Internet 2 and Media

By: Karl F. Klemm

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Abstract

This report will look at Internet2 and evaluate its potential impact on the different media's, specifically music. Different technical aspects, the next generation of applications, as well as the social impact will be discussed. Internet2 is the next generation Internet. It is being developed by universities, private industry, and the government in much the same way that the Internet was developed. Its aim is to provide a platform for new and amazing applications that will allow things never before possible.

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Table of Contents

1. Introduction 5
2. The Internet Today 6
2.1 Birth of the Internet 6
2.2 The World Wide Web 7
3. Internet2: The Project 9
3.1 History of Internet2 9
3.2 How Internet2 Works 10
3.2.1 Changes in Hardware 10
3.2.2 A New Protocol 11
4. Applications of Tomorrow 13
4.1 Archiving 13
4.2 Medical Applications 13
4.3 Real-Time Transactions 14
5. Conclusions 15
5.1 Where Internet2 will take us 15
5.2 The Social Impact 16
Appendix A 17
Bibliography 20

1. Introduction

In this report Internet2 will be examined and evaluated as to its potential impact on the different media's, specifically music. Firstly the root of the world wide network, the Internet, will be discussed. Next background information on Internet2 will be presented along with basic technical changes from today's Internet to Internet2. Current and future uses and applications will be discussed next. As Internet2 is not fully operational yet much of the discussion on applications and uses will be an educated guess based on the research done. Finally, conclusions about the future of life on Internet2, including the social impact will be discussed.

Internet2 is the next generation Internet. It is being developed by universities, private industry, and the government in much the same way that the Internet was developed. Its aim is to provide a platform for new and amazing applications that will allow things never before possible. On the Internet2 things such as remotely controlling telescopes or home lighting will be possible. Entire libraries will be available at the click of a mouse. Surgeons will be able to operate on patients across the globe without leaving their office.

2. The Internet Today

Before discussing Internet2, a look at where the Internet of today has come from, and where it is now must be examined. This will show how a world wide system is created and can function. Moreover it will be shown why a new system is needed.

2.1 Birth of the Internet

In 1973, the U.S. Defense Advanced Research Projects Agency initiated a research program to investigate techniques and technologies for interconnecting networks of various types. The objective was to develop communication protocols that would allow networked computers to communicate across multiple networks without having to navigate through each one individually. This system of networks, which emerged from the research, was known as the "Internet". The system of protocols, which was developed in tandem with the networking effort, became known as the TCP/IP Protocol Suite, Transmission Control Protocol (TCP) and Internet Protocol (IP).

In 1986, the U.S. National Science Foundation (NSF) began the development of the NSFNET, which today provides a major backbone service for the Internet. With its 45 megabit per second facilities, the NSFNET carries approximately 12 billion packets each month between the networks it links. Other government agencies such as NASA and the U.S. Department of Energy have also contributed additional backbones to the Internet. In Europe, major international backbones provide connections to over one hundred thousand computers on a large number of networks.

During the course of its evolution, particularly after 1989, the Internet began to integrate support for other protocols into its basic networking structure. Both public and

commercial implementations of the roughly 100 protocols of TCP/IP became available in the 1980's. During the early 1990's, OSI protocol implementations also became available and, by the end of 1991, the Internet had grown to include some 5,000 networks in over three dozen countries, serving over 700,000 host computers used by over 4,000,000 people.

2.2 The World Wide Web

The concept of the World Wide Web was, as much of the Internet was, born in the 1980's. The basic concept is to allow links to be made between arbitrary nodes on interconnected networks. Each node would have a title, a type, and a list of bi-directional typed links. This was known as Enquire-Within-Upon-Everything, or ENQUIRE for short.

In 1989 a proposal was drafted on information management. This document was released again a year later with the dates changed to reflect that. It outlined the problems with the current information management system, and proposed the use of "hypertext" to greatly improve the system. Hypertext is still the basis for all web pages on the World Wide Web today.

Later on in 1990 work on the World Wide Web (www) began. This is not the World Wide Web of today, but rather a graphical browser used to navigate the Internet. Starting in 1991 much development and revision of hypertext, www, and other protocols and web browsers, such as the File Transfer Protocol (FTP) and Mosaic began to emerge. As the mid 1990's arrived the World Wide Web was increasing in popularity and use. From July of 1991 to April of 1994 traffic on the Internet increased by over 10,000 times.

In 1995 the World Wide Web was introduced and demonstrated at the G7 meeting in Brussels. This was the year that applications for the Internet began to be developed. Societies began to pop up across the globe that were dedicated to the development of the World Wide Web. Since then the Internet and the World Wide Web have grown by leaps and bounds. But unfortunately the limits of the current network infrastructure are being reached. Thus a new Internet is needed for the next generation of applications.

