial de red, utilizándola como un gran laboratorio de pruebas con el fin de posibilitar y acelerar la migración de IPv4 a IPv6. En la implementación del modelo se utilizó software de uso libre para configurar un router IPv6 con soporte multicast y se utilizaron herramientas de videoconferencia para verificar su funcionamiento correcto. Se pudo verificar que el mecanismo de conexión permite conferencias de audio y video en buena calidad a escala global. Por lo tanto, se puede promover el uso de IPv6 para aplicaciones de este tipo.

Palabras clave: Multicast, IPv6, M6Bone, UACH, videoconferencia, RENATER.

### ABSTRACT

*This work describes the participation of the Universidad Austral de Chile (UACH) in the experimental network M6Bone or IPv6 multicast network. Currently the M6Bone network works in distributed manner, giving support to connections at global scale. Its administration is coordinated from the French research and development network RENATER. Many research projects make use of this worldwide network structure, using it as a great test laboratory with the intention to enable and accelerate the migration of IPv4 to IPv6. In the implementation of the model, free software was used to configure an IPv6 router with multicast support and videoconference tools were used to verify the correct operation. It could be verified that the connection mechanism enables video and audio conferencing of good quality on global scale. Therefore, the use of IPv6 for applications of this type can be promoted.*

*Keywords: Multicast, IPv6, M6Bone, UACH, videoconference, RENATER.*

### INTRODUCTION

M6Bone is the name given to the experimental network that uses the protocol IPv6 (Internet Protocol version 6) [1] to give multicast support to its interconnected networks. This network provides a work space with laboratory characteristics on global scale, facilitating the experimentation with multicast over IPv6 [2] in research and development networks with international coverage. The configuration and services of the network M6Bone are based on the French model of IPv6 used by RENATER (Le Réseau National of Télécommunications pour la Technologie, l'Enseignement et la Recherche)[3].

The main objective of the M6Bone network is to experience and to develop advanced multicast services over IPv6 with the purpose of participating in the promotion of the new Internet protocol [9]. This contemplates mainly the use of tools with high demands such as videoconferencing in the new network.

### PARTICIPATION

The network M6Bone is coordinated from France and provides global coverage as shown in Figure 1. There it

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can be seen that M6Bone ended to be a pilot experiment a while ago, now becoming a high performance network, likewise in coverage, connection quality and supported services.

The physical connectivity of this network is mainly supported by academic and research networks, however any connection to Internet can serve to give support and interconnection to it.

For the sector of Latin America the University of Guadalajara in Mexico is the point of contact on our continent and the UACH (Universidad Austral de Chile) the IPv6 multicast node for Chile just as illustrated in Figure 2.

At the same time the node of Mexico is interconnected with two big networks in the United States (CISCO, NYSERNET) and also gives connectivity to the Brazilian network of CPqD and the sites UNAM, University of Navojoa and Wichita State University.

## OPERATION

In RENATER a so-called RP (Rendezvous Point) is installed that works as head equipment (root) of the tree-like multicast group and distributes the announcements of sources to each one of the interconnected sites. This transmission is carried out by any of the three established mechanisms that are illustrated in Figure 3.

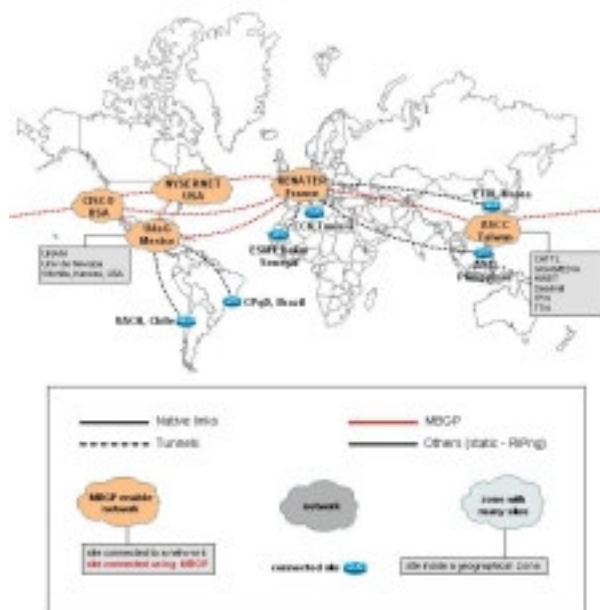


Fig. 1 Current connectivity state of the M6Bone network.



