Introduction to the Impact of Public Policy on Computer Graphics

July 2002

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Course Description

This first course in the policy sequence provides computer graphics developers, users and researchers with an overview of the impact of policy issues particularly relevant to computer graphics: use and protection of intellectual property, digital copy protection, deployment of broadband telecommunications, convergence of computing and television and research support.

As the proliferation of personal computers and access to the Internet has increased the public's use of and access to computer graphics, researchers, developers and practitioners will find that policy issues and the law increasingly affect our professional lives. After a brief overview of computing and policy issues in general the course will explore issues of particular relevance to computer graphics. This course will prepare the attendee for the follow-on policy course on intellectual property/digital rights management. The material in this course will not be repeated in the other course.

Prerequisites

There are no formal prerequisites, but an interest in the use of computer graphics by the general public and how policy affects our professional lives is useful. Only minor knowledge of computer graphics technology is required.

Course Syllabus

Introduction to Public Policy (Ellis and Simons) (5 Minutes)

Overview of Computing and Public Policy (Simons and Ellis) (25 Minutes)
- Cryptography (Simons)
- Digital Copy Protection (Ellis)
- Electronic Commerce (Ellis)
- Free Speech (Simons)
- Intellectual Property (Simons)
- Internet Futures (Simons)
- Privacy/Surveillance (Simons)
- Telecommunications (Ellis)
- Convergence of Computing and Television (Ellis)
- User Access (Ellis)
- Research Support (Ellis)

Deployment of Broadband Telecommunications (Ellis) (10 Minutes)
- Digital Subscriber Lines
- Cable Modems
- Satellite
- Terrestrial Wireless
- Security
- Privacy
- Regulatory Policy

Use and Protection of Intellectual Property (IP) (Simons) (10 Minutes)

- Definition of IP
- Using IP
- Creating IP
- World Intellectual Property Organization (WIPO)
- Digital Millennium Copyright Act (DMCA)
- Fair Use/First Sale Rights
- Contract Law/Shrink Wrap Licenses (UCITA)

Digital Copy Protection (Losch/Ellis) (10 Minutes)
- Technological Mechanisms (Cryptography, Watermarking, etc.)
- Users' Rights
- Copyright Holders Rights
- Consumer Acceptance

Convergence of Computing and Television (Ellis) (10 Minutes)
- Digital Television (DTV)
- High Definition Television
- Influence of Digital Copy Protection on DTV
- Future of Free Terrestrial TV Broadcast

Research Support (Ellis) (10 Minutes)
- Role of Government
- Role of the Private Sector
- SIGGRAPH Activities

Public Policy (Ellis and Simons) (10 Minutes)
- How Effected
- How Influenced
- Role of Technical Societies
- Role of Professionals
- Role of Citizens
- Public Policy Organizations
- Web Resources

Discussion (Ellis and Simons) (15)

Computer Graphics and Public Policy

Bob Ellis
Barbara Simons
Myles Losch

Introduction to Public Policy

- Introduce Ellis and Simons
- Purpose of Course
- Why is this important?
- Organization of course

Bob Ellis

- Graphics S/W development
- Co-founded Sun's external research program
- Sun representative on CSPP Technology Committee
- Chair SIGGRAPH Public Policy Program

Barbara Simons

- Computing research (scheduling theory, compiler optimization, fault tolerant distributed computing)
- Chaired ACM Committee for Scientific Freedom and Human Rights
- Founding Chair USACM
- Past President ACM & Co-chair USACM

Purpose of Course

- Provide attendees with overview of digital technology policy issues
- Provide attendees with greater depth on issues particularly important to CG
- Provide reference material on public policy

Why is this important?

- Digital technology becoming ubiquitous in society
- Legislatures are passing new laws
- Courts are interpreting old and new laws in light of digital technology

Organization of Course

- Provide overview of policy issues in digital technology
- Explore in greater depth issues particularly important to CG
- How to affect and effect policy

Course Changes 2001-2002

- Tutorial
  - Added material on new developments
  - More on issues not covered in depth
  - Less on copyright
  - More time for discussion
- New course on CR & DRM
  - Tomorrow 10:30-12:15
  - Burk & Simons

Overview of Computing and Public Policy

- Cryptography (Simons)
- Broadband telecommunications (Ellis)*
- Electronic Commerce (Simons)
- Free Speech (Simons)
- Intellectual Property (Simons)*
- Digital Copy Protection (Ellis)*

Overview of Computing and Public Policy (cont'd.)

- Internet Futures (Simons)
- Privacy/Surveillance (Simons)
- Convergence of Computing and Television (Ellis)*
- User Access (Ellis)
- Research Support (Ellis)*

Cryptography (Simons)

- Convert data to form not recognizable by humans or computer
- Mathematical techniques
- Encryption/Decryption
  - Keys
  - Code breaking
- Not widely used by individuals (convenience)
- Law enforcement & export issues

Electronic Commerce (Simons)

- Financial viability (auctions, small high value goods, perishable goods)
- Security
- Privacy
- Customer acceptance
- Sales tax & VAT issue

Free Speech (Simons)

- U.S. Constitution
- National traditions & jurisdictions
- Domain name issue
- Legal approaches (U.S.)
  - 1996 CDA
  - 1998 COPPA
  - 2000 CIPA
- Technological approaches (filters)

Internet Futures (Simons)

- Transition from government to private
- ICANN
  - Representation
  - New TLDs
  - “ICANT”
  - Search engines instead of domain names
- Peer to peer (everybody a server?)
- Information wants to be free?

Privacy/Surveillance (Simons)

- Aggregate vs. personally identifying info
- Legal control vs. self-policing
- Opt-in vs. opt-out
- Surveillance
- Biometrics
- National ID
- USA Patriots Act
- Cybersecurity legislation

User Access (Ellis)

- Universal access (social, economic, location)
- User interfaces
  - Persons w/ disabilities
  - Where am I?
  - Beyond the desktop & broadband
- E-Government

Policy Issues of Most Importance to Computer Graphics

- Deployment of Broadband Telecommunications
- Use and Protection of Intellectual Property (IP)
- Digital Copy Protection
- Convergence of Computing and Television
- Research Support

Conclusion

- Public Policy
- Summary and General Discussion

Deployment of Broadband Telecommunications

Bob Ellis

Broadband Telecom Topics

- Digital Subscriber Lines (DSL)
- Cable Data Services
- Satellite
- Terrestrial Wireless
- Security & Privacy
- Regulatory Policy
- Financial viability of providers

Digital Subscriber Lines – Technology

- Uses existing copper phone lines
- Signals co-exist with analog voice
- Continuously connected
- Can be switched in central office
- Many “flavors” (HDSL, SDSL, ADSL, …)
- Typical speeds up to 1.5 Mb/s)

Digital Subscriber Lines – Technology Issues

- Distance limited
- Crosstalk limited
- Likely to be asymmetric speeds
- Not generally user-installable
- May be multiplexed from central office

Digital Subscriber Lines – Policy Issues

- Cost
- Availability of service & support
- Tainted by ISDN debacle
- Regulatory confusion
- Lack of competitive service providers
- Provider mergers

Cable Data Services – Technology

- Ethernet connection to cable channel
- Shared service for subscribers
- Packets are encrypted
- 10Mb/s downstream
- Up to 2 Mb/s upstream
- Continuously connected
- Captive ISPs

Cable Data Services – Technology Issues

- Performance depends on active connections
- Performance depends on cable network topology
- Need Ethernet interface
- Asymmetric speeds
- Not generally user-installable

Cable Data Services – Policy Issues

- Somewhat regulated
- Not common carrier
- Open access problem
- Equipment not transferable
- Hardware rental
- Provider mergers

Satellite – Technology

- Limited service
- Upstream services becoming available
- 400 Kb/s

Satellite –Technology Issues

- Upstream support new
- Shared resource
- Non-standard “modems” and receivers

Satellite – Policy Issues

- Cost
- Very new service
- Antenna placement
- Not common carriers

Terrestrial Wireless – Technology

- Not mobile service
- Line of sight
- Concentrated subscribers

Terrestrial Wireless – Technology Issues

- Bandwidth
- Cost (new infrastructure)
- Line of sight
- Signal may be affected by rain
- Receiver technology

Terrestrial Wireless – Policy Issues

- Spectrum allocation
- Antenna placement

Security & Privacy

- Continuously connected to Internet
- Static IP address
- Local networks
- Firewall security

Regulatory Policy

- Unfamiliar territory to consumers
- Unfamiliar territory to computing
- Unfamiliar territory to regulators
- Federal vs. local

Financial Viability

- Alternative DSL providers have gone out of business
- Cable ISP AtHome went out of business
- Prices for broadband services have been increasing
- Broadband applications missing
- Rate of broadband adoption is slow

Tauzin-Dingell & FCC Ruling on Cable Internet Services

- Tauzin-Dingell passed by US House permits local phone companies to offer long distance before showing that they've opened up their networks
- FCC ruled that cable Internet services are classified as "unregulated information service" and do not have to open their networks to other ISPs

Two Recent Reports

- National Research Council (NRC) Report – “Broadband: Bringing Home the Bits”
- Computer Systems Policy Project (CSPP) Report – “Building the Foundation of the Networked World”

(See notes for reviews and URLs)

Use and Protection of Intellectual Property (IP)

Barbara Simons

Copyright

Congress shall have the power ...

To promote the progress of science and the useful arts, by securing for limited times to authors and inventors the exclusive rights to their respective writings and discoveries.

User rights under Copyright

- First sale: I can give you my copy
  - Early 20th century publishers attempted to kill used book market by “licensing” a minimum price
- Fair use
  - for purposes such as criticism, comment, news reporting, teaching (including multiple copies for classroom use), scholarship, or research, is not an infringement of copyright.

Length of Copyright

- 1790: 28 years - originally 14 years ….
- Copyright Act of 1976: retroactively extended to up to 75 years after creation
- Sony Bono Copyright Term Extension Act 1998: extended yet another 20 years

Eldred v. Ashcroft

- Eric Eldred published public domain materials
- Did Congress overstep authority by adding 20 years to length of copyright?
  - Encourages “progress of science and useful arts”?
  - Dead creators?
  - Mickey Mouse

Copyright Legislation

- Digital Millennium Copyright Act (DMCA) *
  - Became U.S. law in 1998
- Security Systems Standards & Certification Act (SSSCA)
  - Circulated, but never introduced, by Sen. Hollings
- Consumer Broadband & Digital Television Promotion Act (CBDTPA)
  - introduced March 22, 2002 by Hollings, Feinstein, Stevens, Inouye, Breaux, Nelson

Related legislation

- No Electronic Theft Act (NET Act) *
- Database bill
- Mass contract (shrinkwrap) law: Uniform Computer Information Transfer Act (UCITA)
  - Formerly Uniform Commercial Code (UCC) - Article 2B
  - Passed by Virginia and Maryland w/ changes

The DMCA

- Outlaws reverse engineering except for compatibility, encryption & security research, privacy protection, and to protect minors against porn
- Anti-circumvention and anti-dissemination provisions
- Makes technologies or devices that are primarily designed for circumvention illegal, could criminalize teaching and conducting some computer security R&D

DMCA: Criminal Penalties

- Circumvention of “copyright protection” or of “integrity of copyright management information” for commercial advantage or private financial gain:
  - first offense: <= $500K or <= 5 years prison, or both
  - subsequent offenses: <= $1M or <= 10 years prison, or both

Digital Era Copyright Enhancement (Boucher/Campbell)

- Prohibits altering or deleting copyright management information for purposes of infringement
- Prohibits enforcement of terms in "shrink- wrap" and "click-on" agreements when they reduce privileges recognized by copyright law
- Incorporates fair use and first sale rights

Ed Felten

- Two weeks before presentation all authors, all their employers, all program committee members, and all their employers threatened with civil suit by RIAA and SDMI.
  - Withdrew paper
  - resubmitted to USENIX Conference
    - Brought suit against RIAA, SDMI, Verance, John Ashcroft, and mystery company
  - RIAA, SDMI, Verance promised not to sue

ACM and Felten

- ACM submitted declaration in Felten case
  - Concerned about ACM November '01 Workshop on Security and Privacy in Digital Rights Management
- www.acm.org www.acm.org/usacm/
- Nov 28, 2001 case dismissed by Judge Garrett Brown
  - SDMI, RIAA, and DoJ said they will not sue
  - Felten will not appeal

Dmitry Skylarov

- Arrested for criminal violation of DMCA after presenting paper at DefCon in Las Vegas
  - Russian computer science grad student
  - Talk focused on weaknesses in Adobe copy protection system
  - His company sold software that allowed people who purchased e-books to make copies
    - now available free on the web
  - Allowed to leave US in Dec; agreed to testify later

US v. Elcom Ltd, aka Elcomsoft Co., Ltd, and Dmitry Sklyarov

- EFF amicus signed by USACM, the ACM Law Comm., the American Assoc. of Law Libraries, Music Library Assoc., CPSR, EPIC, CPT, 35 law professors
  - http://www.eff.org/IP/DMCA/US_v_Elcomsoft/
- Case pending (as of March 2002)

DVDCCA v. Bunner (CA case)

- Nov 1, 2001 CA appeals court overturned an earlier order that barred hundreds of people from publishing the code for DeCSS online. Posting the code is just like publishing other types of controversial speech - protected by Constitution
- Programmers could still be prosecuted for posting illegal software but could not be prevented from doing so in the first place.

