Internet2 in Catalonia: The Video Internet

Jesús Alcober, Rosa M. Martin and Artur Serra

The Internet2 CAT project forms part of the international projects generically known as "Internet2" www.ucaid.edu. One of the aims of this project is to show that the Internet can be the big global platform for the mass development of digital TV and cinema and that Catalonia has a great opportunity to become an advanced laboratory in this convergence at the global scale.

Digital Television, the course to which all advanced countries are committed, may or may not be TV over the Internet. One of the key challenges for the Internet2 CAT project is to help the two worlds, i.e., DTV and Internet, to understand each other. They are two different research projects from two different cultures, the first basically from the industrial world and the second from academia. However, convergence is possible.

Jesús Alcober
Professor at the Technical University of Catalonia (UPC), responsible for MediaCAT (i2CAT)

Rosa M. Martin
Head of projects LCFIB-UPC, responsible for the Dexvio Project (i2CAT)

Artur Serra
Professor at the Technical University of Catalonia (UPC) and coordinator of i2CAT Project

1. Video Internet, the Internet for everybody

The Internet needs video to reach everybody. Until the Internet is available in a language that can reach 100% of people in the way TV does, it will not easily be able to become a medium with the impact that TV (and to a lesser extent radio and the movies) has around the world today. The reason is cultural. We all know how to speak, but we don't all know how to read or write (even less on a computer). So until the Internet is a platform for voice and images, it will not be for everybody. As Raj Reddy, a computer professor with an Indian background at the School of Computer Science at Carnegie Mellon University in the US has said, an illiterate Indian peasant needs a much more powerful computer than American IT workers do, precisely because he cannot type or read English. This person will only be able to enter the digital era with his own cultural tools, i.e., his language, images and symbols.

Furthermore, the audiovisual world needs the Internet to be able to renew its offer, extend its possibilities and formats and to provide full interactivity and intercommunicability, i.e., to connect things that are local to things that are global. The low level of interaction permitted by DTV platforms is completely insufficient for any web surfer. Full interaction needs open and symmetrical networks. The theoretical horizon of this intercommunication would be videoconferences by many people for many people, where TV becomes a fully interactive channel between transmitters and receivers. This is possible with the second-generation Internet.

But the audiovisual world is not just about images. The Internet world comes from the IT world and includes the graphics, 3D images, virtual reality, etc., that animate all types of computer games and all sorts of simulations, training tools, tools for creation and research, design, etc.

The film world is increasingly difficult to understand without the simulation capacity provided by computer graphics and which form part of the daily life of young people. Internet 2 is the video and multimedia Internet.

Next-generation Internet, or Internet 2, projects were started up in the late 1990s to design a network able to support this new audiovisual information, new visualisation formats and virtual reality without problems or delays. Catalonia was the first, and for now only, region in Spain where these types of research projects were established. The possibility that Catalonia may lead the second-generation Internet was noted by in the Catalan Chapter of ISOC, 1998.

<http://www.keys.es.pgp.net/isoc/inetcat98/aserra.html>

The first contacts for starting up an Internet2 project in Catalonia were initiated by different groups within the UPC in the same year, who organised meetings with various sector companies. Finally, the 'Catalonia Online' Strategic Plan, under the leadership of the Generalitat of Catalonia and LocalRed, officially included the proposal to create an Internet2 project in Catalonia in April 1999.

2. The i2CAT project, www.i2cat.net

i2CAT is essentially a strategic research programme for Catalonia to lead the second-generation Internet in Spain and become a leading country in Europe and the world in this new Internet. In particular, it involves leadership not just in the field of web technologies but also audiovisual content and new advanced services.

How does i2CAT work? It is a research project based on collaboration between the academic world, the public sector and private industry. Its unique secret is the agreement built around the desire for innovation in the digital field. It is a first step towards a possible Catalan model of the information society that makes use of our time-honoured tradition of pact-making, updates it to the digital era and applies it to a field we all know is critical, i.e., advanced research in new technologies.