Fig. 2 Map of American connectivity with presence of Chile.

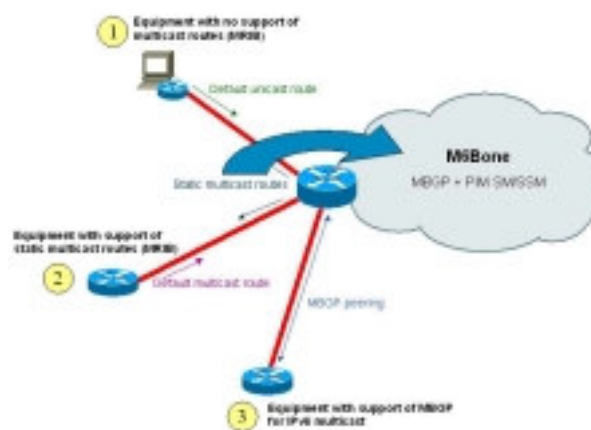


Fig. 3 Interconnection mechanisms to the M6Bone network.

1. For sites without native multicasting support, a separate multicast router would establish a tunnel IPv6 multicast over an IPv4 or IPv6 unicast connection.
2. For sites using a router with MRIB support

(Multicast Routing Information Base), i.e., static multicast routes, this router handles all traffic and establishes a tunnel IPv6 multicast over IPv4 or IPv6 unicast.

- For sites that have a router supporting BGP (Border Gateway Protocol), a session will be established over MBGP (Multiprotocol BGP) [4], similar to the mechanism 2, but with dynamic routing capabilities.

## Model UACH

In the case of the connection between the Austral University of Chile and the University of Guadalajara we opted to raise a tunnel IPv6 multicast over IPv4 [5], using for it a separate PC multicast Router configured with the operating system FreeBSD 4.8 according to mechanism 1.

The configuration of each one of the interfaces used in our router is detailed below:

```
rl0:
flags=8a43<UP,BROADCAST,RUNNING,ALLMULTI,SIMPLEX,
MULTICAST> mtu 1500
    inet 146.83.248.3 netmask 0xfffffe0 broadcast 146.83.248.31
    inet6 fe80::208:a1ff:fe57:301c%rl0 prefixlen 64 scopeid 0x1
    inet6 3ffe:400f:f000::1 prefixlen 64
    ether 00:08:a1:57:30:1c
    media: Ethernet autoselect (100baseTX <full-duplex>)
    status: active

vx0:
flags=8a43<UP,BROADCAST,RUNNING,ALLMULTI,SIMPLEX,
MULTICAST> mtu 1500
    inet6 fe80::2a0:24ff:feba:1d5b%vx0 prefixlen 64 scopeid 0x2
    ether 00:a0:24:ba:1d:5b

gif0:
flags=8251<UP,POINTOPOINT,RUNNING,ALLMULTI,MULTICA
ST> mtu 1280
    tunnel inet 146.83.248.3 —> 148.202.239.253
    inet6 3ffe:82f0:3004::2 —> 3ffe:82f0:3004::1 prefixlen 128
    inet6 fe80::208:a1ff:fe57:301c%gif0 prefixlen 64 scopeid 0x8
```

Just as can be seen in the configuration of the logical interface gif0, the PC is configured with dual stack, that is to say it supports both IP versions natively. It also provides a tunnel over the IPv4 Internet connection. On this IPv4 tunnel travels all the encapsulated IPv6 multicast traffic of the network of the UACH.

## Protocol PIM-SM

The module pim6sd (version 20030901a) was installed and configured in this machine. This package provides the functionalities of the protocol PIM-SM (Protocol Independent Multicast-Sparse Mode) [6] for the transport and routing of the multicast traffic. This protocol routes packets to multicast groups and it is designed to establish

distribution trees through wide area networks in an effective way.

