Remote Video-cam control over IPv6

GABRIELA A. CAMPOS, JESÚS LICEAGA
Depto. Sistemas de Información
Depto. Mecatrónica y Automatización
ITESM-CEM
Carr. Lago de Guadalupe Km 3.5, Atizapán Edo. Méx., CP 52926
MÉXICO
gcampos@campus.cem.itesm.mx, jliceaga@campus.cem.itesm.mx

Abstract: - In this paper, the control of a Video Camera (VC) using the protocol IPv6 is presented. Communication was established through a socket interface using tunneling IPv6 packets over IPv4 routing infrastructures, because that current network technologies do not yet support the IPv6 protocol.
The objectives of control are to manipulate remotely and open-loop vertical and horizontal movements of the VC. Despite the need of IPv4, the results of the project proved that IPv6 may be a more efficient and secure protocol, and therefore, a better option to handle audio and video in real time.

Keywords: - IPv6, applications, sockets, open-loop control.

1 Introduction

The constant need for more efficient ways of data transmission on the Internet has produce a new protocol name IPv6. Therefore, it is important to investigate the potentialities of IPv6 (Internet Protocol version 6); even more, when the needs of audio and video transmission in a secure and efficient way are of great need.

The transmission of information on the Internet is based on an structure of layers of abstracts functionalities called protocols; basically, protocols add special characteristics to the transmission of data. Actually, Internet works using the Protocol IPv4.

The close relation between IP with TCP (Transmission Control Protocol) has created the popular nomenclature of TCP/IP protocols which is the cornerstone of the Internet.

More recently, real time services for data transmission are required in applications such as telephone services, remote control, and long distance surgery. Moreover, because Internet has been used for commercial purposes mechanisms for more integrity, security and availability are required. This situation has given rice to the creation of solutions based on the actual standards such as: Protocol RTP [11] – normally used for real time applications because of its QoS (Quality of Service) by means of RTCP, and because it also provides integrity and confidentiality in the transmission of data – and the Protocol RSVP [12] – for the use of security algorithms in the upper layers of the Protocols –. Because the commonly used Protocol is IP, the new version of IP, IPng (IP new generation) is intended to offer an **open standard** which will helps the protocols mentioned above (RTP and RSVP) to integrate the new requirements for the web services. In order to assign a name to the new IP, and because version 5 (IPv5) was assigned to the ST protocol which runs in parallel to IPv4 in some routers, it was decided to name it IPv6.

Basically, the need for the new IP comes from the way addresses are assigned in the Internet. IPv4 uses 32 bits which allows 4300 millions of addresses locations, totally insufficient to the near future demand. For this reason, the new standard uses 128 bits which permits 3.4×10^{38} possible addresses. Other advantages of IPv4 are:

- **Heading formats:** IPv6 uses a heading format totally different from IPv4. Ipv6 simplifies the heading using only 7 fields. This change allows the routers to increase its performance in packages processing.

- **Headed of Extension:** Changes in the way IP header options are encoded allows for more efficient forwarding, less stringent limits on the length of options, and greater flexibility for introducing new options in the future.

- **Audio and Video:** IPv6 includes a mechanism that allows to establish a trajectory of high quality by the network, thus supporting, applications like audio and video in real time.

- **Authentication and Privacy:** IPv6 defines extensions headers that allow the authenticity of the users, the integrity and confidentiality of the data by means of cryptography tools.

- **Possibility of Auto configuration:** IPv6 contains several forms of auto configuration like the configuration "Plug and Play" of directions of nodes on an isolated network thanks to the characteristics offered by DHCP (Dynamic Host Configuration Protocol).

In addition, IPv6 can handle up to 16 levels of priority of traffic, cryptography and authentication. Nevertheless, although IPv6 contributes to these solutions it needs the collaboration of a new Internet that solves the speed problem. Thus, in October of 1996 the new Internet was announced - Internet2 call (I2)- as a joint effort of investigation and advanced studies that allows the develop to install and to operate a new generation of applications that totally take advantage of the capacities of integration of broadband networks, and collaboration and interactivity in real time; so that the atmospheres of superior education support national research targets, remote education and continuous education, among others. I2, [13], is a private effort administered by the University Cooperation for the Development of Advanced Internet (UCAID) that includes more than 120 universities, some offices of the American government, organizations without profit aims and 30 members of the industry of the computation and the telecommunications like 3COM, Lucent, MCI, Nortel.