The idea was to move beyond the model that was at that time predominant in the European Union in the field of the Internet. The model was based on research networking, such as Red Iris in Spain, and began from the premise that the Internet was fundamentally a "tool at the service of research" instead of a field of research in itself. This anachronistic vision, together with big operators' near-monopoly on telecommunications research, condemned Europe to a position of chronic under-development with respect to the US in the field of the Internet. The i2CAT project began with a different idea, i.e., that the Internet is not just a tool but a strategic technology that should be the subject of basic technological research. The factor that allowed the development of Internet2 is simply that many countries realised they did not want the new Internet to be developed entirely by the Americans. Catalonia is included in this group of countries at the forefront with their own research projects on the new Internet. We have now added networking research to research networking. The i2CAT project has two main work areas:

a) The platform

b) The clusters

The platform includes advanced projects, usually run by universities (currently the UPC and UPF), which give rise to what would be generic experimental services. Clusters are the mechanisms that make it possible to put academic research into contact with business research, grouping the sector in question and facilitating collaboration on collaborative projects. We have created four such projects so far: web technologies, digital media, biomedics and teaching.

The first platform project was GigaCAT, http://gigacat.ccaba.upc.es, created in 1999-2000. This is a package-switching nucleus at a speed that seems revolutionary today, i.e., gigabits (a thousand megabits) per second. It was composed of two gigarouters, one from CISCO and the other from Alcatel and was located in the basement of the CCABA at the UPC northern campus.

To give you an idea of the revolution that web technology has undergone in the past three years, I need only supply one figure. In 1999 we only had the nucleus for a gigabits-per-second network in our facilities. Three years later another i2CAT project (between the UPC and Al-pi) made it possible to build a gigabit service in homes or offices. In other words, we have brought 1,000 megabits per second of Internet access into homes! This revolution is called optical networks. In Europe, we sometimes pitch mobile networks against fixed ones as if they were alternative technologies.

Wrong. The big revolution in mobile networks are today's Wi-Fi networks, largely permitted by the increased capacity of fixed networks (ADSL), in turn supported by optical technology and in particular WDM. http://carisma.ccaba.upc.es. This technology makes it possible to send different wavelengths each with a capacity of 10 gigabits per second using fibre optics and lasers.

At i2CAT we have different optical technology projects aimed at exploring optical network switching and management, as well as gigabit-speed access networks. We work with Nortel equipment and DRACs, developed by the UPC and TVC, and with fibre optics from different operators, including private (Auna, Al-pi) and public ones (fibre optics from the Municipal IT Institute at Terrassa City Council). We have built three metropolitan optical rings that include the city of Barcelona, El Vallès and Baix Llobregat (to Castelldefels) complemented by fibre optic links to TVC and Media Park. The current speed is 2.5 gigabits per second, shortly to be extended to 10 gigabits. These links let us create wireless blocks at speeds of up to 50 Mbps with 802.11 technology.

One strategic aim is to contribute towards creating a completely optical or Eurolight test bank, similar to the ones that Canada (with CANET4) www.canarie.ca and the US (with the National Light Rail project) are establishing.

http://www.cwru.edu/its/strategic/Generic-NLR.ppt

If Catalonia wants to be a reference point for Southern Europe in the way that California is to the US, it is worth knowing that today's slogan in California is "One Gigabit or Bust". J http://www.calit2.net/news/2002/7-24-gigabit.html.

3. MediaCAT: the new Internet-based media test bank

The MediaCAT project http://mediacat.upc.es is the horizontal video and videoconferencing services platform of i2CAT, which supports all the clusters. Our purpose with regard to video services is to transport video flows with the quality that currently exists and which is able to be transmitted from low-speed network encoding, e.g., in Windows Media, Helix, Darwin, MPEG-1, MPEG-4 formats at around one megabit per second, MPEG-2, at around 10 Mbps, DV at 25 Mbps, SDI at 270 Mbps (uncompressed PAL), through to HDSDI at 1.5 Gbps. Each format has its own problems.