SSSCA

- Would have required computer & electronics manufacturers to include copyright-protection technologies in the production of certain products and multi-use devices
  - Sen. Hollings
  - Pushed by Hollywood; opposed by scientific societies, academia, and industry (BSA, etc.)

CBDTPA

- A manufacturer, importer, or seller of digital media devices may not
  - (1) sell, or offer for sale, in interstate commerce, or
  - (2) cause to be transported in, or in a manner affecting, interstate commerce, a digital media device unless the device includes and utilizes standard security technologies that adhere to the security system standards adopted under section 3.

Digital Media Device (CBDTPA)

- any hardware or software that
  - (A) reproduces copyrighted works in digital form;
  - (B) converts copyrighted works in digital form into a form whereby the images and sounds are visible or audible; or
  - (C) retrieves or accesses copyrighted works in digital form and transfers or makes available for transfer such works to hardware or software described in subparagraph (B) .

Some Problems

- Inclusion of anti-copying technology in general purpose equipment-- real-time computing devices used in traffic control, air flight control, medical equipment, & manufacturing -- adds to their complexity & potential for failure. Unexpected interactions with other code, & accidental activation of protection protocols cannot be ruled out; in many venues the potential for damage is extreme.

Why Does Copyright Matter?

- Trade-off: limited time monopoly to encourage creativity and availability of information
- What if information becomes privatized?
  - Education
  - Democracy
  - Science

Where are we going?

- What is a library?
- Is copyright being replaced by shrink-wrap licenses?
- Will copyright be replaced by contract law?
- Will we have pay-per-view?
- Do scientists and engineers have any ethical responsibility for how their work is used?

What can you do?

- Support professional societies (ACM)
- Interact with policy makers, journalists, other decision makers

Digital Copy Protection

Bob Ellis

Digital Copy Protection Topics

- Situation and Solution
- Technology
- DAT, DiVX and DVD
- CPRM, SDMI, etc.
- VHS copies
- Digital Television
- CBDTPA
- Copy-protected audio CDs
- Broadcast flag
- Issues

Situation

- Digital devices permit perfect copies
- Copyright holders fear infringement
- Copyright laws difficult to enforce

Solution

- Prohibit copying
- Authorize limited copying
- Leave audit trail
- Pay per view

Technology

- Encryption
- Digital watermarking
- No digital data stream

DAT, DiVX and DVD

- DAT failed in marketplace
- DiVX failed in marketplace
- DVD first successful product w/ copy protection
- DVD Content Scrambling System (CSS)
- DeCSS
- License prohibits digital data stream
- Regional coding

CPRM, SDMI, etc.

- Content Protection for Recordable Media
- Secure Digital Music Initiative
- Globally Unique Identifier
- Includes computer, storage and peripheral manufacturers
- Would secure **all** recordable media

VHS

- Macrovision adds colorburst and other signals to vertical blanking
- Prevents VHS copies using composite and s-video outputs
- Product (VHS recorders) previously achieved success

Digital Television

- Content providers concerned
- “Free” broadcast television
- Betamax decision

The Consumer Broadband and Digital Television Promotion Act (CBDTPA)

- Would require all digital electronics devices and software to restrict reproduction of copyrighted material
- Yet another attempt to turn computers into entertainment devices
- Recording & movie industries
- Computer & consumer electronics industries, etc.
- Won’t really promote broadband or DTV
- It was SSSCA and it will be back!

Copy-Protected Music CDs

- Intentionally violate “Red Book” standards
- Unplayable on many computers and some CD-Audio players
- Phillips has threatened to withhold permission to use the logo and/or require a warning on the label
- Will popularity of CDs be reduced?

“Broadcast Flag”

- Permits digital recording
- Prevents playing recordings on other equipment
- Couldn’t take a time-shifted show to someone else’s house to replay

Copy Protection Issues

- Impacts fair use
- Content providers don’t care
- DMCA prohibits production and distribution of circumvention technology
- CBDTPA impacts all digital electronics
- Consumer acceptance
- May slow rate of DTV adoption

Convergence of Computing and Television

Bob Ellis

Myles Losch

Convergence of Computing and Television: Food for Thought

"... People will be canceling their Internet accounts because they can get most of what they want on interactive TV ..."

by Mark Snowden, Gartner Group senior research analyst for Internet and new-media businesses (quoted in "Daily Variety" for April 20, 2001 - page A2)

Convergence of Computing and Television: Topics

- Visions of convergence
- Motives for convergence
- Roots of convergence
- Forms of convergence
- Enablers of convergence
- Constraints on convergence
- Governmental roles in convergence

Visions of Convergence

- Entertainment and other video applications
- Diverse usage scenarios
- A Display is a Display

Motives for Convergence

- Cost
- Physical space
- Energy efficiency
- Visual realism
- User control

Roots of Convergence

- Japan's analog HDTV
- Digitization of electronics

Forms of Convergence

- Program origination: production and post-production
- Delivery: pre-recording; transmission
- Reception and viewing

Enablers of Convergence

- General purpose computers and software (open platforms)
- Integrated microcircuits and Moore's “Law”
- Open networks

Constraints on Convergence

- Global standardization
- Protectionism (industrial, cultural, political)
- Transmission infrastructure (wired and radio)
- Copyright issues

Governmental Roles in Convergence

- Radio spectrum allocation
- Technical standards adoption
- Transmission regulation
- Copyright policy setting
- International coordination

Growing Concern

- Lack of broadcast facilities & air time
- Lack of content
- Consumers not buying
- “HD-ready” TV set sales are increasing
- Used with high quality standard definition sources (digital cable, satellite receivers, DVD players)
- Constraints on copying (CBDTPA, etc.)

Research Support

Bob Ellis

Research Support Topics

- Role of government
- Role of the private sector
- SIGGRAPH activities

Role of Government

- Funding for research
- Research institutions
  - Peer-reviewed
  - Pre-competitive
- Commercial organizations
  - Contractor style
  - Should not pick winners and losers

Role of the Private Sector

- Take research and reduce to products
- Research is really product development
- Can’t do adequate peer review
- Support existing university research
  - Relevant work
  - Engineering support
  - Non-proprietary

SIGGRAPH Activities

- Computer graphics research misunderstood
  - Nothing left to do!
  - Frequently part of an application
- Working on NRC CSTB study
  - Definition complete
  - $50K for seed funding approved
  - Seeking additional sponsors

Public Policy

Bob Ellis
Barbara Simons

Public Policy Topics

- How policy is implemented
- How policy is influenced
- Role of technical societies
- Role of professionals
- Role of citizens
- Public policy organizations
- Web resources

How Implemented

- By legislative initiative
- By administration initiative
- By the courts

How Influenced

- By financial contributors
- By representatives of organized groups
- By constituents
- Meetings, calls, faxes and letters
- No email except for follow-up (no spam)
- Timing is everything!

Role of Technical Societies

- Inform members of issues
  - Columns in member publications
  - Courses & sessions at conferences
  - Web pages
- Inform policy makers on technical aspects and monitor policy activities
- Possibly take positions
- Query and report on members interests (SIGGRAPH on-line surveys)

ACM Public Policy Office

- Located in Washington D.C. (contact information in notes)
- Washington Update email newsletter (subscription information in notes)
- Interact w/ ACM members and policy makers
- Director is Jeff Grove

SIGGRAPH On-line Survey (Computer Graphics Feb. 2001)

- Important issues
  - User access
  - Free speech
  - IP/copyright
- IP laws about right (pre-DMCA?)
- Keep broadband services unregulated
- Strong copy protection limits adoption
- Fairly limited support for PP activities

SIGGRAPH Public Policy Email List

- Based on S2001 BOF meeting
- Experiment
- Mark Banas
- Exchange information
- Generally low level of activity
- Subscription and archive information in notes

Role of Professionals

- Know the material and situation
- Contact with policy makers*
- Testimony
- Outreach to general public*
  - Speak at meetings
  - Talk with fellow citizens (and learn)
  - Make it relevant

(* Additional material in text backup)

Role of Citizens

- Contact with policy makers
- Comment on issues
  - Letters to policy makers
  - Letters to the editor (response is best)

Public Policy Organizations

- Provide focus on a set of issues
- Home for public policy professionals
- Contacts with policy makers
- Tracking and timing

Web Resources

- Almost everything worth knowing is on the web!
- Know who the site represents

Summary and Discussion

Bob Ellis
Barbara Simons

Overview Issues

- Cryptography
- Electronic Commerce
- Free Speech
- Internet Futures
- Privacy/Surveillance
- User Access

Computer Graphics Issues

- Deployment of Broadband Telecommunications
- Use and Protection of Intellectual Property
- Digital Copy Protection
- Convergence of Computing and Television
- Research Support

General Issues

- Public Policy Activities
- Issues not discussed

Discussion

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Overview of Computing and Public Policy

Robert Ellis
April 2001
Revised March 2002

Introduction

As the general public's use of digital technology (computing, recording (CD, DVD, etc.) and data transmission (Internet, HDTV, etc.)) has dramatically increased, governments at all levels have been rapidly passing new laws and the courts have been busily interpreting these and existing laws. Many of these laws directly impact what you can and cannot do with this new technology for both your professional and personal use.

For example, in the pre-digital days you could access copyrighted printed material by simply buying a book or checking it out of a library. You might copy a few pages for your personal use but it was considerable work, expensive and the copies were generally not high quality. In the digital age, just to read material downloaded from the Internet or contained on a CD-ROM, a copy must be made inside your computer. Once there, perfect copies can be made with little or no trouble and expense. And perfect copies can be made from those copies. This simple change has had profound effects.

Cryptography

Cryptography is the use of mathematical techniques to transform data into a form that can't be interpreted by humans or machines until it is transformed back into a readable form by using a mathematical "key" or by extensive processing with a very powerful computer. It offers the only good technique to provide privacy of files and email messages. This is important because essentially anyone having access either physically or electronically to a computer is likely to have some capability to read data stored on that computer.

Unfortunately cryptography has not been widely used except by those who want to take strong measures to provide the security of their data. Cryptographic techniques have been awkward to use and not widely available, in part because some governments have restricted the use and export of software implementing "strong" (that which is unbreakable except by the most powerful computers) cryptography in order to keep it out of the hands of people who might abuse it. A number of proposals have been advanced that would require users of strong cryptography to register the transformation keys with trusted third parties who would then make them available to law enforcement agencies when appropriate approval has been obtained. Almost nobody has supported these proposals except law enforcement agencies.

Cryptography has lead to systems of digital copy protection (see below).

Digital Copy Protection

As holders of copyright protection on information have grown increasingly concerned about the ease of making perfect digital copies, they have begun to rely on techniques to restrict the ability of users of such information to make copies. Uses such as being quoted in criticism, scholarly research and copies made for personal, private and with no profit gained have been called "fair use". Many people are concerned that the widespread use of copy protection systems will give overly broad protection to copyright holders. Others see the need for such systems in order to further the "digital economy".

For example, DVD movies are protected by a system of weak encryption called CSS (Content Scrambling System) and licensees of CSS are prohibited from providing an unencrypted digital data stream. In fact the only way to view a DVD movie in digital form is on a laptop computer (or self-contained DVD player) with built in digital display screens or projectors. Of course CSS has been broken (DeCSS) and copyright holders of CSS-protected material have been quick to block its distribution and publication, actions that have run squarely into the objections of free speech advocates.

A number of consumer electronic devices such as DAT (Digital Audiotape) and DiVX (a special DVD player and discs) that have incorporated copy-defeating mechanisms have failed in the market place. Until the advent of inexpensive DVD players and widespread availability of movies in the format, consumers have generally not accepted such devices. The original audio CDs were not copy protected but recently copy-protected versions have been introduced. Until recently, it was easy to make copies of VHS videocassette tapes, but a product called Macrovision makes this impossible for some pre-recorded tapes.

New initiatives continue to be developed and promoted. The Secure Digital Music Initiative (SDMI) under development by contractors to the recording industry would provide copy protection to a wide range of consumer music devices. SDMI uses a watermarking technique which records a signal over the music content that is supposed to be imperceptible to human listeners but would be detectable by electronics and prevent copying of material so marked. A challenge to break SDMI resulted in claims and counterclaims. Several research groups claimed to be able to break the technology, but SDMI supporters are not willing to agree that the copies have not been altered to human hearing. The departure of the effort's Executive Director in January 2001 has lead some observers to suggest that the initiative has failed, but not all agree.