3. Internet2: The Project

In this section the history and workings of Internet2 will be discussed. This is to provide a basic understanding of the differences between the Internet today and Internet2. In addition, this section will show how the next generation of Internet applications will be developed.

3.1 History of Internet2

In October 1996, 34 research universities across the United States began working on Internet2. In September of 1997, the University Corporation for Advanced Internet Development (UCAID) was created to give an organizational body to the project. Since then the Internet2 initiative has grown vastly in both number of participants, and in the technology used.

Internet2 is a consortium is currently being led by over 190 universities working with industry and the government to develop and deploy advanced network applications and technologies, accelerating the creation of tomorrow's Internet. The development of Internet2 is being carried out in much the same manner as the creation of the Internet of today. The primary goals of Internet2 are:

- Create a leading edge network for the national research community
- Develop a platform for revolutionary Internet applications
- Rapidly migrate the new Internet2 services and applications to today's Internet users.

3.2 How Internet2 Works

As Internet2 emerges, software and hardware are becoming much more intertwined. While there are upgrades to hardware there are also major changes to software, mainly in the form of new networking protocols. The implementation of the new software is moving towards the melding of the boundaries of software and hardware.

One parallel of the differences between today's Internet and Internet2 is the difference between a Pentium2 computer with Windows95 and a Pentium4 computer with WindowsXP on it. While the Pentium4 computer could run Windows95 the difference would only be in speed. But if the Pentium4 computer were running WindowsXP, there would be an array of new options including increased security. Also, if the Pentium2 was to run WindowsXP, it would be possible, but there would be such a lack of speed that WindowsXP could not be fully appreciated.

3.2.1 Changes in Hardware

Indeed there are major changes in hardware. Some examples are more fiber optic cable being laid, new network routers that can transmit data of rates of over 20Gbits per second, and end user equipment to take full advantage of the Internet2's resources. More specialized equipment is also being developed. These are things such as HDTV studios for webcasts over Internet2 and remote access equipment.

Since the entire structure of the physical interconnects change in both arrangement and type, going from mixed copper lines and fiber optics to all fiber optics, there will be a dramatic increase in speed. As the Internet2 project progresses high speed networking will expand until it is as far reaching as to the home user. Currently only

members of the Internet2 project have access to this new high-speed technology, but anyone with access to the Internet is able to use the applications and resources of Internet2. Even though a university may be an Internet2 partner and be hooked into the network, the new capabilities can only be fully exploited in Internet2 wired locations, such as laboratories and HDTV studios.

While there are major changes in hardware, they are far too complex for the interests of this report. The brain of the new networking technology is the new Internet Protocol version 6 (Ipv6), which will reside in the hardware.

3.2.2 A New Protocol

Although the hardware is critical to Internet2, Internet2 would not exist without the new Internet Protocol Version 6. The current Internet Protocol, Version 4 (IPv4), is what makes today's Internet tick. IPv6 will provide most of the transparent changes. The main differences between IPv4 and IPv6 are, different routing methods, such as priority encoding, see Figure 1 in Appendix A, and multicasting see Figure 3 in Appendix A, quality of service, and better security. Many of these aspects will be realized in new Internet2 Application Specific Integrated Circuit (ASIC) processors that will be used as the processor in new Internet2 routers.

The aforementioned features all contribute to the overall speed of the Internet2. The increase in speed is the main driving force behind creating new and better applications. This is especially true for applications that need real-time or near real-time data rates, such as medical applications and video conferencing. This is where priority encoding comes into play. The medical data can be tagged with priority markers that tell

any router that it comes across to allow it to pass before lower priority data. This ensures that an email going across the same router does not impair that medical data from arriving at its destination on time. Priority encoding will bring about some of the most major changes in the switch from today's Internet to Internet2.

Multicasting is targeted at distributing real-time data to large amounts of users at the same time. The old method, unicasting, see Figure 2 in Appendix A, would require streaming data to be relayed from one recipient to the next, whereas multicasting sends the data directly from the server to the end user. The main use for this would be in live video casts, for both medical, scientific, and entertainment purposes.

Improved security is one of the components that will bring about the new quality of service. Security has always been an issue on the Internet, especially as of recently since there are many more users. Improved security will encourage more online transactions, and reduce denial of service, such as server downtime due to hacker attacks.

4. Applications of Tomorrow

Current uses and research initiatives of Internet2 are aimed at three main areas. These are archiving, medical applications, and real-time transactions. Archiving is making large volumes of data, especially music and video, readily available to Internet2 users. Medical applications are high priority applications that require uninterrupted service. Real-time transactions are those that require high data transfer rates, so that lag is virtually nonexistent, which include medical applications and many other high bandwidth applications.