We are working with two groups within Internet2: ViDeNet, http://www.vide.net or the video services group of the UCAID consortium, and Research Channel, the consortium that includes TV channels from 17 US universities, with i2CAT as the first European partner. With Research Channel (www.researchchannel.org) we are working with HDTV technology on the Internet that makes it possible to incorporate the digital film world to the IP world.

With regard to IP videoconferences, our aim is to cultivate among Catalan society and its companies in particular the use of this advanced telephony system that enables us to see our fellow participants. The idea of starting up a stable IP videoconferencing platform in Catalonia or VIDECAT is a goal we have begun to work towards with companies like Techno Trends (www.ttrends.com) and Al-pi (www.al-pi.com).

However, although technologically it is already possible today, it needs a cultural impulse to promote its use in such potentially interesting environments as corporate training. In this area, i2CAT is working on the UCAID Megaconference project http://www.mega-net.net/megaconference.

The Megaconference project is an event held each autumn, the latest being the fourth. It consists of holding a videoconference in which around 400 institutions take part simultaneously. It is like a telephone call with 400 participants where they can also see the person speaking. The aim of the project is to show the scaleability of IP videoconferencing. The event is organised by Bob Dixon of Ohio, the headquarters of America's Internet2 Commons, the heart of the hierarchical gatekeepers structure that provides numbering to videoconference equipment. MediaCAT took part in the roll call of the successful fourth Megaconference, which consisted of checking the attendance of all the participants and explaining to the others who and where we were. This time, the videoconference was made at 768 kbps in H263 codec, the highest quality of the ones normally used in H323.

According to the predictions in an IDC report (1) , Internet traffic is set to double over the next five years. This growth will involve expanding from 180 petabits/day in 2002 to 5,175 petabits/day by 2007, and we at MediaCat are convinced it will happen. Some people say fibre optics will offer a bandwidth that we won't be able to exhaust, but we

believe there is still a lot to be discovered. We can foresee a time in which we will go to the movies and see a film served by all the cinema houses in the world from the one server in Hollywood, in high definition uncompressed HDSDI, which needs around 1.5 Gbps for each flow (i.e., each cinema) and the camera operator will only have to press the play button on the one reproducer. You can do the sums yourself.

Finally, on 31 January we took part in a pilot test in the field of advanced Internet-based virtual reality which may have consequences. Organised by the company En.Red.Ando, it consisted of connecting three CAVEs or virtual reality spaces in Chicago, Luleå and Barcelona (at the Virtual Reality Centre of the UPC at the Parc Tecnològic de Barcelona) (www.crv.upc.es) using Internet2. Professor Daniel Sandin, from the EVL in Chicago, led the experiment. For the first time, these virtual reality spaces were connected in a single global virtual space.

4. The Digital Media cluster: the Òpera Oberta, Media House and Dexvio Portal projects

The audiovisual cluster, or Digital Media at i2CAT, brings together audiovisual industries and companies that want to experiment with advanced Internet networks and services aimed at private or professional users, to study the convergence of audiovisual and advanced Internet systems more profoundly or to experiment with the new audiovisual standards (MPEG4, MPEG7).

Some of the projects we have developed or collaborated on over the past two years are the Òpera Oberta, Media House and Dexvio Portal projects.

a) Òpera Oberta

This project was promoted by the Liceu Theatre and developed within the context of the i2CAT project with the following goals:

- To carry out a live broadcast of an opera using a high-quality signal by data network, in a room with the best technical and environmental conditions possible.
- To exceed the theatre's physical limits and spread its cultural message to a greater number of citizens.