The Content Protection for Recordable Media (CPRM) development includes computer, storage and peripheral manufacturers and would place copying from and to **any** recordable media under the control of copyright holders. This technology, currently in development by committee, would make it possible for software, music and video publishers to prevent any copying whatsoever internally or externally to the user's computer. It would require a Globally Unique Identifier (GUID) to be encoded on all protected devices and would not permit content to be copied to any device with a GUID different from the one registered by the customer.

Recently (March 21, 2002) U.S. Senator Hollings introduced the Consumer Broadband and Digital Television Promotion Act (CBDTPA) which used to be known as the Security Systems Standards and Certification Act (SSSCA). The act would require that **all** digital

electronic devices, hardware and software, that were capable of reproducing copyrighted material have systems that would restrict copying. Hearings on the earlier bill pitted the movie and recording industries against the computer and consumer electronic industries. While the current proposal is unlikely to become law in the near future, readers should be aware that this bill, or ones similar to it, will undoubtedly surface pretty continuously in the future. See the references for additional information.

Another recent development is the arrival of copy-protected music compact discs. Copy protection is accomplished by intentionally violating the “Red Book” standard for CD-Audio that makes them unplayable on many computers and even some CD players. Phillips, which owns the copyright for the standard has threatened to prohibit the display of the CD-Audio logo on copy-protected discs and/or require warning labels. The recording industry has not perceived this as much of a threat. It remains to be seen what effect this will have on their popularity, which was established before the discs were copy-protected.

Yet another proposal, this time for digital television, would introduce a “broadcast flag”. This mechanism would permit digital recordings of DTV shows but would prevent playback on all devices except those associated with the ones that made the original recording. This would, for example, prevent a consumer from taking a digitally time-shifted recording of a show over to someone else’s house for playback. One reason for this capability is said to be to “keep free DTV shows off the Internet”. Of course this could also inhibit the purchase of such equipment.

Electronic Commerce

In spite of the much-described failure of many companies in this business, many people expect this to be the future of commerce. A number of obstacles exist. Many potential customers are concerned over the safety of their personal information. Several highly publicized events of unauthorized access to credit card numbers on these systems have served to reinforced these views.

Privacy is another stumbling block. In the U.S., there are almost no government restrictions on what a company can do with the personally identifying information they collect from their customers. Video rental records, information about children and student records are among the few exceptions. The only restrictions are that a company must abide by any voluntary statements (which may change with little or no notice) about what they will do with this information. In other countries there are laws that control the use of such information.

Sales and other taxes are another issue. In the U.S., sales taxes do not have to be collected unless the seller has a business presence in the state where the buyer resides. This is consistent with mail order sales. Most states do have "use" taxes that must be paid in lieu of sales taxes. Enforcement is lax but some states have begun to put questions regarding purchases falling under these provisions on their state income tax forms. The wide variation of sales tax rates imposed by states and local municipalities that do not even follow postal or telephone area code boundaries are a valid impediment to collecting these taxes. Those who feel this situation puts local merchants at a disadvantage have proposed various schemes to make these tax rates uniform across the jurisdictions. The EC is also working on this issue by attempting to get sellers to

collect the appropriate VAT.

Free Speech

The U.S. has strong constitutional protections against government restriction of the right to freely speak or publish. This has frustrated those who would impose such restrictions on unsolicited email or the availability of material deemed harmful to children. Several attempts to legislate such restrictions have been declared unconstitutional. These attempts include the 1996 Communications Decency Act (CDA) and the 1997 Child On-line Protection Act. Other measures include the 1998 Children's On-line Privacy Protection Act (COPPA) which restricts the type of information that can be collected from children under 13 and the 2000 Children's Internet Protection Act (CIPA) which will limit federal funding for Internet access in schools which don't have adequate technological protection measures (filters). COPPA and CIPA are still in the implementation stage. The fact that some speech is less protected than others is a recognized doctrine, but a U.S. Supreme Court justice has stated that the Internet deserves the highest form of protection because the cost of entry is so low.

Other countries have different traditions. For example several European countries have very strict laws controlling the availability of information and the sale of items related to certain events of World War II. This puts them at odds with many U.S. based Internet sites. While there are no U.S. laws against a private entity from restricting speech, different laws make it very difficult for Internet based companies because the Internet doesn't recognize national boundaries.

Considerable hope has been placed on filters which block access to certain "undesirable" Internet sites as a means for parents, librarians and schools to restrict access by children to those sites. As reported in USA Today, a Consumers Research project found major problems with all the filtering programs because they either blocked sites that should not have been blocked or failed to block obviously undesirable sites. Filters work by either automatically searching sites for certain key words or phrases or by using humans to review Internet sites. Both methods have significant limitations in the world of the rapidly growing and changing Internet.

Intellectual Property

Intellectual property includes copyrights, patents, trademarks and trade secrets. In the United States, laws governing these derive from the U.S. Constitution. Article I, Section 8 (the powers of Congress) states, "To promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries".

Besides being brief, this paragraph contains at least three important concepts. First there's the concept of rights for the authors and inventors. Second there's a concept of limited times. And last there's the concept of promoting the progress of science and the useful arts. Each of these concepts has given rise to aspects of the laws governing intellectual property. Also note that the term "intellectual property" is something of a spin because there is nothing in Article I, Section 8 that even suggests such ideas should be considered a form of property.

Rights for authors and inventors have directly lead to the laws governing copyrights and patents. These laws provide certain rights to the holders such as reserving the right to make copies or publicly perform a copyrighted work or to have exclusive use of patented inventions.

These rights are only available to the originators for a limited time. For example, patents are only valid for 17 years. Copyright protection for individual authors is the life of the author plus 90 years and for corporations it is the original publication plus 70 years. Some argue that these terms greatly exceed what the framers of the U.S. Constitution meant by a "limited time" because they are an appreciable fraction of the time of existence of the United States as a country.

Finally, the concept of promoting the useful arts has given rise to the requirement for disclosure of patent details and certain "fair use" in copyrights as well as the concept of the work entering the public domain after patent or copyright protection has run out. For example, portions of a copyrighted work may be quoted in criticism or scholarly works and owners of copyrighted material may engage in certain acts of copying and use of the work as long as the actions are "personal, private and do not generate profit". For example the owner of a book or music CD may give away or even sell it. A person who receives copyrighted works on their television may make a copy for later viewing.

Copyright holders do not always agree to these definitions of fair use. It is generally regarded as permissible for the owner of a copyrighted CD to make a cassette tape copy to play in their automobile that may not have a CD player. The recording industry does not exactly agree with this interpretation of fair use.

A recent international addition to the scene is the World Intellectual Property Organization (WIPO). WIPO is a United Nations' intergovernmental organization with some 175-member countries that was created to insure uniform treatment of copyright in all countries. WIPO has introduced a series of treaties that are being considered and generally accepted around the world.

In the United States one reaction to the WIPO treaties has been the passage of the Digital Millennium Copyright Act (DMCA). This law enforces certain aspects of the WIPO treaties. One highly controversial aspect of the DMCA is that it is now illegal in the U.S. to produce and distribute technology that would make available copyright works in digital form that are protected by technological means such as CSS which protects DVD contents. As noted in the earlier section on Digital Copy Protection, technology to "break" CSS has achieved much notoriety. In fact the current direction is to see who can develop the shortest program or script to do the job!

On another front, the U.S. Supreme Court announced that it would hear a case (Eldred v. Ashcroft with Stanford professor Lawrence Lessig representing the plaintiffs) challenging a 1998 change to the copyright laws that greatly expanded the length of the period a copyright could be held. This has caused many people to wonder just what the framers of the U.S. Constitution meant by a “limited time”.

Internet Futures

Today's Internet had its start over 30 years ago as an U.S. Department of Defense

research project. Access was initially restricted to organizations participating in the project. Over the years the access policy has gradually been relaxed, first giving access to other research institutions, then to commercial organizations (for non-commercial purposes) and finally to all forms of commerce.

But governance and control had always resided in the hands of research and commercial contractors to the U.S. government. A few years ago a non-profit corporation was formed called the Internet Corporation for Assigned Names and Numbers (ICANN) with an initially appointed board to oversee the administration of the Internet. From the start ICANN has been dogged with controversy ranging from the way board members were selected to fundamental concern over just what it's mission was.

Along the way, ICANN has performed some controversial actions. These range from developing a dispute resolution process, which some say favors large corporate interests, to soliciting and selecting a new set of top level domains (.biz, etc.) a process that generated much controversy and moved with great slowness. Last year, ICANN held an election for board members elected by and representing the user constituency. This too has had its controversial aspects.

The future is anybody's guess. ICANN could work out the kinks and become an important force. Or the U.S. (and perhaps other governments) could take back control. Or perhaps even a coup might occur which would break all ties to governments and non-profit organizations and put control of the Internet into commercial hands.

This author has previously suggested a rather drastic solution to the problem of competition for certain domain names: do away with alphanumeric domain names and use the purely numeric IP addresses like the telephone system. Most see this as a step backward and a decidedly unfriendly move for users. It certainly would remove the issues of competition for particular domain names.

Recently a new style of Internet use called peer-to-peer (P2P) has been popularized by services such as Napster and Gnutella. In these services users share useful files by providing access to their computers via either a centralized or distributed directory of available files. Some observers have called this the future of the Internet.

I'd like to sound a cautionary note. Statistics show that only a small percentage (10%) of Napster users actually provide files while the vast majority only take copies of files. Another concern is that users providing files are essentially operating Internet servers because the system only works well if the users providing the files have high bandwidth connections and leave their computers connected to the Internet for long periods. There are two problems with operating a server. First many consumers' ISP agreements specifically prohibit operating a server. The reasons may be to reduce bandwidth problems for the ISP or even just a marketing strategy, but the restrictions exist and must be honored. Second, a long term, high bandwidth Internet connection exposes the user's computer to great security risks, something most consumers are ill equipped to handle.

We are all used to accessing the Internet without charge except for perhaps our basic connections. Recently Dan Gillmor, technology columnist for the San Jose Mercury News, has proposed that it may indeed be time for users to pay for the services they

receive. The failure of many "free" Internet sites has shown that the current commercial models do not work over the long term and it's time for users to start paying their way.

In his column in the January 12, 2002 edition of the San Jose Mercury News, technology columnist Dan Gillmor postulates that the availability of effective search engines such as Google greatly reduces the fervor to register the perfect domain name. As support he cites his own experience letting his domain names expire, the lack of enthusiasm for the new top-level domains (TLDs) and the shrinkage in the number of web sites. My own personal experience backs this up. When looking for an entity on line I now almost always use a search engine instead of trying to find the right domain name or using my stored and organized collection of URLs.

Fast on the heels of the controversy generated by the election of “at-large” members of its Board of Directors new controversy was generated by ICANN’s CEO M. Stuart Lynn’s statement that ICANN needs reforming. Dubbed by some as “ICANT”, his statement has generated a call for drastically changing ICANN to reduce its efforts to more technology and less policy making. Others have called for less drastic changes. There is one thing you can say about ICANN - it always provides material for good copy!

Privacy/Surveillance

Privacy was discussed under cryptography and electronic commerce. Privacy legislation is currently very hot at all levels of government. Businesses generally feel that self-policing is the policy of choice, but recent problems involving business sites changing their privacy policies and deciding that collected personally identifying and aggregate data is a valuable business resource to be bought and sold. This is a serious problem when a business is in financial difficulties and executives, stockholders and creditors are anxious to liquidate any resources of value.

Surveillance is also a current topic of much interest, particularly in the U.S. where freedom from massive government surveillance is guaranteed by the Constitution. Systems such as the FBI's Carnivore for legal "wire tapping" email messages and the biometric-based photo surveillance system employed at a recent Super Bowl has many people worried. Clearly there is a need to balance the rights of people and businesses and law enforcements need to protect.

Private surveillance is also an issue now that the Internet has made massive amounts of data available.

In the wake of the September 11, 2001 terrorist attacks in New York and Washington there have been increased calls in the U.S. for expanded surveillance and infrastructure security. Legislation has been introduced that would greatly increase the penalties for hacking or defacing web sites. There has also been much discussion about the utility, workability and privacy aspects of a national ID and electronic surveillance based on biometrics. At the time this is written (late March 2002) little concrete has happened except for the passage of the USA Patriot Act.

Telecommunications

Broadband access to the Internet is becoming widely available. Broadband Internet

access is essential for anything but text and small audio and visual data streams. Unlike computing and the Internet itself, access to these services are controlled by government-based telecommunications regulatory agencies.

The key to availability of broadband access is low cost, ease of installation and security for the users. All continue to be problems.

Many telecommunications regulatory agencies are concerned that customers of plain old telephone service (POTS) may be paying for a share of new services even if they don't use them so they control the price at which broadband access can be offered. Other agencies allow telecommunications companies to charge whatever they want for these services. Another problem is the fact that various forms of broadband access (DSL phone service, cable, satellite and wireless) are regulated differently or not at all.

Installation has been a problem and typically requires a service call. This raises the cost and requires trained service personnel, although it's been getting better.