Therefore, the protocol IPv6 along with Internet2 could have diverse applications such as:

- Remote handling of telescopes, in where the activity of a scientist, in particular an astronomer, can harness its academic work by having opportune contact with the results of his observations and data acquisition.

- Synchronous manipulation of models in molecular dynamics, in where the necessities of calculation and synchrony in applications require control and manipulation of models in distant points.

- Transmission of medical images, in where the possibility of operating and of sharing expensive medical equipment can be done by means of a computing network. In this case it is required to transmit audio-video and signals of control to the medical equipment in cases of remote operations.

- Control of mechanisms in atmospheres of virtual reality. These applications based on virtual reality require of distributed calculation and efficient control algorithms through the network to manipulate machines or robots.

2 Socket Client-Server

A socket is a point of communication through which a process can send or receive information. Processes deal with sockets like description archives which causes that the operations of send/reception of messages are similar to the read/write process in a file.

A stream socket describes the form in which the information through socket is transferred. In this paper, a stream socket is used, since it uses a oriented connected service using protocol TCP which guaranteeing that all the sent packages will be received in the destiny socket in the same order in which they have been sent. In addition, it is

indicated for the implementation of network services like remote control, since UDP is a protocol with a service of delivery of packages connectionless and non-reliable that may result in possible duplication, disorder or loss of packages.

2.1 Changes in the interface socket IPv6

The new options of the socket are necessary to control the shipment and the reception of the packages of the multicast IPv6. The required changes for the socket IPv6 interface which are use for the application of the control of the camera, are the following ones [9 y 10]:

- Address Family and Protocol Family
- Address Structure
- Socket Address Structure
- Socket Functions
- Wildcard Address
- "Nodename to Address" Translation
- Address Conversion Functions

3 Communication protocol

In order to obtain the communication between these processes the socket previously described was created. Sockets are objects that create access to the client and the server. The server assigns the socket to a direction and settles down a queue to wait for request of connection to socket. Once the connection is carried out, a *full-duplex* communication channel settles down between the two processes (client-server)

However, the first thing we must define is what functions we want our server to execute, and on the other hand, what requirements needs our client. The idea is to develop a server program which will wait for petitions from a client in order to position a video-cam according to the required movements. The applications Client/Server is shown in Fig 1.

3.1 Scheme Client-Server

From Fig 1 it is possible to see that host A and host B are communicated by a socket. On the other hand, the first step is the establish a connexion between the client and the server. In video-cam case the server (located at the Universidad Nacional Autónoma de México, UNAM) called "camserve" will connect the client (located at the Instituto Tecnológico y de Estudios Superiores de Monterrey Campus Estado de México, ITESM-CEM) which was called "camclien". Ones the connection is establish the task commands are executed. It is necessary to mention that the distance between the ITESM-CEM and UNAM is approximately 50 Km.

The server tasks are:

1. It waits for the connection to the some client.
2. If the connection is a established, the server sends a positive recognition to the client so that server execute the requests.
3. The server waits for the commands from the client.
4. The server opens the RS-232 port, [15].
5. If the command is received successfully the server sends a positive recognition to the client and waits for more instructions.
6. The server sends the movements instructions to the video-cam by the RS-232 port.
7. If the command has not been received during certain time the server closes the connection.
8. If the command contains an error the server sends a message for retransmission to the client and goes back to step 3.
9. Waits for the client to close the connection. Espera cierre de conexión.
10. Closes the RS-232 port.

The client tasks are:

1. To establish the connection with the server.
2. Wait for the connection recognition (ack).
3. In case of not connection recognition it will send again a petition for a new connection.
4. Ask for input commands to the user (up, down, left, right and home).
5. Sends the user command to the server.
6. Waits for the recognition command (ack, error, timeout).
7. In case of not recognition command (ack, error, timeout) the client sends again the instruction.
8. If the instruction given by the user does not exist, and new command is requested.
9. It sends again the new command or retransmit the command to the server if it is asked by the server.
10. Closes the connection established by the server.