4.1 Archiving

Archiving is the first use that will be, and in fact already is, available and most prominent to end/home users. Archives ranging from online art collections to music collections to video archives are already accessible on Internet2, and from the current Internet. The head of the Internet2 initiative, http://www.internet2.edu, has several archives of such things available. Many of the participating colleges have also begun digitizing and making available their own archives. Currently the most commonly archived media is music. Many of the colleges have made available their entire music collections.

4.2 Medical Applications

Medical applications being such that they require very high, uninterrupted bandwidth are some of the most highly tested applications on Internet2 today. Since the

Internet2 is not fully operational yet, due to IPv6 is still being in the works, these high priority applications are helping to develop it. The medical applications that are currently being tested are such things as sending mammogram images, which are very large in size, and observing operations and giving feedback.

4.3 Real-Time Transactions

Since one of the most notable differences between the Internet and Internet2 is speed, real-time applications will provide a fertile platform for new and amazing applications. The current real-time applications being developed and tested are remote access programs. Things such as manipulating telescopes or microscopes from hundreds and thousands of miles away. With the use of force feedback controls a user could even reach out and touch objects remotely.

This has far reaching uses in nearly every conceivable science and media. A doctor in Michigan could operate on a patient in South Africa from his home computer. An engineer in Singapore could work on a nanotechnology system in California. In addition to the medical and scientific applications more common things such as distance learning, videoconferences, and other media presentations will all benefit. Distance learning will be able to include interaction between the professor and students over an HDTV connection. Videoconferences can have streaming high quality video, and have multiple participants. The media applications are endless. From high quality webcasts, to video on demand, to musicians hundreds of miles away playing together.

5. Conclusions

Internet2 will be the internet that people have been dreaming of since the concept first arose. Anything the mind can dream will be possible. And the Internet will finally be a safe place.

5.1 Where Internet2 will take us

Although Internet2 is not complete yet the applications currently being test on it give a glimpse of the future of telecommunication. The finest doctors in New York and Boston will be able to treat patients anywhere Internet2 is located. HDTV will provide streaming video of concerts, plays, and streaming video over the Internet. One will be able to watch any movie ever recorded on demand on their desktop. Research in libraries will be able to be done from the comfort of one's computer room. Children wanting to see what life is like on the ocean floor can do so remotely, even pick up objects and play with them. The music industry will have a new tool to bring musicians in China, Tasmania, and Wisconsin together and form a band. A person listening to the radio will be able to instantly remix the song. Cartoons will become interactive, allowing the audience to navigate through the topic of the show as they wish.

Internet2 will also allow the access of household items such as interior and exterior lighting, heat, phones, home security systems, and more. One will be able to turn on or off the driveway light of a home in San Francisco while on vacation in the Mediterranean. A phone system can be setup to forward important messages to one's

cellular phone. The use of voice commands could be used as well to control all of the aforementioned items.

5.2 The Social Impact

Although this all sounds extremely exciting and amazing, the social impact of such a tool must also be examined. The question of how much is too much technology must be asked. At what point does the technology reach so far that humanity begins to degrade. The Internet as well as Internet2 are simply tools. No matter how amazing or useful a tool, especially one that can consume massive amounts of time, must be used as a tool. It should be a place where people can research and learn, as well as be entertained.

The current generation will grow up in a world that is no longer bound by seas and roads, but only by the limit of what they are willing to do. If they spend their whole lives immersed in technology how are they to appreciate what it actually does. While common sense will keep the "toaster that toasts the Dow Jones index on the morning bagel"[1] off the market, what will keep the instant messenger out of the car.

[1] Based on an idea of F. Bianchi.