Security has remained a problem although not all users are as aware of the issue as they should be. Many of these services make the user's system very attractive to break-ins with their high speed access, fixed IP addresses, always on nature and services shared among many customers. Firewall systems and increased support from suppliers has partially addressed the problem, but much remains to be done.

Open access has also been an issue. For telephone based services in the United States the 1996 Telecommunications Deregulation Act required local telephone companies to open their physical plant to alternative providers before being able to offer lucrative long distances services. As you can imagine this has not really happened and a number of alternative DSL providers have gone out of business. Cable providers of broadband Internet services have historically relied on captive ISPs. But recently some have begun to open up. AOL as a condition of the AOL Time-Warner merger was required to offer access to outside ISPs and now offers several. The recent bankruptcy of AtHome could have provided cable operators opportunities for opening up their services but most have opted for in house ISP services.

The recent collapse of alternative DSL providers and AtHome has given rise to speculation about the financial viability of such services. Without effective competition rates for broadband service have been creeping upward with both telephone and cable operators increasing their prices. This is having a negative effect on the rate of broadband adoption by consumers.

Two recent (March 2002) U.S. government actions have potential impact on deployment of broadband Internet service. The U.S. House of Representatives passed the bill introduced by Representatives Tauzin and Dingell that permits local telephone companies to offer lucrative long distance service without first showing that they’ve opened their networks to competitors. Observers say this is likely to finish off any alternative DSL providers that haven’t already gone out of business.

And the Federal Communications Commission (FCC) ruled that cable Internet services were “unregulated information services” and therefore cable providers would not have to open up their networks to outside ISPs. Again, observers see this move as one that will

reduce competition. AOL/Time-Warner is not affected by this ruling because the Federal Trade Commission (FTC) had previously ruled that this company must open their networks to outside ISPs as a condition of the merger. There is a movement to similarly classify telephone company-provided Internet access.

These two actions taken together will likely mean that most consumers will only have two choices for broadband Internet services: their local telephone and cable companies. Many have said that a choice of two providers does not provide the necessary competition.

Broadband has become a hot topic for study and comment. Early in 2002 both the National Research Council (NRC) and the Computer Systems Policy Project (CSPP) issued reports. See the section of the notes on Broadband for a detailed review of the reports.

Briefly, both reports support the importance of broadband Internet access. The NRC report is a few hundred pages long and provides an excellent reference on the subject. Recommendations are not earth shaking, but represent a consensus of the group. The CSPP report takes the tack that even today's broadband technology and deployment are not really sufficient and calls for more availability and competition. The CSPP report also makes a point of the great importance of wireless broadband access.

The CSPP report generated some controversy when in a copyrighted article in Computerworld (http://www.computerworld.com/cwi/story/0,1199,NAV47 74_STO68141,00.html), David Moschella commented that the CSPP has confused the role of the U.S. government. He asserts that while the government is clearly involved in the spectrum allocation issue, it should not be involved in broadband in general. But the report calls for a vision and not a lot of regulation. After all it was a government vision that got us the Internet in the first place and the telecommunications industry initially showed no interest at all in the project.

The CSPP report is accessible to all but the NRC report is pretty much intended for specialists.

Convergence of Computing and Television

Computer displays which are digital until the very end and television with its all-analog technology have always been separate. The advent of high definition digital television (HDTV) has the potential to change the situation. This could make possible the seamless connection of computer graphics and television.

Unfortunately there are many barriers. Television, unlike computing, is highly regulated. This means that the rate of adoption is not entirely in the hands of manufacturers, broadcaster or consumers. Spectrum allocation and availability of digital-ready TV sets are particular issues.

Protection of intellectual property is also an issue. Many digital television programming providers are worried that their copyrighted materials will be too easy to copy. This means we are probably headed for a situation where it may not be possible for consumers to record digital television programming. This is likely to slow down the

adoption of this technology by consumers.

Recently, concern has been increasing over the apparently slow rate of adoption of HDTV. Broadcasters have been slow to install upgrades and those that have do not broadcast much HDTV, citing lack of receivers and content. Content providers have been slow to provide HDTV content citing lack of intellectual property protection, broadcast facilities and receivers. Consumers have been slow to buy HDTV receivers although so-called “HD-ready” sets have been doing quite well.

In fact there have been examples (perhaps not well founded) of consumers buying an HD-ready set, connecting to a high quality source of standard definition signals (e.g., digital cable, satellite receiver, DVD player) and believing they were watching true HDTV! This indicates that consumers have not yet realized the great quality improvements possible with HDTV.

Previous FCC Chairman William Kennard proposed requiring set manufacturers to incorporate the new formats. Predictably, the set manufacturers complained saying that it would raise the cost of a TV set by $300. But if the requirement were phased in starting with large screen models perhaps we would see adoption growing much as it did for UHF capability decades ago.

Research Support

Government support of research activities in computing is often criticized. The main theme of this criticism is that computer companies have lots of money so they should support research in this field like the pharmaceutical companies. Citing the pharmaceutical companies is somewhat misleading because a significant amount of their R&D expenditures are related to achieving government approval for new drugs, an expense which is not directly related to research.

Government support for science and technology research is sometimes misunderstood. Many people associate it with elected and appointed government officials picking winners and losers. While this is sometime true, usually a peer review process evaluates research support where knowledgeable scientists and technologists establish research priorities and review proposals for research.

Industry support on the other hand is directed towards work that generally affects the bottom line in the near term. Even industry support for research in universities is generally directed to projects that potentially impact the business in the near term. In addition, industry frequently supports research projects with the goal of proving the company's products to be superior to other products. Finally, industry does not typically have appropriate personnel to properly evaluate research projects.

Nevertheless, there is a role for industry support of internal and external research. In particular, the author has had several years' experience providing industry support for university research projects. This support typically was used to augment ongoing research projects that were of interest to us. Our process also had the involvement of engineering sponsors. All of this support was for non-proprietary, pre-competitive research and the participants were encouraged to report any and all results in an unbiased manner. There is much to recommend this form of industry support university

research.

User Access

There are two problems in user access. First, it has been noted that access to computing and the Internet are not equally distributed across all social and economic groups. This disparity exists in many situations, but as computers and the Internet become key to accessing government, social and economic systems concerns have been raised. There are many dimensions to the problem and there have been many studies with conflicting results, which limits the extent to which remedies can be developed.

The other access problem is that computing and the Internet are not as easy to use as they could be for people who are not technical experts or are challenged in some way. Some call this the usability problem. For example, non-technical (and sometimes the rest of us as well!) computer users frequently find themselves lost in a forest of web pages. This leads to the well known “where am I” problem. A number of innovative experimental user interfaces have been developed to address this problem but are not widely used. Another example is the recent interest in “beyond the desktop” user interface metaphors. Both of these user interfaces are greatly aided by widespread use of broadband Internet services. Also many people with visual disabilities rely on "screen readers" that transform the printed material on a computer's display screen to verbal format. The Internet, with its graphically oriented interface sometimes defeats this technology unless a text-based form is also available.

Recently there has been much discussion of the disappointing rate of adoption of broadband Internet services. A common response is that there are no compelling applications. While true, I believe that costs approaching $50 (US) per month are also a significant factor. Most broadband proponents seem to believe that the killer application for broadband is downloading and watching movies if only the piracy problem could be solved (see CBDTPA). I disagree because there are so many less complicated ways to access movies such as traditional rentals, rentals via the Internet and postal service, etc. I believe an important use for broadband is improved user interfaces (see preceding paragraph).

Disclaimer

The author is not an attorney and the material in this work should not be considered legal advice. The material is the personal opinion of the author. The references to certain URLs contained in this work are provided as a service to the reader. Their presence should not be interpreted to mean that the author either supports or endorses the referenced material. Due to the dynamic nature of the Internet, the author cannot guarantee that these URLs are still valid at the time of this reading.

The author has made a best effort to determine the validity of the material at the time of writing, but makes no claims as to its continued validity.

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Robert Ellis retired in 1993 as Sun Microsystems' representative on the Technology

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DTV “Broadcast Flag” - http://www.eff.org/IP/Video/HDTV/20020215_bpdg_compliance_rules.html

Research Support

ACM SIGGRAPH - Prospective NRC Study on Computer Graphics Research - http://www.siggraph.org/pub-policy/CGColumn-02-2001.html
ACM - USACM on Science Research Support - http://www.acm.org/usacm/funding/
Computing Research Association (CRA) - http://www.cra.org/

User Access

ACM SIGCHI - Conference on Universal Usability - http://www1.acm.org/sigs/sigchi/cuu/
ACM SIGGRAPH - The Digital Divide - http://www.siggraph.org/pub-policy/CGColumn-08-2000.html
Closing the Digital Divide - http://www.digitaldivide.gov/
PBS - http://www.pbs.org/digitaldivide/
Universal Usability in Practice: Principles and Strategies for Practitioners
Designing Universally Usable Sites - http://www.otal.umd.edu/UUPractice/
Universal Usability - http://www.universalusability.org/

Deployment of Broadband Telecommunications

Robert Ellis
April 2001
Revised March 2002

This section is primarily a collection of articles that have appeared in the SIGGRAPH quarterly, Computer Graphics.

We have not had time to cover in depth two recent (March 2002) U.S. government actions that have potential impact on deployment of broadband Internet service. In late February he U.S. House of Representatives passed a bill introduced by Representatives Tauzin and Dingell that permits local telephone companies to offer lucrative long distance service without first showing that they've opened their networks to competitors. Observers say this is likely to finish off any alternative DSL providers that haven't already gone out of business.

Also the Federal Communications Commission (FCC) ruled that cable Internet services were "unregulated information services" and therefore cable providers would not have to open up their networks to outside ISPs. Again, observers see this move as one that will reduce competition. AOL/Time-Warner is not affected by this ruling because the Federal Trade Commission (FTC) had previously ruled that this company must open their networks to outside ISPs as a condition of the merger. There is a strong push by local to telephone companies to similarly reclassify Internet access provided by them.

These two actions taken together will likely mean that most consumers will only have two choices for broadband Internet services: their local telephone and cable companies for both access and ISP. Many have said that a choice of two providers does not provide the necessary competition.

"Last-Mile" Bandwidth Issues

Bob Ellis
Myles Losch

(Reprinted from Computer Graphics, May 1999)

Although bandwidth and computing capacity are issues throughout the Internet, it is perhaps most acute in the connections people have into their Internet Service Provider (ISP). It is the one parameter, other than content, which figures most heavily in their perception of the Internet. It is also about the only aspect, other than the capacity of their own computer that they can actually do something about. In the following sections we take a look at current technologies, survey technical issues and review policy issues associated with the new, high-bandwidth data communications services.

Computer professionals all know that response time is a critical aspect of user-computer access. Although it has been often reported, it has been most recently described by Jakob Nielsen (Nielsen, Jakob, "User Interface Directions for the Web", *Communications of the ACM*, January 1999/Vol. 42, No. 1, pp. 65-72 and http://www.useit.com/) in relation to the WWW. He describes necessary response times as: less than 0.1 second for the appearance of instantaneous feedback, less than 1.0 second for the user's flow of thought to stay uninterrupted and 10 seconds as the limit for keeping the user's attention focused on the dialogue.

Why is this so important? It is clear that high-speed communications provides a more positive graphics experience on the Internet. But just the ability to download graphics faster is not the primary benefit. One way to enable more people to use the Internet effectively is to present it as a graphical experience, both in terms of content and user interface, which requires response times as, described above.

Two examples come to mind. All of the new models for health care assume that individuals will take greater responsibility for their own interactions with health care professionals. The key to this is access to medical records. Imagine if these records were all on line (with suitable security and privacy protections) and patients could access data in their record by *graphically* exploring this data by looking at a chart showing the timeline of significant events. See the LifeLines project of Ben Shneiderman and colleagues at the University of Maryland (http://www.cs.umd.edu/hcil/lifelines/).

The second example is help for the problem we have all faced of being "lost in cyberspace". How many times have you worked your way through a web site (or series of web sites) only to discover that you had no idea of where you were in the structure or how to get back to a previous point? Although many sites try to provide some textual information on location, what's missing is the computer equivalent of the familiar "You Are Here" maps found in many physical environments such as museums, zoos, etc.

Why don't these capabilities exist? They do, but not on the Internet. And they don't exist on the Internet because the bandwidth needed to provide the greatly increased amounts of data simply is not available to most users. In fact many who access the Internet over dial up lines do so with the graphics turned off!

For a summary of the potential, see the first SIGGRAPH public policy white paper (SIGGRAPH White Paper, "Computer Graphics, Visualization, Imaging and the GII: Technical Challenges and Public Policy Issues", http://www.siggraph.org/pub-policy/whitepaperGII.html).

Because our knowledge is primarily of the situation in the United States, this description is of necessity oriented towards the U.S. However, some of the technologies described (e.g. the G.lite version of ADSL) are being globally standardized by the International Telecommunication Union (ITU) (www.itu.int), and others (e.g. for cable TV networks) will likely be adapted to conditions elsewhere.