The Òpera Oberta project was developed throughout 2001 (http://www.fib.upc.es/i2catdime/OperaOberta.htm), culminating in the live broadcast of *La Traviata* on 18 December at CINESA Diagonal (the only cinema house in Barcelona equipped with high-definition technology) and at four universities.

Òpera Oberta involved the use of two different technologies to reach the same aim: the live broadcast of a show to remote places, offering the best image and sound quality possible. The selection of two technologies was determined by the conditioning features of the necessary infrastructures:

- **High definition**: Live broadcast of an opera from the Liceu Theatre to the CINESA Diagonal cinema complex, broadcasting high-definition, uncompressed images (1.5 Gbps) on fibre optics (HDSDI 1920x1080@50i). This format was necessary to fill the 50m2 screen in the cinema with the desired quality.

The transmission capacity of this type of signal is up to 250 times superior to conventional digital television signals and it was necessary to use optical technology equipment (DRAC equipment, jointly designed by TVC and the Optical Communications Group at the UPC) to make the transmission. Òpera Oberta was thus the first new-generation optical communications experiment.

- **High quality**: This environment allowed simultaneous high-speed transmission between the Liceu Theatre and various Catalan universities (UdG, UdL, UPC) and the Cine Club Catalunya (Terrassa), equipped with rooms with advanced multimedia resources:
- Transmission over the i2CAT network using IP multicast.
- MPEG II compression at 10 Mbps, quality superior to DVD.

Òpera Oberta was a demonstration of the new services that future broadband networks will be able to offer the public.

17 entities and companies (Admira, Alfacam, Terrassa City Council, Barco, Cesca, CINESA, the Liceu Theatre, i2CAT, Ovide B.S, Thomson Multimedia, Telefónica, Televisió de Catalunya, the University of Girona (UdG), the University of Lleida (UdL), the Polytechnic University of Catalonia (UPC), the Ramon Llull University and Vídeo Digital) worked on the project, i2CAT providing the high-speed network and transmission equipment and co-directing the technical aspects of the project.

This experiment led in 2002 to the Liceu Theatre, in collaboration with universities from around Spain, developing a project of the same name based on technology that made use of a high-quality environment.

Furthermore, the content generated in high-definition format has since been projected in the Liceu Theatre, with cheap tickets that open the way to a new opera-going public.

At i2CAT we have begun research work on high-definition signal transmission using IP protocols, in collaboration with the University of Washington. www.researchchannel.org

b) Media House, www.metapolis.com

This project consisted of building a future home at Mercat de les Flors containing all constructive and environmental elements with high-speed Internet technology (from 27 September to 7 October 2001) under the slogan, "The House is the Computer, the Structure is the Web". The project won the Barcelona City Prize (Multimedia). http://www.metapolis.com/3.0/index.htm

The Media House project was organised by Metapolis, the Fundació Politècnica de Catalunya and the MIT Media Lab, with the collaboration of i2CAT (Al-pi, UPC, Nortel Networks, TV3, Media Park, Techno Trends and BATM) and the Escola Elisava.

c) Dexvio

Dexvio (www.dexvio.org) is an experimental audiovisual portal aimed at future residential Internet users. The project was organised to meet the increased demand from these users for high-quality content at the start of new ways of relating to the Net.

In the context of this project, we understand that these second-generation residential Internet users will have a permanent broadband connection (with capacities of over 2 Mbps), be familiar with the Internet and be very demanding and active with regard to quality and level of interaction. They will be users who want to produce their own content and share it online (this type of behaviour can already be seen with current ADSL and cable users).

With these premises, Dexvio aimed to offer a personalised access experience to audiovisual content that made it possible to choose what, when, how and with whom people wanted to visualise content.

The project was devised on the basis of offering:

- **Television over the Internet**, using streaming or video on demand with quality digital TV content (750 Kbps), advanced search tools and automatic personalisation based on metadata or descriptive information associated to audiovisual content.