In our case the addresses of the RP - which is the root of the distribution tree - were assigned manually as can be seen below.

```
static_rp ff0E::/16 2001:660:3007:300:1:: priority 1;
static_rp ff1E::/16 2001:660:3007:300:1:: priority 1;
static_rp ff3E:30:2001:700::/64 2001:700:e000:501::2 priority 0;
```

PIM-SM is "protocol independent", because it can use the routing information that any routing protocol introduces into the multicast routing database [5]. Examples of these routing protocols are unicast protocols, such as RIP (Routing Information Protocol) and OSPF (Open Shortest Path First). Additionally, the use of multicast protocols for filling the routing tables, such as DVMRP (the Distance Vector Multicast Routing Protocol) [7], is also supported.

The Sparse Mode means that the protocol is designed for situations where the multicast groups are dispersed in an extensive region. The protocols of Sparse Mode can work in local area network (LAN) environments, but they are more effective in wide area networks (WAN).

## MULTICAST TOOLS

The tools that the node of the Austral University of Chile uses in the M6bone network in the area of videoconferencing are the following ones: VIC, RAT and SDR [8]. All of them are migrated and support the protocol IPv6. They all work in environments Windows, Linux, Solaris, FreeBSD and many more.

### VIC (Video Conference)

VIC is a video conferencing application developed by the Network Research Group at the Lawrence Berkeley National Laboratory in collaboration with the University of California, Berkeley. It is able to transmit video in IPv4 and IPv6 multicast.

### SDR (Session Directory)

SDR is a session directory tool designed to allow the advertisement and joining of multicast conferences in multicast networks such as the M6Bone using both IPv4 and IPv6.

### RAT (Robust Audio Tool)

RAT is an open-source audio conferencing and streaming application that allows users to participate in audio conferences over the internet. These can be between two participants directly, or between a group of participants on a common multicast group. It works for IPv4 and IPv6 multicast.

RAT does not require any special configuration for the point to point communication, only a network connection and a sound card. RAT uses IP multicast for conferences and consequently all the participants should reside in a multicast network. It also uses RTP (Real-time Transport Protocol) over UDP (User Datagram Protocol) as transport protocol.

### TEST RESULTS UACH

The tests were carried out from a client connected directly to the network segment of the multicast router. The client was a Pentium III computer with 256 MB of RAM, running the operating system Windows XP SP2 and having the IPv6 module installed. In the following, the configuration and results of such a test will be described.

#### Client IP Configuration

The client's IP configuration is detailed below. Addresses beginning with 3FFE:400F: belong to the Chilean pseudo Top-Level Aggregation Identifier of the M6Bone, those with FE80: are link-local unicast addresses.

##### Windows IP Configuration

Ethernet Adapter Local Area Connection:

Specific DNS connection suffix:

IP Address ..... : 146.83.216.131

Subnet mask ..... : 255.255.255.128

IP Address ..... : 3ffe:400f:e001:0:e97d:e589:2364:70c4

IP Address ..... : 3ffe:400f:e001:0:250:baff:fe86:f81b

IP Address ..... : fe80::250:baff:fe86:f81b%4

Default gateway ..... : 146.83.216.129

..... : fe80::210:7ff:fe69:2000%4

Tunnel Adapter Teredo Tunneling Pseudo-Interface:

Specific DNS connection suffix:

IP Address ..... : fe80::5445:5245:444f%5

#### IPv6 Multicast Client

After installing the applications SDR and VIC in the client, SDR was executed to verify the access to multicast sessions. A screenshot of the session directory can be seen in Figure 4.

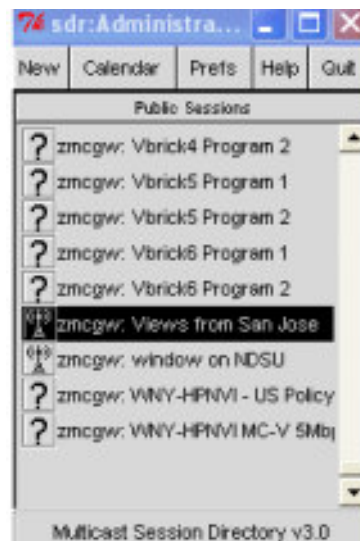


Fig. 4 Session information generated by SDR.