Current and Near Term Future Technologies

Currently and in the near term future, few residences and small businesses will be directly served by optical fiber, because the construction and equipment costs of this

technology can seldom be recovered within a reasonable time from such customers. Thus we don't discuss "fiber-to-the-home". Starting in the 1980s, a growing number of fiber-based competitive local telephone companies (Telco's) were launched to serve businesses in metropolitan areas. A few electric and/or natural gas utilities (including municipally owned ones) also began to use their rights of way for new fiber networks. The 1996 Telecom Act encouraged such trends, and this will gradually expand the number of available broadband data services, often in combination with other technologies that we examine more closely below.

It should be noted that broadband services for the residential market are usually priced at flat monthly rates between about US $40 and US $60, vs. typical current ISP charges for dialup access of around US $20/mo. We feel that these prices are generally attractive to consumers, given the improved performance.

Digital Subscriber Line

The Telco's plus some ISPs and new local carriers using Telco wires are starting to deploy and offer Digital Subscriber Line (DSL) service in a number of metropolitan areas. DSL employs a high frequency carrier signal on existing copper lines to provide high bandwidth digital communications. DSL can coexist with normal analog phone service. DSL is a continuously connected service. DSL connections will be supported by many of the usual ISPs.

DSL comes in many variations; hence the acronym is frequently written as xDSL. The following paragraphs describe the key parameters. Note that some forms of DSL are asymmetric, meaning that the upstream bandwidth is lower than the downstream bandwidth. Depending on the application, this may or may not be a problem. Except as noted potential data rates decrease on longer loops (with the supported limit being about 18,000 feet from the Telco switching office). Line quality and configuration also affect performance, and some providers impose speed limits for marketing reasons, e.g. to enable tiered offerings priced for different customer groups.

1) HDSL: The earliest DSL service was developed by Bellcore in the 1980s. HDSL uses two wire-pairs (all other xDSLs use one) to provide T1 or fractional T1 service at lower cost than T1's original 1960s technology. Data rates are 1.5 Mbit/s in each direction. It is now being superseded by newer technologies.

2) SDSL: Advanced DSP chips enable T1 service (like HDSL) to be transported on only one wire-pair, so the limited capacity of Telco's' copper cables can be used more efficiently and costs lowered.

3) IDSL: IDSL provides "narrowband" ISDN's Basic Rate service (144 Kbit/s bi-directionally for the full 2B + D channel configuration), transported via DSL technology so as to lower the Telco's costs.

4) ADSL: ADSL is an asymmetric service designed for MPEG-2 compressed TV movies-on-demand, and is now used for Web surfing. It trades off upstream bandwidth (capped between 640 Kbit/s and 1 Mbit/s, depending on the implementation) so that up to 8 Mbit/s can be sent downstream. The asymmetry also deters businesses from replacing T1s with less-costly ADSL.

5) "G.lite" or "splitterless" ADSL: This is ITU-T's new standard for home Internet access. Unlike all other DSLs (for which an installer must visit the customer's site), consumers simply plug their "modem" into a home phone jack. To achieve this labor-cost and usability benefit, data rates are capped at 1.5 Mbit/s downstream and 384 to 512 Kbit/s upstream.

6) VDSL: This still-evolving short-range service is ADSL's upward migration path. On a 1000-ft. loop (from a fiber terminal), up to the OC-1 rate of 52 Mbit/s can be sent downstream, vs. 1.5 to 6.4 Mbit/s upstream. A symmetrical business version is to carry the E3 rate of 34 Mbit/s bi-directionally. At VDSL's 4500-ft. loop length limit, speed roughly equals ADSL's. Telco's plan "fiber to the neighborhood" in support of VDSL wherever ADSL's use is heavy enough to justify the cost of running fiber. If multichannel HDTV movies-on-demand becomes popular, that would also justify early VDSL rollouts.

Good places to find out more about xDSL are www.adsl.com, www.ieee-occs.org/dsl_lite and www.uawg.org

Cable Data Services

Cable television companies are also rolling out their answer to the telephone companies' xDSL services. A special interface (misleadingly called a cable "modem") is used to interface a computer to the cable for data services. These interfaces are typically packaged as an external peripheral device that is housed in its own case like an external dial-up modem. The interface to the computer is then via a 10 Mbit/s Ethernet.

Bandwidths are typically up to 10 Mbit/s downstream and are capped between 200 Kbit/s and 2 Mbit/s upstream. Cable data service is a shared service for several subscribers using the same channel and traveling through all these subscribers' interface cards. Packets are encrypted as a privacy measure. It is also a continuously connected service. Cable services, while regulated, are not common carrier services; therefore captive service providers, such as @Home or RoadRunner, typically provide Internet access.

Good places to find out more about cable data services are www.cablelabs.com and www.home.net or www.rr.com

Satellite

Satellite television providers have some limited data services. For example, DirecPC provides downstream data rates of 400 Kbit/s. Because there is no practical way to provide uplink capability to subscribers, upstream data services must utilize another medium, such as telephone. Note that for some applications, such as Web surfing, the upstream data rate requirements are quite low and could be satisfied by analog modem connections.

Good places to find out more about satellite data services are www.direcpc.com and www.loral.com -- especially the latter site's details on CyberStar and Loral Orion.

Terrestrial Wireless

Cellular telephone service has had the ability to transmit data for a long time. But the bandwidths are low and the costs are high, so the service has primarily been used by a few individuals who wish to take advantage of Internet connections (mostly for email only) while traveling.

Companies like Ricochet are now providing medium speed data connections by blanketing an area with low power transmitters/receivers to provide an Ethernet-like connectivity without wires. It is only available in a very few metropolitan areas and is used mainly by traveling professionals who want Internet access.

High-speed broadband data services are starting to be provided by companies such as WinStar, Teligent and Advanced Radio Technology. The plan is to have fiber connected local hubs that feature line-of-sight to nearby buildings. These services are provided on frequency bands as high as 38 GHz. Current economics result in targeting business customers located in buildings of 10,000 square feet or greater. Consumer service is not yet available, but multi-unit dwellings like apartment houses and condominium complexes have costs of service comparable to businesses of similar size. Thus, homes of this type are an attractive future market for service providers like those named above.

Other firms have been freed by the U.S.' 1996 telecom reform to offer broadband wireless data services, and some have signaled interest in doing so. Among the potential players are:

1) Established wireline Telco's, which have for years used wireless local loop (WLL) radio equipment to serve very remote or inaccessible customers' premises. AT&T has been actively developing a new generation of such technology.

2) Digital cellular and PCS carriers, who are standardizing a new "third generation" (3G) family of services that carry data at up to the E1 rate of 2 Mbit/s. Note that fixed-site cellular data service dates from the 1980s, when it came into use for telemetry in scientific, industrial and security surveillance applications.

3) "Wireless cable" television service providers, and other owners of radio frequencies newly auctioned by the FCC.

4) Established terrestrial TV broadcasters, who may use parts of their newly granted digital TV channels for data transmission to paying customers.

Good places to find out more about terrestrial wireless data services are www.art-net.net, www.netro-corp.com, www.winstar.com and www.teligent.com.

Technical Issues

Digital Subscriber Line

Digital subscriber line services have two major technical limitations: they are distance and crosstalk limited. The Telcos'' plans for incremental extension of fiber into residential

areas (noted above under VDSL) will slowly address these constraints by shortening the copper loops used for older forms of DSL. Just how big a problem these shortcomings will be really waits to be assessed until the service is more widely deployed. DSL services may be asymmetric, with upload speeds significantly lower than download speeds. Whether or not this is a problem is largely application dependent. For example, surfing the Internet is largely thought to have large downloads in response to a few characters of user interaction data which is uploaded. One of us (Ellis) has noted in his own personal web surfing that the ratio of uploaded data to downloaded data may be as high as 1:4, a somewhat unexpected result.

Speeds are expected to be 52 Mb/sec for VDSL or (for ADSL) far less, varying with loop length and quality. New “modems” are also required which cost $200 or so. There’s also the question of installation, although some services (G.lite ADSL) are user-installable.

Of course the high-speed “last-mile” service of xDSL (or any other broadband data service) is only as good as the complete path from subscriber to ISP. Subscribers should be aware that their path after reaching the Telco switching office might include being aggregated or multiplexed onto a circuit with many other subscribers. This might lower their throughput and response time if not properly engineered to handle large loads.

Cable Data Services

Although many people probably do not realize it, the tree-and-branch topology of existing cable TV networks means that these services are shared resources so there are concerns of lowered performance as more subscribers join. Cable operators plan to address this, like the Telcos cited above, through incremental fiberization guided by continuous performance monitoring. Thus, the cable network's topology will slowly evolve so that ever-fewer customers (ultimately, just one -- if traffic rises by enough) use each cable segment. In addition, there are security and privacy concerns, which cable industry standards will address through per-user encryption.

Speeds are also asymmetric, with faster download than upload speeds as previously noted. Non-standard modems are required although standards are being developed. Some early ones are 1-way, thus needing phone lines for uploading data. Also, lack of “plug and play” user installation has been a constraint. And since cable and PC technicians have limited cross training in each other's fields, they've had to be sent out in pairs, doubling labor costs.

The typical requirement of connecting the cable data interface to the computer via Ethernet requires an Ethernet interface on the computer. Typically, home computers do not have an Ethernet interface as standard equipment, and business computer users may not want to tie up an Ethernet port this way.

Satellite

Currently, services are provided on geosynchronous Direct Broadcast Satellites (DBS) which are definitely one way because the equipment used on customer premises is receive only. A second data service is needed for uploading. New Low and Medium Altitude Earth Orbits (LEO/MEO) communication satellites that Iridium and other new

mobile service communications operators use may enable two-way service, including mobile.

Non-standard “modems” and radios are required. And the shared resource nature of the service limits capacity in the short term.

Terrestrial Wireless

Bandwidth and cost are the primary concerns, plus the need for new (and non-standard) "modems". Other technical issues include the need for somewhat new technology for computing such as radios. Novel concerns include “line-of-sight” requirements and possible signal blockage by rain or other environmental factors! For "wireless cable" operators and terrestrial TV broadcasters, a further issue is their one-way radio infrastructures, which (like cable TV) were optimized to deliver non-interactive entertainment.

Policy Issues

Digital Subscriber Line

Although Telcos, ISPs and others are beginning to widely advertise DSL services, cost and availability are definite problems. Also the ISDN debacle continues to haunt the minds of potential subscribers. Some have suggested (see the 1998 Harvard workshop at www.ksg.harvard.edu/iip/ngct/ngct.html) that the Telcos would really like their DSL to be a mostly unregulated, non-common carrier service.

DSL availability is also tied up in the deregulation confusion from the 1996 Telecommunications Act that sets the scene for a clash between the normally state regulated telephone services and federal laws and regulations. Access to these services by ISPs and Competitive Local Exchange Carriers (CLECs) continues to be a problem. Telcos, despite recent Supreme Court decisions against them, continue to litigate against (and thus delay) competitive service providers.

Cable Data Services

Cable services, while regulated, are not common carrier services. This means there is no ISP choice without extra cost. Some fear that small ISPs who shelter controversial free speech could thus be forced out of business. The issue is important enough to existing ISPs and “portals” that AOL is actively campaigning for these services to be “open”, although they are not suggesting that they be assigned common carrier status. A coalition of advocacy groups for opening cable networks to any ISP may be found at www.nogatekeepers.org. Availability also continues to be a problem, partly because cable operators feel little competitive pressure to quickly offer broadband data service.

Some feel that the best way to get meaningful competition to the Telcos is to let cable operators “do their thing” without requiring them to open their services to competitors. Others feel that because the Telcos are under pressure to open their systems to competition, it is only fair to place the same requirement on cable operators.

While subscribers may always discontinue service, the use of non-standard “modems”

means that an equipment investment inhibits transfer to another type of service. Also, the cable companies would prefer to rent the interface device to you, which restrains competition. Possible standardization forced by the FCC is looming which would bring an element of competition to the sales of the interface equipment. But until universal (DSL, Cable, Satellite, etc.) interface devices (similar to the universal handsets which have been lacking in the United States' non-standard digital cellular situation) become available, the requirements for investment in fairly costly interface devices constrain ISP choice.

Another current policy issue is industry mergers as typified by the AT&T/TCI merger. AT&T will get access to homes over TCI's cables and can begin to offer competitive telephone and other services. A side issue has been the attempts of some local governments to deny approvals for the "new" TCI until they open their systems to competition.

Satellite

Costs and competitive issues are important. Satellite television services are about where cable television was a decade or more ago, but the adoption curve has reached the point of rapid increase. Satellite data services are in their infancy. The newness makes it difficult to predict where policy issues might surface.

As usual with a new technology, esoteric issues such as interactions between FCC antenna regulations and local regulations limiting their placement will be discovered. Antenna placement regulations may be a particular problem for apartment and condominium dwellers whose antenna cannot "see" a desired satellite from their own window, balcony, patio or similar attachment point.