- **Shared visualisation spaces.** These spaces combined different web collaboration tools to offer the experience of enjoying audiovisual material with other net users (in a community). Spaces could be public (accessible to all portal users) or private (to share content with a restricted group of users, e.g., family, friends, etc.).

The project aimed to provide participating companies and entities (2) with experience, tools and knowledge in the following aspects:

- To know the changes in the process chain for the production and broadcasting of audiovisual content in the context of the arrival of broadband and technological convergence.
- To search for new needs of content providers.
- To propose innovative technological solutions in automation and broadcasting to cut costs in the audiovisual communication sector.
- To develop new advanced services aimed at end users.
- To experiment in the Internet 2 broadband environment.

5. Cultural diversity and the new Internet

The future work of the i2CAT project in the field of digital media includes the following:

a) To establish a global HDTV IP platform with Research Channel in Seattle and various telecommunications companies. In September 2002, we carried out the first HDTV video broadcast, made by the UPC on the Year of Gaudí, between Seattle and Amsterdam at 270 Mbps (www.igrid2002.org). The next step is to make Barcelona a centre of this global high-quality, Internet-based video network. The local version of this platform will connect the cities of Barcelona and Terrassa in a veritable metropolitan image city.

b) To prepare a second version of the MediaCAT platform with the participation of TVC Netmedia

(http://www.tvcmultimedia.com), CCRTV Interactiva and various local TV stations within XTVL (http://www.xtvl.org) and open a Catalan convergence model between Digital TV and the Internet. This involves connecting various TV stations by fibre optics and proving that any type of IP video is feasible in terms of both production and distribution. We also anticipate incorporating BTV and various district TV stations to the platform, as well as local TV stations such as Terrassa (which is already connected to i2CAT).

c) To initiate VIDECAT in collaboration with Techno Trends and other leading sector companies as the first stable Internet-based videoconferencing platform, connected to the global ViDeNet network and with applications in the areas of health and education. This involves generating a stable, experimental IP multiconference service both locally and globally.

d) To finish the Dexvio Portal as a video portal that works with companies and institutions in the audiovisual sector and to offer it as a model to be adapted to other sectors, such as cartoons (Dexvio Nens), biomedicine, training, etc., with other names but using the same model of an open and collaborative portal where it can be shown that public participation is no longer limited to consuming other people's productions, but that people can produce and distribute their own films and creations.

e) To initiate collaboration with the research centres of sector companies installed in Catalonia, such as Telefónica I+D and others, and some of their strategic projects, e.g., Imagenio, with the purpose of being able to facilitate access to Internet-based digital videos in the home as quickly as possible, without depending on the DTT deployment time scheduled for 2011.

The idea is to show that Catalonia, and more specifically Barcelona and its metropolitan area (e.g., Terrassa), is the most advanced laboratory in Europe in terms of the new video Internet and images.

Finally, the impossible dream: that Forum 2004 opens a small window to this new Internet in the new web-based media, to show that cultural diversity, peace and sustainability can be developed within the new global information society through the new Internet.

We have so far presented the Forum with the project of a festival entitled "The Internet of Cultures", which basically consists of making use of the global Internet2 infrastructure that currently connects countries like Brazil and South Korea, Mexico and Singapore, Canada and Catalonia, to show an Internet of local television stations in global intercommunication. This is all we need do to provide a new vision of the digital world. Local audiovisual communication globalised through the new Internet provides the dosage of multilinguism, cultural diversity and public participation that we all want as the future of a plural and non-exclusionary knowledge society.

Notes

1. http://www.idg.es/comunicaciones/noticia.asp?id=29384
2. Dexvio1.0 included the participation of the following companies and entities: Activa Software, CCRTV Interactiva and Televisió de Catalunya, the Ramon Llull University (La Salle Centre for Digital Television), CIDEM, Fabchannel, the Liceu Theatre, LaviniaTV, Media Park, the IT Institute at Terrassa City Council, SUN Microsystems and the Polytechnic University of Catalonia.