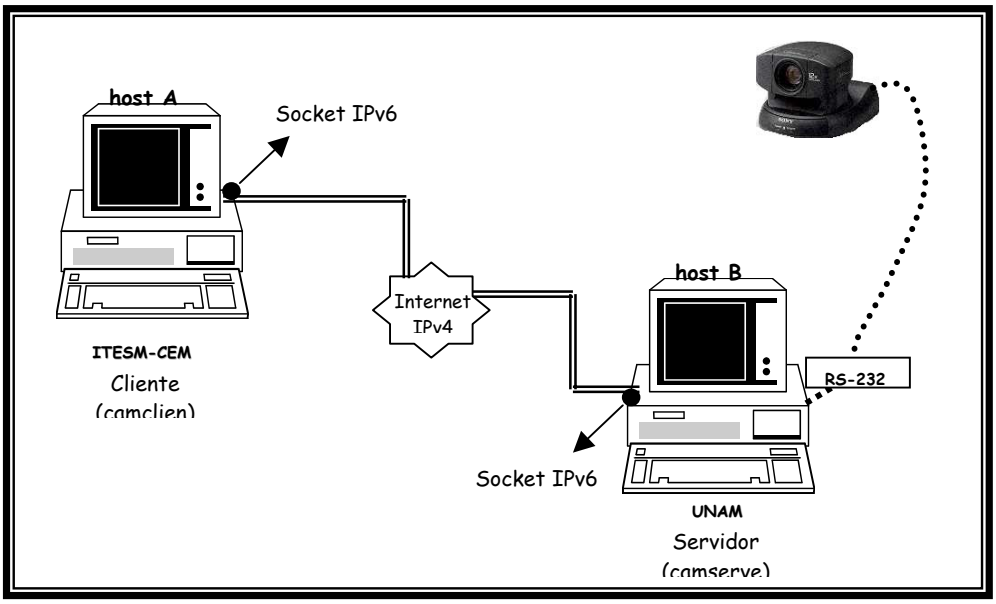

Fig 1 Scheme Client-Server

4 Operative Test

The prototype of network was done through the connection of the following computers: SUN[14] Table. 1.

The video cam connected to the server has the following specifications, [16]:

- High Speed, Wide Range Pan/tilter
- X12 Optical Zoom, High Speed Auto-Focus Lens
- 6 Position Preset
- Auto Tracking/Motion Detector
- RS232C Serial Control
- IR remote Commander
- Time, Date Generator

Once the connection between the client and the server (acorral-dogbert) has been settled the following position commands to control the video-cam were sent to move it from home the next sequence of positions:

- 10 movements to the left.
- 6 down movements.
- 13movements to the right.
- 5 up movements.

CLIENT **(acorral)**	**SERVER** **(dogbert)**
Workstation Type: SUNW, □ltra-5. Address: 3ffe:1cff:0:fd::3 Domain: cem.itesm.mx Operating System: Solaris 7 FCS, SunOS 5.7	Workstation Type: SUNW, SparcStation-4. Address: 3ffe:1cff:0:fd::1 Domain: dgsca.unam.mx Operating System: Solaris 7 FCS, SunOS 5.7

Table 1 Characteristics Client/Server

5 Conclusions

During the development of the project is was possible to see that Ipv6 preserves the characteristics of Ipv4 that made it highly successful. Similar to Ipv4, Ipv6 works connectionless, that is, each datagram has one destiny address and it is directed independently; also, it permits to the transmitter to select the size of the datagram and the maximum number of jumps that the datagram can make before been eliminated. In addition, Ipv6 uses longer addresses and also includes new characteristics such as: Header Format, Extension Headers, handling of audio and video, autentification and privacy.
Also, Ipv6 checks completely the datagram formats replacing the field of variable options of IPv4 by a series of headers with fixed format.

Once the IPv6 header formats has been analyzed the addressing, routing and fragmentation can be use to take advantage of the numerous characteristics that make so attractive IPv6, such as: Real time support communication, auto configuration of system and security.
In particular for this project, the mechanism of control was successfully implemented through the network to move a video-cam. It is considered efficient thanks to the introduction of labeled flows (with priorities) and by the restriction services in real time which make IPv6 having the capacity to deal with sensible traffic and delays more efficiently than IPv4.

To the creation of the mechanism of control, it was necessary to program the socket in IPv6. It was done using the family of **PF_INET6,** the structures **in6_addr, sockaddr_in6**, **hostent *getipnodebyname,** the function **inet_ntop,** the protocol TCP and the establishment of a protocol between the server and the client in order to guaranty the optimal performance in the server-client application assuring the *full-duplex* flow and the secure delivery of the commands in the correct form.
To work using IPv6 it was necessary to install the *Release* IPv6 for Solaris 7 FCS and the necessary toolboxes for the compilation of sockets.