Terrestrial Wireless

Consumer terrestrial wireless data access is even less developed than satellite services. Issues include spectrum allocation, though a solution may in time emerge from the FCC's new debate on allowing ultra-wideband, micropower CDMA services. FCC rules (also cited above for satellite services) that restrict outdoor line-of-sight radio antennas are another concern in some housing complexes.

Summary

Deployment of broadband data services is well underway. Significant, but not insurmountable problems exist. Perhaps the biggest is that this is all caught in the deregulation of telecommunications. For example, many industry analysts agree that Telcos' congressional lobbying before passage of the 1996 Telecommunications Act, and their litigation afterward; have impeded competition in the markets they dominate. In 1998, MCI and others suggested that to counter this, Telcos should be made to divest their copper loops. While there is now little interest in such drastic measures, continued failure to achieve local service choice for most customers could spur demand for them, and even for parallel steps against cable TV operators.

A special symposium sponsored by the Harvard Information Infrastructure Project called: "Next-Generation Communication Technologies: Lessons from ISDN"

(http://www.ksg.harvard.edu/iip/ngct/ngct.html) was held in June 1998. While the overall results were inconclusive (everyone basically said “it wasn’t our fault”) there was a serious attempt to learn the lessons of this failed three-decade effort to digitize the “last mile”.

First, stable standards were very late, and their implementation later still ... yet for the residential customer who must rely on ISDN for both voice and data, important features are lacking even now. Among these are convenient extension telephones and easy interfaces to consumers’ existing analog Customer Premises Equipment (CPE) such as phones, answerers, auxiliary “ringers” (e.g., lights and gongs), wiring devices, etc. The market seemed to offer windows of opportunity in the early 1980s and again in the mid-1990s, but Telcos were too slow moving to exploit these -- and some say that utility regulation left them little reason to do so.

Many states' ISDN tariffs also wrongly priced the service, as customers saw it. Telcos' chronically weak grasp of users' data needs, and their poor record in order handling and tech support, were further obstacles to success. And AT&T's 1984 divestiture sowed dissension among the companies that had to collaborate in order for ISDN to do well in the U.S. (The service won greater acceptance overseas.)

DSL -- and cable modem service as well -- are immune to some of the problems that beset ISDN, but vulnerable to others. Telcos and cable TV firms have had little success at selling and supporting advanced data services for consumers. This suggests that ISPs, CLECs, et. al., be helped to do so. But the incumbent owners/operators of wired infrastructure in the U.S. typically disfavor such ideas.

Experience in Canada may be useful on this point. That country's counterpart agency to the FCC ordered that cable TV networks be opened to all data communication service providers who wish to serve cable modem customers. Many in the U.S. will observe these arrangements with interest.

Security and Privacy Issues with High Speed Internet Connections

Bob Ellis
Myles Losch

(Reprinted from Computer Graphics, November 1999)

There are two issues we didn’t stress in our May report. Because most knowledge and experience is with DSL and cable modem service, we will restrict our discussion to those services. First, the “always on” (except if you turn off your computer!) means that you are connected to the Internet for potentially long periods of time with a static IP address. This means that “cracking” programs have ample opportunity to break into your system. In fact we know of a number of technically sophisticated home computer users who implement a firewall computer separate from the computer they use for processing. Such users report break-in attempts several times per hour. Given the low level of network security of the typical home computer, this means sooner or later such a break in attempt will succeed and possibly compromise the operation of and files stored on the computer.

A partially mitigating situation is the fact that most DSL providers assign a floating IP address each time you do reconnect. So if a cracking program has found something interesting on your computer, it will find a different computer after a new IP address is assigned. It is unclear to what extent cable TV Internet providers may adopt similar practices.

The other issue relates to the use of whatever local area networking software is commonly run on the subject computer to make the actual connect to the data service. This requires extra diligence on the part of the user to insure that others on the local area net do not have access to the computer. Microsoft Windows is a particular problem in this respect because the default local area networking parameters are set to share everything. This means, for example, that the people you are sharing your cable Internet access channel may have access to your files and even your printers unless the default settings are changed. Indeed, there have been reports in the popular press describing just such situations.

Finally, in our May report we provided a pointer to the group No Gate Keepers (www.nogatekeepers.org) which advocates that cable Internet services provide access to any ISP who wishes to gain access to their networks. At the time, we mentioned that there were groups advocating the opposite position: that cable Internet services should be allowed to continue to provide access only to self selected ISPs. One such group is NetAction (www.netaction.org). Note that NetAction's position is related to their interest in seeing competition in all aspects of consumer communications: entertainment delivery, voice and broadband data services. Cable networks are typically designed for only the first of these and require costly upgrades to support the other services. In order for cable providers to do this, NetAction and others argue that it is reasonable to allow cable operators the freedom to provide non-voice services on their own terms. As you can see, this is a complex issue and thus broadband and other non-traditional cable services cannot be separated from telephony with its legacy of regulation.

Self-Installation of (Wired) Residential Broadband Internet Access

Myles Losch

(Reprinted from Computer Graphics, November 2000)

Among the obstacles to widespread home adoption of both DSL and cable modem services, has been the typical need for expert onsite technical skills furnished by service providers' field crews. Past attempts to let consumers self-install [in industry jargon, "self-provision"] such broadband links (as they would a dial-up telephone modem) fared poorly, due to technical and standardization problems.

But better technology, combined with quickly growing demand, has prompted new efforts to cut labor costs and delays by offering the customer an "out-of-box experience." Broadband access providers, with equipment makers and retailers, have developed (and cautiously begun to deploy) a new generation of streamlined industry standards for self-installation.

The research consortium Cable Television Laboratories (www.cablelabs.org) developed, and tests hardware compliance with, the DOCSIS (Data Over Cable Service Interface Specification) standard for cable modems. Phone companies' corresponding initiative for ADSL service, once called "G.lite," was standardized by the International Telecommunication Union (www.itu.int) as Recommendation G.992.2. This standard is being overseen by a new deployment consortium, OpenDSL (www.opendsl.org).

Retail packaging of both types of broadband access device is expected to take two forms: kits for use with separately purchased computers, and inboard versions pre-installed in both computers and fixed function "Internet appliances" such as Microsoft's Web TV terminals.

Industry analysts expect that such products, if successful, will do much to speed public acceptance of broadband Internet access. In future columns, we hope to assess the results.

`Imploding DSL Carriers` (Recent DSL Business Turmoil and Its Consequences)

Myles Losch

(Reprinted from Computer Graphics, August 2001)

As regular readers know, this column has covered the spread of broadband network connections, which we see as necessary to bring homes and small businesses easier access to synthetic digital imagery. The two most popular alternatives for achieving this are:

1) Cable television wiring plus fast new modems, and ...

2) Telephone wires upgraded with Digital Subscriber Line (DSL) technology.

But over the past year, the U.S. DSL business encountered setbacks that weakened competition, boosted prices for consumers, and led diverse groups to urge government intervention. Some industry analysts trace the problems back five years, to flaws in the 1996 Telecommunications Act that ordered local phone companies (mainly the 'Baby Bells') to rent their wires to rivals.

But the Bells sued to block parts of the Act and, said critics, delayed or mishandled orders from competitors. Together with other difficulties, this reportedly sped the recent demise of a number of small, aggressive independent DSL providers (such as NorthPoint, which abruptly collapsed, leaving over 100,000 customers without service).

Facing fewer serious rivals, the Bells (which dominate the U.S. DSL market) raised DSL prices for home Internet access by up to a quarter, thus encouraging cable television companies to follow suit. Such moves increased the public pressure on government to act. Among the consequences have been:

1) Calls by the Bush administration's new FCC chair Michael Powell for an eightfold rise

in penalties against phone companies that improperly thwart rivals, plus relaxed time limits for pursuing such misconduct, and other tough new rules.

2) Moves by some state regulators to force the Bells to restructure (but not [yet] to divest) their "last mile" wiring business, so as to make discrimination against competing service providers more difficult.

But the Bells have not been complacent in the face of regulatory countermoves: they have fought for new legislative authority to carry interstate traffic without first meeting the market-opening requirements of the 1996 Telecom Act.

All of this has taken place against a background of rapid growth in DSL (and its alternatives). But some analysts fear that price rises will dampen demand, and even speculate that this is among the Bells' goals. In this view, the Bells want:

1) Much more time to refine their DSL implementation techniques and the supporting business processes, both of which remain seriously immature by the standards of voice telephony.

2) Lower annual capital investment needs for upgrading their wired infrastructure to support DSL. This is said to result from the Bells' heritage as heavily regulated public utilities, which traditionally face strong pressure (from investors in their stock) to maintain high dividend payouts.

Were the Bells obliged to seriously compete for market share against many fast-moving DSL rivals offering low prices (holds this hypothesis), their resulting need for investment capital would conflict with shareholder expectations; hence the alleged preference for more gradual growth of DSL service.

Several of the developments noted above will clearly require significant time to unfold, and we hope to follow them in future columns.

``DSL Woes Spread to Cable Modems: Bankruptcy Cuts Service to Half-Million Homes``

Myles Losch

(Reprinted from Computer Graphics, February 2002)

In August 2001 this column noted how business failures among broadband Internet providers had disrupted, and raised the price of, DSL service over phone lines. Residential and small business users of fast Internet access (so useful for transmitting digital imagery) suffered a greater setback in December 2001 from the bankruptcy of Excite@Home, the largest U.S. provider of Internet access over cable television lines.

Several major North American cable TV companies had long relied on Excite@Home for their subscribers' Internet service. But the impact fell most abruptly on some half-million AT&T Broadband cable modem customers, whose only immediate alternative was to use far slower dial-up modems over phone lines.

They, along with millions of other users, had to cope with sudden changes in their e-mail addresses, as well as the loss of information storage and other supporting services from Excite@Home.

This episode followed other setbacks for broadband Internet service. While continuing to grow at a pace that mature industries would envy, the subscriber population expanded in 2001 (albeit from a larger installed base) at a significantly slower rate than earlier predicted. Factors contributing to this included:

(1) Higher monthly fees, which (as we noted last August) followed a decline in competition among broadband Internet providers.

(2) Deteriorating economic conditions in many developed nations, causing some consumers to see fast data service as a luxury to be deferred, or even abandoned.

(3) The failure of many Internet-related companies, whose employees were natural users of (and word-of-mouth marketers for) high-speed Internet access.

(4) A lack of "killer applications": compelling uses to drive consumers' migration to the broadband Internet.

On this last point, entertainment industry officials have argued (somewhat self-servingly) that greater online availability of their broadband content would spark mass adoption of high-speed digital access. This assertion is typically offered as justification for ever-stronger copyright laws (so that copyright holders would open more of their film and tape vaults to remote audiences).

Much of the thinking by many broadband Internet applications providers sees the public mostly as passive recipients of packaged works. The Internet, though, has always been a vehicle for interaction, both among users and with content. Some analysts question whether a 1950-style "couch-potato model" will lure empowered 21st-century audiences. And this issue (as we've noted in past columns) has policy implications well beyond the market for fast Internet access.

As we went to press, the U.S.' National Research Council was preparing to release a book-length study of that market, entitled "Broadband: Bringing Home the Bits" (ISBN 0 309-08273-0; see http://www.nap.edu/books/). We hope to review the NRC study in a future column.

Two Reports on Broadband Internet Service

Bob Ellis

(Reprinted from Computer Graphics, May 2002)

Introduction

I've recently reviewed two reports on broadband Internet services. The National Research Council's (NRC) (http://www.nrc.edu/) Computer Science and Telecommunications Board (CSTB) (http://www4.nationalacademies.org/cpsma/cstb.nsf) has released a report titled "Broadband: Bringing Home the Bits"

(http://www4.nationalacademies.org/cpsma/cstb.nsf/web/pub_broadband?OpenDocument) and http://www.nap.edu/books/0309082730/html/). The Computer Systems Policy Project (CSPP) (http://www.cspp.org) has recently issued a report titled "Building the Foundation of the Networked World" (http://www.cspp.org/reports/networkedworld.pdf).

As regular readers know, the SIGGRAPH Public Policy Project has stressed broadband Internet access as vital to computer graphics (http://www.siggraph.org/pub-policy/CGColumn-0599.html, http://www.siggraph.org/pub-policy/CGColumn-0899.html and http://www.siggraph.org/pub-policy/CGColumn-1199.html). In addition, our SIGGRAPH 2001 Tutorial covered this issue (http://www.siggraph.org/pub-policy/pdf/PPCourseNotes-S2001.pdf). Not only will high-speed access make access to images and animations better, it will enable the development of innovative applications and user interfaces.

Many computer graphics professionals have high speed Internet access via their place of employment and are probably early adopters of such access for their homes. But the general public has not been quick to adopt these new technologies due to availability, cost and lack of compelling applications. This inhibits the availability of our work.

I must also mention the importance of regulatory structures in this context. These services are sometimes regulated by government agencies and sometimes not. Regulatory policy is something most of us prefer not to pay attention to unless our phone or electric rates increase. Unfortunately, there is a need to understand this regulatory environment if we want to make the results of our work widely available.