In order to verify if access to multicast packets was possible, an international public session was searched in SDR that offered source information of the announcement, which in this case had to be IPv6.

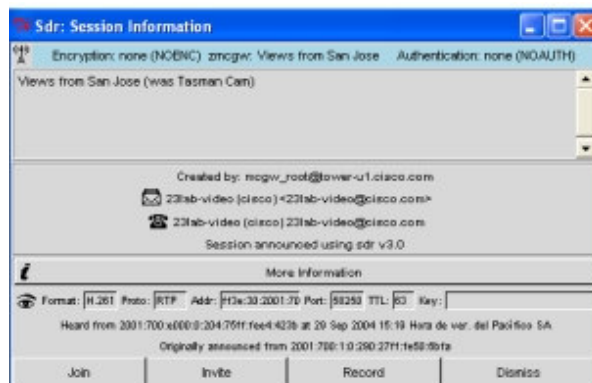


Fig. 5 Session information “zmcgw: Views from San José”.

One of those was the session “zmcgw: Views from San José” announced by the peer with the IPv6 global unicast address 2001:700:1:0:290:27ff:fe50:6bfa just as indicated in Figure 5 above. It can be seen that the peer announced its session also via SDR. The address of the FF3E:30:2001:700::/64 subnet is the multicast group address for the session, belonging to the RP as defined above.

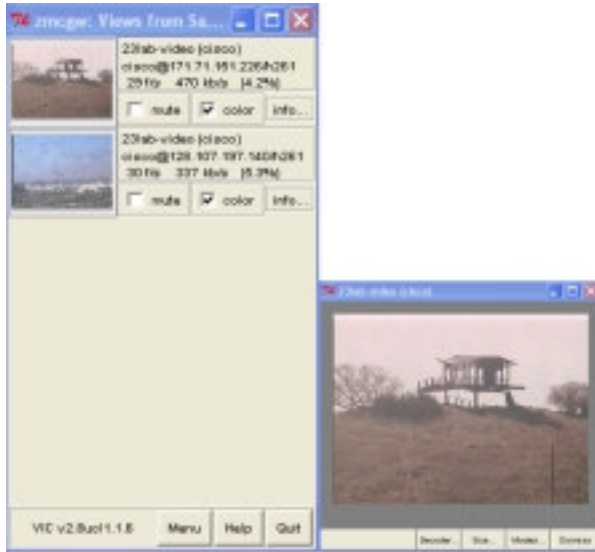


Fig. 6 Video received from session “zmcgw: Views from San José”.

Upon revision of the source information for the video stream (Figures 5 and 7), one could verify that it was sent from an IPv6 computer with the address: 2001:700:E000:0:204:75FF:FEE4:423B.

As can be seen in Figure 7, the packet transmission is stable and of a good level (average 470 Kbps at a frame rate of 29 fps).



Fig. 7 Source Identification of the video and transmission rate.

## CONCLUSIONS

The quality of the received video transmissions was very good, although the traffic IPv6 had to be encapsulated over a tunnel IPv4. In a way this indicates that the generated router using free software is of an acceptable level and the network connections support the high demands of a video session, i.e., they do not introduce too much delay or jitter. Since the M6Bone administration incorporated a multicast gateway for traffic IPv6-IPv4, one had access to all the public IPv6 and IPv4 multicast sessions.

The tools used in these tests allowed to identify the IPv6 addresses and the distribution groups of the contained IPv6 multicast traffic which was necessary to distinguish IPv4 and IPv6 sessions and to check the configurations. The tools are all free and available for many operating systems, and thus allow anyone to take part in the video- or audio conferencing.

In general one can say that multicast limitations do not exist for the adoption of the protocol IPv6 as a production protocol. The use of multicast capabilities on the IP layer enables a standard interoperable solution for all upper layer multimedia transport protocols. This approach greatly reduces interoperability problems.

## ACKNOWLEDGEMENTS

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