Therefore, the socket programmed in IPv6 works perfectly allowing the efficient communication between the server and the client in order to move successfully the video-cam using the standard network. In addition, it was shown some of the advantages IPv6 offers such as 128 bits addressing and compatibility with IPV4 protocol, that is, hosts and routers can transport the IPv6 traffic through the routing topologies of IPV4 by encapsulating, allowing the updated nodes to interact with the IPv4 nodes. Due to the results of the project it is possible to conclude that IPv6 is better than IPv4 and is very likely that IPV6 soon becomes the new standard protocol of the Internet.

References:

[1] Christian Huitema, *IPv6 the New Internet Protocol*, Prentice Hall, 1996.

[2] Comer E. Douglas, *TCP/IP Vol. I*, Prentice Hall, 3° Edition, pp.497-518.

[3] Comer E. Douglas, *Redes de Computadoras, Internet e Interredes*, Prentice Hall, 1° Edition, pp. 239-249.

[4] IPv6

IPv6 Networking for the 21st Century
http://www.ipv6.org

6bone te testben for deployment of IPv6
http://www.6bone.net

[5] Specifications IPv6
IPv6 Related Specifications
http://www.ipv6.org/specs.html

Internet Protocol Version 6
http://telecom.noc.udg.mx/~kenya/cen-contenido.html

Exposition IPng
http://a01-unix.gsyc.inf.uc3m.es/~baudoux/presentacion.html

Protocolo IPv4 vs Protocolo IPv6
http://www.disc.ua.es/asignaturas/rc/trabajos/ip/indice.html

Protocolo Internet Version 6 (IPv6)
http://www.ldc.usb.ve/~93-25298/Tema15/index.html

IPv6 Specifications and RFC's
http://gate.ticl.co.uk/ipv6rkCD/docs/fdocidx.htm

[6] Steve King, Ruth Fax, Dimitry Haskin, Wenken Ling, Tom Meehan, Robert Fink, Charles E. Perkins, *The Case for IPv6*, INTERNET DRAFT, (January 1999).
http://www.ietf.org/internet-drafts/draft-ietf-iab-case-for-ipv6-04.txt

[7] S. Bradner, A. Mankin, *The Recommendation for the IP Next Generation Protocol*, RFC1752, (January 1995).
http://www.iol.unh.edu/training/general/rfc1752.txt

[8] S. Deering, R. Hinden, *Internet Protocol, Version 6 (IPv6) Specification*, RFC2460, (December 1998).
ftp://venera.isi.edu/in-notes/rfc2460.txt

[9] R. Gilligan, S. Thomson, J. Bound, W. Stevens, *Basic Socket Interface Extensions for IPv6*, RFC2553, (April 1997).
ftp://ftp.isi.edu/in-notes/rfc2553.txt

[10] Technical Standard: Networking Services (XNS) Issue 5.2 Draft 3.0
http://www.opengroup.org/orc/DOCS/XNS/webcom.htm

[11] H. Schulzrinne, S. Casner, R. Frederick, V. Jacobson, *RTP: A Transport Protocol for Real-Time Applications*, RFC1889, (January 1996).
http://info.internet.isi.edu:80/in-notes/rfc/files/rfc1889.txt

[12] R. Braden, L. Zhang, S. Berson, S. Herzog, S. Jamin, *Resource ReSerVation Protocol (RSVP)*, RFC2205, (September 1997).
http://info.internet.isi.edu:80/in-notes/rfc/files/rfc2205.txt

[13] Internet 2
Corporación Universitaria para el Desarrollo de Internet (CUDI)
http://www.internet2.edu.mx/antece.htm

Internet2 o la Próxima Generación de Internet (Primera Parte)
http://web.ati.es/PUBLICACIONES/novatica/1997/127/intdos.html

Internet2 o la Próxima Generación de Internet (Segunda Parte)
http://web.ati.es/PUBLICACIONES/novatica/1997/128/intdos-2.html

Internet 2
http://www.internet2.edu/html/about-i2.html

[14] SUN
http://playground.sun.com/pub/solaris2-ipv6/html/solaris2-ipv6.html
Release Notes
http://www.ipv6.org/solaris-quick.html
http://playground.sun.com/pub/solaris2-ipv6/html/BOOK.htm

[15] Serial Programming Guide for POSIX Compliant Operating Systems
http://dns-gate.easysw.com/~mike/serial/

[16] Sony EVI-D30 Teleconferencing Cameras
http://www.avtg.com/SonyEVI-D30-specs.htm