NRC Report - Broadband: Bringing Home the Bits

(In the interest of full disclosure SIGGRAPH has been working with the NRC to define a study of computer graphics research and has contributed $50,000 as seed funding for the study (http://www.siggraph.org/pub-policy/CGColumn-02-2001.html).)

This review is based on a pre-publication copy, but I'm sure the final report with the clever title is very close. As usual for a NRC study, the study and its report are extremely thorough and unbiased. It is also a very large document. However the findings and recommendations are not particularly earth shaking and lack some concreteness as is typical of NRC studies; I suspect that it is the need for consensus that forces such results.

The thoroughness of the report makes it an excellent, if somewhat intimidating, vehicle for understanding broadband from technology to regulation and policy. For example, the reader will become thoroughly familiar with the crosstalk problems inherent in DSL technology and even learn that A. G. (probably Alexander Graham) Bell invented the twisted copper pair!

There are seven findings, several with sub-parts. Finding 1 says that broadband is a convergent technology that supports multiple applications ranging from Internet access to digital television distribution. Finding 2 states that broadband should be defined in a dynamic and multidimensional way and not fixed to any particular technology or performance characteristics.

Finding 3 says that the demand for broadband is evident even with a limited set of enabled applications. While I agree in general, I feel that demand cannot be separated from cost and in fact at today's costs, there is in general not a great demand. Finding 4 states that broadband deployment should be a national and local imperative. Others have made this statement and it is probably only mildly controversial.

Finding 5 summarizes the many factors that face deployment of broadband. These include issues associated with cost and investment with technology playing a minor role. Finding 6 discusses the shape of broadband deployment. There are several sub findings including the rapidly evolving technology, uncertainties beyond the next several years, avoidance of a race among competing technologies, competition that will have substantial geographical differences, the uncertainty of the future of competitive providers and while the underlying technologies are keeping pace with computing, the deployment of these technologies is not.

Finally, Finding 7 states that the relationship between broadband and the content and applications businesses is critical and in flux.

There are also seven recommendations with several having multiple parts. Recommendation 1 is to prioritize widespread deployment and defer new regulation in the early stages. Although pretty general, there are some strong messages here. Recommendation 2 states that regulation should be structured to emphasize facilities based competition and encourage new entrants. As with the first recommendation, the intent is to emphasize market-based solutions rather than extensive new regulation. Of import is a sub-recommendation to favor alternatives to physical unbundling. This recognizes the difficulty of some of the current regulatory directions of trying to promote competition by requiring last mile providers to open access to their physical plants.

Recommendation 3 says to reflect the convergent nature of broadband and target policy at the appropriate layer by targeting regulation at services rather than technology. Recommendation 4 is to take steps to promote increased deployment. Sub-recommendations are focused on support for local initiatives.

Recommendation 5 is to increase local capacity to promote broadband deployment by supporting planning grants, field trials and establishing a national clearinghouse for information. Recommendation 6 is to defer a universal service policy for broadband until the nature of broadband services becomes clearer. Recommendation 7 is, as always, to support research and experimentation. All in all, the report has a solid set of recommendations.

There are other interesting ideas in the report. Although there is talk of innovative applications, much of the justification for broadband relies on video download as a primary application. Unfortunately, there are numerous almost as convenient alternatives for accessing video content. Plus truly innovative applications including "beyond the desktop metaphor" user interfaces are not mentioned.

Wireless considerations are not emphasized saying that the problem of installation requiring FCC certified installers is difficult to surmount. The report is probably too quick to relegate wireless access to this minor status.

The report does a great service by emphasizing the difficulties alternative providers have under the current regulatory, technical and business structures and supports logical layer, rather than physical layer unbundling.

There is a good discussion of security issues, but it is all buried in the body of the report.

There is also good information on the tendency of certain service providers to control content either by caching policies or by outright control of access to certain sources of information. Entertainment-based providers, such as cable companies, are particularly prone to this control.

Finally, there is some discussion of the fact that it's not always the last mile where the bottlenecks lie, but again, it's buried in the body of the report.

I highly recommend this report to anyone interested in understanding issues about broadband.

CSPP Report - Building the Foundation of the Networked World

(In the interest of full disclosure in 1991-1993 I was Sun Microsystems representative on the CSPP Technology Policy Committee.)

The CSPP is a public policy advocacy group consisting of the Chairmen and CEOs of leading information technology companies. The current CSPP Chair is Michael Dell. Companies represented are Dell, Compaq, HP, Motorola, IBM, Intel, NCR, EMC and Unisys.

The report follows the usual style of CSPP reports: slick, but with solid content. The report is 25 pages long with 30 references. The report addresses wireless as well as wired broadband. The central thesis of the report is that today's broadband is not adequate for the future in terms of speed, mobility, access and availability. Fiber to the home (FATTY) is probably a minimum requirement. The report is interesting to the technical audience and accessible to policy makers. There are numerous charts and graphs, some of which have substantial quantitative content.

The report begins by pointing out the rate of broadband adoption is much less than for basic Internet services. It also indicates in the period 1992-to 2001 microprocessor speed has increased by 4,778% while modem speed has only increased by 268%. Comparison is made to historical rates of adoption of other technologies. Reports are cited giving the potential economic impacts of widespread broadband Internet use.

The report next describes the impact of new applications that would be enabled by broadband including public health, improved business operations, electronic commerce, distance learning, access to government, appliances, entertainment and location independent access. Some aspects of several fixed and mobile broadband technologies are reviewed. Unfortunately for computer graphics one of my favorite reasons for broadband, innovative user interfaces, is not among the list.

CSPP's offers specific recommendations:

1. A national vision should be adopted which would provide by 2003 that 80% of U.S. homes should be able to get at least 1.5 Mbps and 50% should be able to get at least 6 Mbps from at least two providers. By the end of the decade 100 million U.S. homes and businesses should be able to get up to 100 Mbps of affordable capacity. Also, CSPP recommends that by 2004 120 MHz of spectrum should be made available for wireless broadband with another 80 MHz by 2010 to be harmonized as much as possible with global spectrum use.

2. Regulatory reform should result in steps toward eliminating barriers to widespread broadband deployment. By the end of 2003 the FCC should complete a review of current unbundling and price regulations for last mile broadband facilities and services. Further, state and local governments should review road and building codes to assure the use of new trenching techniques such as those used in Europe. Finally the administration should convene an interagency National Spectrum Management Policy Group to determine goals for the long-term management of spectrum. Other recommendations address access to public rights of ways, adoption of incentives such as a rural broadband tax credit, build-out of infrastructure and making available analog TV broadcast spectrum to other uses.

3. Research should be supported and carried out by public and private sectors in the development of innovative applications and the speed, security and mobility of 21st Century networked infrastructures. In addition, the public and private sectors should commit to funding programs that help educate the next generation of researchers.

4. Industry should commit to implementation of ease of use, security, interoperability, interconnectivity and the development of richer content. Industry should be responsive to government partnerships. Finally, industry must commit to resolving copyright issues and the development of a digital rights management strategy that protects content consumer choice and technical innovation.

On February 11, 2002 in a copyrighted article in Computerworld (http://www.computerworld.com/cwi/story/0,1199,NAV47-74_STO68141,00.html), David Moschella comments that the CSPP has confused the role of the U.S. government. He asserts that while the government is clearly involved in the spectrum allocation issue, it should not be involved in broadband in general.

Moschella makes an interesting point. But I do think the report calls for a vision and not a lot of regulation. After all it was a government vision that got us the Internet in the first place and the telecommunications industry initially showed no interest at all in the project. The sentence "The CSPP would be wise to let the telecommunications industry sort itself out and perhaps aim its lobbying efforts at the music industry and other sources of potential new consumer demand." shows one problem with the criticism: the telecommunications industry, unlike the computer industry, has no history of being able to sort itself out or even come up with any sort of visionary implementations of technology.

I highly recommend the report.

Intellectual Property (IP)

Robert Ellis
March 2002

Introduction

Intellectual property according to Pam Samuelson[1] is "intangible rights in intangible information". (Samuelson's Website: http://sims.berkeley.edu/~pam/ is an excellent source for information such as articles, presentations, etc., on intellectual property.)

In the United States, the Constitution is the source for the right of the Congress to enact laws concerning intellectual property. Article I, Section 8 defines the powers of Congress. One of the enumerated powers says, "To promote the Progress of Science and useful Arts, by securing for Limited Times to Authors and Inventors the exclusive Right to their respective Writings and Inventions". From this simple statement have come the United States' intellectual property laws.

Note that there are three components: promoting the progress of science and the useful arts, giving authors and inventors exclusive rights and a limited time period. The first can satisfied by making writings and inventions widely available, putting a time limit on the exclusive rights and/or by providing an incentive to authors and inventors. The rights provided by intellectual property law to authors and inventors satisfy the second. And putting time limits on the rights of authors and inventors satisfies the last.

Laws concerning patents, trade secrets, trademarks and copyrights control rights in intellectual property. Patents are used for inventions, trade secrets for commercially viable secrets (e.g., source code, product designs, marketing plans, etc.), trademarks are certain words, names or designs by which a product or manufacturer is known and copyright for making copies of any intellectual material which has been fixed in some form (e.g., printed, web page, motion pictures, etc.). We will only explore copyright in any depth here.

Patent protection has a long tradition. It protects inventors and those who might license their invention from any duplication by others. Even if something is developed without knowledge of the patented invention, it still cannot be made available without infringing on the patent. In exchange for this strong protection all patent applications are placed in the public domain for others to access and study. It is worth noting that the duration of a patent is no more than 20 years, much less than for copyright.

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[1] Samuelson, Pamela, "Copyright Tutorial, http://www.sims.berkeley.edu/%7Epam/coptutor/, January, 1999.

Patent protection is fairly non-controversial with the exception of software and business method patents. For a long time, software was not considered patentable material because it was not reduced to a physical item. A few years ago this changed and there have since been a number of software patents issued. Controversy has developed because many consider that the U.S. Patent and Trademark Office (PTO) has not done a good job of researching the "prior art". Patents are for uniquely new inventions and if something is already common practice, it cannot be patented. We will not consider patents further because the software patent issue is not particularly unique to computer graphics and most people seek the advice of an attorney who specializes in patents for assistance in obtaining a patent. Business method patents are perhaps even more controversial. Many see such patents as the one Amazon has for "One Click Ordering" as a major change in what is patentable.

Trade secrets are much used in the high technology area. We frequently see material in the media regarding trade secret violations. We will also not discuss trade secrets further.

Trademarks are something we all see every day, but most of us probably did not think much about them until the Internet domain name controversy. What happened was that people started registering domain names that were the same as trademarked names. Sometimes the person registering the name was hoping to be able to sell it to someone else. Sometimes the person registered a variant, such as the infamous "xxxsucks" domains that were intended for websites expressing criticism of "xxx" by persons using their free speech rights. Many feel that the pendulum has currently swung too far in the direction of protecting the rights of trademark owners. Trademark law is not straightforward and has many nuances. Although it is undoubtedly important to the reader, going further would come close to providing legal advice, something we are completely unqualified to do.

Among forms of IP, only copyright and patent are grounded in the U.S. Constitution's intellectual property clause. Federal trademark law on the other hand is based on the commerce clause, while trade secrets and the right of publicity (which governs the use by others of your name, likeness, etc.) are based generally on state commercial law.

But it is copyright that affects the majority of us directly. In the U.S. anything we write or any image we create is automatically protected by copyright. Conversely, every time we look at any material whether in print or electronically copyright law potentially impacts us. And if we ever decide to make a copy, even for permissible uses, we are subject to copyright laws. Another reason to spend more time on copyright is that some copyright infringements can result in criminal prosecution.

An exciting recent development (March 2002) was the U.S. Supreme Court's agreement to hear Eldred v. Ashcroft, a case that will test the constitutionality of the Sonny Bono Copyright Term Extension Act. This law significantly increased the term of copyright to nearly 100 years in some cases. Some call this the "Mickey Mouse Law" because the efforts on Disney and other studios expended on behalf of its passage in order to stop their intellectual property from entering the public domain. Many saw this as a perversion of the phrase "for Limited Times" in the U.S. Constitution's clause (see above) because the "limited time" is now an appreciable percentage of the time the U.S. has been in existence. As noted above, no such lengthy term exists for patents.

Tutorial on Copyright and Implications for Computer Graphics

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(Reprinted from Computer Graphics, August 2002)

Copyright -- we hear about it in the electronic world all the time, but just what is it and how was it established? The power to grant and regulate copyright is given to the U.S. Congress by the Constitution; therefore copyright is a federal law. The law, though it may be interpreted differently from one federal judicial circuit (region) to another, is uniform from state to state.

Section 102 of the U.S. Copyright Statute states that, "Copyright protection subsists in original works of authorship fixed in any tangible medium of expression, now known, or later developed, from which they can be perceived, reproduced, or otherwise communicated, either directly or with the aid of a machine or device."