Appendix A

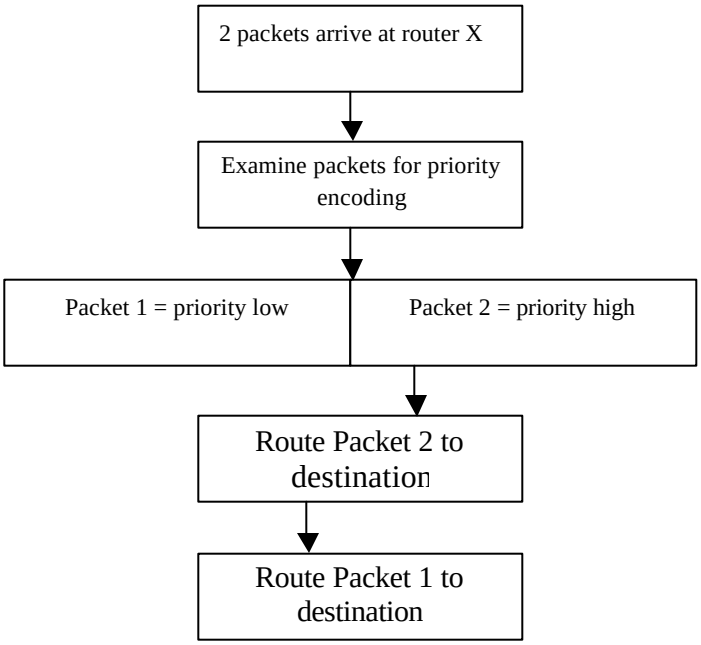

Figure 1: flow chart of priority encoding

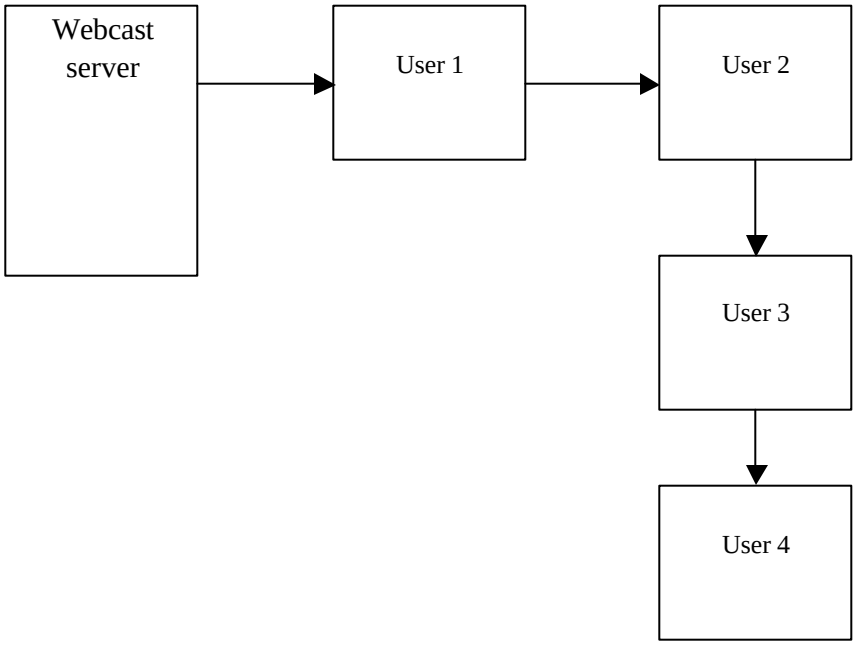

Figure2: Unicasting

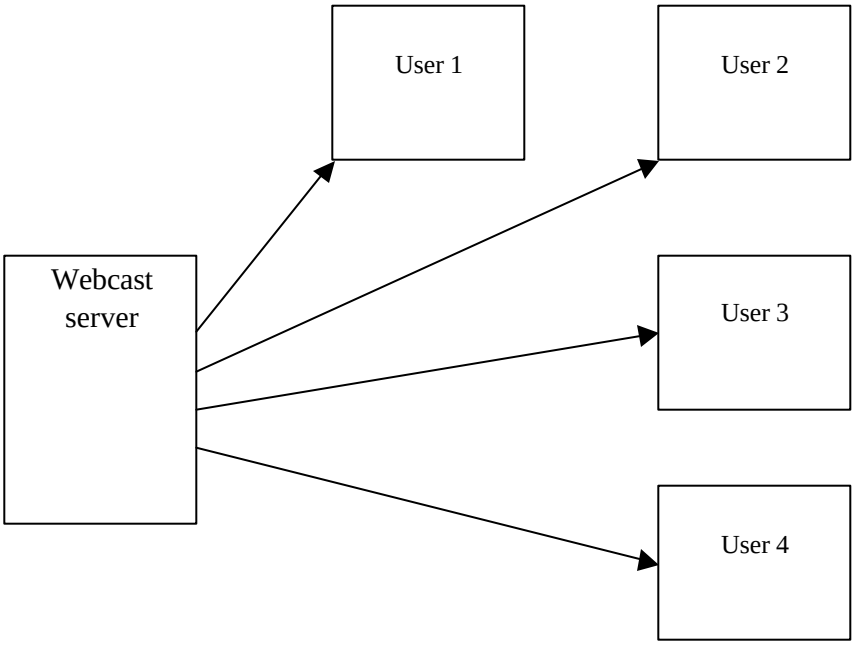

Figure 3: Multicasting

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