So we have some terms that need to be defined:

"Original" A work is considered original if the idea can be traced to the author and not copied from someone else's work. This doesn't mean that the work is unique, novel, or good. A work can still be considered original if it has some preexisting work embedded in it, but only the part which is original falls under the newer work's copyright protection.

"Works of authorship" They run the gamut from literary work to sound recordings. Some examples of authorship are as follows:

Written works- newspapers, magazines, novels, poems, computer programs
Musical works- songs, instrumental pieces, advertising jingles, sound effects
Performance or choreographic works- dancing, theater, mime
Images- photographs, graphics, paintings, sculptures
Films, multimedia projects, training videos, television shows, animation
Sound recording- music, lyrics, and sounds

"Fixed" The law defines "fixed" as, "Sufficiently permanent or stable enough to be perceived, reproduced, copied, or communicated for a period of more than transitory duration." This means anything from writing it down on a piece of paper to loading it into RAM on your computer.

Now that we know what is copyright protected, what isn't.

* Ideas
* Facts
* Titles
* Names
* Short Phrases
* Blank Forms
* Compilations such as the phone book, because they lack originality

* Federal Government documents and publications, though they need to be attributed
* Processes and systems described in copyrighted works
* Public Domain works

You as a copyright owner have five exclusive rights:

The Right to Make Copies- this is the right to copy or duplicate your work.
The Right to Make Derivative works- you can modify your original work to make a new work
The Right to Distribute- the ability to decide how you will distribute your work to the public. This can be in the form of selling, leasing, renting or lending.
The Right to Perform a Work in Public- you have the right to decide the public venue for your work to be shown, read, or performed.
The Right to Display- this right allows you to show a copy of your work in a public venue or transmit it to the public.

The duration of copyright protection depends on when a work was created, who created it, and when it was first distributed.

Any work published before December 31, 1922 is now considered public domain (i.e., no longer protected by copyright). For works that were published between January 1, 1923 and December 31, 1968, there was a copyright term of 28 years with the author then being able to apply for another 28-year term. This was not an automatic renewal, so if the author did not apply for the renewal, those works are also in the public domain. For works published between January 1, 1923 and December 31, 1977, which display proper notice, these works are protected for 95 years. For works created before December 31, 1968 but never published, the term is the life of the author plus 70 years or until December 31, 2002, whichever provides longer protection.

The Copyright Act of 1976 changed the term of protection, from a publication-based term to an author's life plus 70 years. Works created on or after January 1, 1978, when the Copyright Act of 1976 took effect, have copyright protection for the life of the author plus 70 years. If the work is considered a "work for hire" then the term of protection is 75 years from when it was first published, or 100 years from when it was first created.

So we have another term, "work for hire". Normally the person/s who creates the work has the copyright protection. This is true except when an employee within the framework of his/her job responsibilities creates a work. If it is, then the employer holds the copyright on the work because it is considered "work for hire".

Now that you know what your rights are, let's look at the infringement side of the coin. In the past twenty years the use of copy machines, faxes, computers, scanners, video digitizers, and the like has made copying of material easy. Just because you have the knowledge and equipment to copy materials doesn't make it a legal practice. As a rule of thumb, if it isn't your work, you need to ask for permission to use it. There are a few exceptions, such as materials in the public domain, facts or ideas from a protected work, and government documents.

FAIR USE

The Internet has raised issues as to whether materials are in the public domain or whether they have copyright protection. The common fallacy is that the web is public domain. While some of the material on the web might be public domain, most of it is copyright protected. Unless an author has specifically put the work into the public domain, or the term of copyright (which I discussed earlier) has expired, it is copyright protected. Don't let yourself be fooled that Disney, Time Warner, TNT, or any of the major brokers of intellectual property would be pleased for you to use their work. Their trailers and promos are on the web to give individuals accessibility, not to have you take and use these works as you see fit and violate their rights in the process.

For works published on or after March 1, 1989, the use of a copyright notice has become optional for the author. Anything created after that date is automatically protected whether it has a notice or not. If you don't see the symbol, it doesn't mean that it isn't protected. Of course registering with the U.S. Copyright Office gives people notice that the work is protected, and it also helps when one wants to recover damages, legal fees, etc. after a lawsuit is filed. The law allows for penalties up to $100,000 per offense, so abuse of another's copyright is a major violation.

Even if you only copy a "small" amount of a document, you could still be infringing the copyright, particularly if that "small" amount is the major thrust or focus of the piece. It doesn't matter if you give credit to the author for taking this small portion of the piece. There is a legal difference between plagiarism and copyright infringement, and it usually shows up in the monetary award. Nonetheless, you should always give attributions to the source materials you quote or adapt.

So how do you go about getting copyright permission? Normally copyright permission is obtained in one of two ways, either getting a license, which is limited and specific to the work and how it will be used, or through an "assignment", in which all intellectual property rights of a work are transferred to the party wanting to use it. For musical works especially, two places to start in obtaining rights would be Broadcast Music, Inc. (BMI) http://www.bmi.com/home.asp and The American Society of Composers, Authors, and Publishers (ASCAP) http://www.ascap.com.

When you are making your demo reel and sending it to perspective employers, don't be caught with material that isn't your work. It makes you as well as the educational institution you graduated from look bad. If you have done "work for hire", ask your employer if they will allow you to use their work for your portfolio. It is the fair and legal way.

What is fair use? It is a term that is thrown around in academic circles all the time, but what actually is fair use? From District Judge Pierre N. Leval's opinion in New Era Publications International vs. Henry Holy and Co., 695 F.Supp. 1493 (S.D.N.Y., 1988) on fair use, he states, " Our statute and our judge-made law talk about the subject. They mention factors, but give no standard. And those factors are stated in an opaque and uninformative way. We are told for example to look at the purpose and character of the secondary use and at the nature of copyrighted work. 'What about them?' you may ask. We are not told. We are told to look at the amount of the taking and the effect on the market. 'How much is too much?' We are not told. *** Our understanding of the doctrine has made very little progress over 300 years." Now with the Internet, Section 107, which grants fair use, in the US Copyright Statute gets muddied even further.

How do we use materials for classes, professional presentations and any event in which promotion of learning is foremost? First, check with your institution's business or legal department on the guidelines that they have in place for you. With the advent of the web, e-commerce, and distance education classes, most organizations have a policy on what they advise you to do. There is a provision called "the good faith fair use defense" [17 USC 504 (c)(2)], which applies to a person who believes they have acted reasonably in their copying of material and felt it was fair use. But if you have not followed the guidelines your organization has supplied to you, this defense goes out the window. So check.

While Section 107 does not negate the provisions of the copyright holder granted in Sections 106 and 106A, the code allows for the reproduction of protected works for the purpose of news reporting, teaching, scholarship, criticism, and comment. There are four factors, which must be considered when talking about fair use:

* The purpose and character of the use, including whether such use is of a commercial nature or is for nonprofit educational purposes;
* The nature of the copyrighted work;
* The amount and substantiality of the portion used in relationship to the copyrighted work as a whole;
* The effect on the use upon the potential market for value of the copyrighted work.

What do those factors mean to us?

The first one takes into account whether the work is for commercial or educational purposes, while not guaranteed; the preference will be given to those works that have a non-profit, educational slant. It also looks to see if it is for criticism, comment, new reporting, parody, teaching, scholarship, or research. If it falls into one of these categories it is easier to use the fair use defense. Lastly, the first provision looks to see if the new work supplants the original work, adds value to the original work thereby altering the message, intent, and nature of the original piece.

The second factor basically says that some copyrighted works are of more value and therefore need to be protected differently. The law looks at the original work and determines where on the copyright spectrum the work resides.

Item number three is not a ratio value. It doesn't say that taking 20% of a work is OK, but 21% can land you in the middle of a copyright infringement action. Sometimes using any of the work would not be considered fair use. This portion of the code takes not only quantity of the material copied but quality as well, how much of the original work plus the consideration of what is needed to serve the objective use.

Lastly, the fourth provision takes into account what impact the use of the work has on the original's marketability, as well as the marketability of the derivative works. In the Sony Corporation of America v. Universal City Studios, Inc. (Supreme Court of the United States, 1984. 464 U.S. 417, 104 S. Ct. 774, 78. L. Ed2d 574), which dealt with whether the selling of VTR's to the general public constituted violation of copyright laws. The judges ruled that most use of recording of programs by the general public was because they could not view the program as it was being televised, and therefore was using the

concept of time shifting to be able to watch the program at a time that was convenient to them. Universal was unable to prove that their commercial value was decreased by this practice of time shifting. This case in fact showed that there was a market to be gained by selling or renting copyrighted material to persons who could not watch the programs during their original airing.

Here are some basic guidelines, which are based on The Conference on Fair Use (CONFU - http://www.uspto.gov/web/offices/dcom/olia/confu/index.html) Final Report and can be applied to course packs, distance learning, digitizing, and research copies.

* Limit the amount that you copy from an article, journal, or book
* Limit the number of charts, graphs, or illustrations you use
* Incorporate performances of others' work only if the institution possesses a legal copy of the work
* If it is available in a digitized form, buy it or license it. Don't ever use anything that can be purchased.
* If it not available for purchase, limit access to peer conferences and to students enrolled in a class. Take the works offline as soon as the course is finished.
* Making multiple copies and distributing them is ill advised.

There are several things that you must do when using these materials. Always include any copyright notice on the original work and appropriately give attribution to the source of the materials.

There is one other thing that you must do when you use copyrighted materials for your class. If you plan to use the materials on a regular basis you need to obtain permission from the copyright holder. My professor, Sheldon W. Halpern, at The Ohio State University Law School, stressed that "immediacy" was at issue with fair use. If you found an article and you wanted to use it for a class or conference that was to be held in the next few weeks, then it could be considered fair use. But using that same article the following term or the following year was not considered fair use. If you have time to track down the copyright holder, you need to do so.

To summarize, if the work is not yours, ask for permission. It usually isn't hard, and it usually isn't difficult. You can rationalize all that you want about what you are doing, but infringement is infringement. Be judicious in the use of materials for classes and conferences, if they are available purchase or license them. If you want to use them long term, ask for the permission to use them.

If you are interested in learning more about copyright, two books that I would highly recommend are Kenneth D. Crews book called "Copyright Essentials For Librarians and Educators", and "Internet Law and Business Handbook: A Practical Guide" by J. Diane Brinson and Mark F. Radcliffe. If you want to see the case law which has shaped this provision of our Constitution, "Copyright Cases and Materials", by Sheldon W. Halpern, David E. Shipley, and Howard B. Abrams is a wonderful tool.

SIGGRAPH 2001 Panel Session on Copyright

Beyond Copyright: The Brave New World of Digital Rights Management

Myles Losch

(Reprinted from Computer Graphics, November 2001)

Panels at past SIGGRAPH annual conferences have on occasion considered public policy issues. But 2001 was the first year that our SIG's Public Policy Program organized such a session, and it was a good one (to judge by the quality of its concluding Q. & A. exchanges with the audience). This review will survey a group of significant themes dealt with by the panel; in a future column, we hope to give readers a more detailed sampling of what took place.

On the panel were Dan Burk, law professor at the University of Minnesota and a former molecular biologist; Robert Ellis, ACM SIGGRAPH Public Policy Program Chair and panel co-organizer; Dr. Barbara Simons, immediate Past President of SIGGRAPH's parent ACM, USACM (ACM U.S. Public Policy Committee) co-chair and founder, and a retired IBM computer science researcher; Deborah Neville, a veteran intellectual property lawyer in the entertainment, software and computer industries; and Sarah Stein, long a maker of award-winning documentary films, who now teaches media studies at North Carolina State University.

Absent were representatives of such copyright-based industries as book publishing, music recording and motion pictures. This may have denied the audience some rhetorical fireworks, but more than compensated by leaving time to explore emerging and under-reported topics that rarely surface in such forums. As a result the panel amply delivered on the promise of its title, "Beyond Copyright."

(1) A key theme was that today's online copyright battles should be seen in context, as part of a much wider war for control of information technology (IT) in general and especially the Internet. Computers, particularly when networked, are a disruptive technology that challenges established centers of power in society.

By empowering new groups of people, IT puts pressure on settled arrangements (commercial, social, cultural, religious, governmental, familial, etc.) Evidence of this can be seen in policy conflicts over (e.g.) online censorship and e-commerce taxation.

Other examples, cited by panelists in part for their relevance to copyright, include open-source software and online peer-to-peer (P2P) file transfers.

Open-source code is resistant to some IT control methods ("security by obscurity"). As for P2P, research indicates that online music sampling through services like Napster led in many cases to increased sales of commercial recordings. That prompted panelists to observe that the music recording industry's battles against P2P were driven at least as much by a technology control agenda as by revenue concerns.

(2) This naturally brings us to a second key theme of the session, which was to place today's issues into historical perspective by recounting copyright's centuries-long

evolution. Early copyright laws were narrow in scope (saying nothing about [e.g.] public performance rights), nor was it clear that they covered once-new media technologies like player-piano rolls, movies, and videocassette recorders.

Copyright-based industries have long sought to expand their monopoly control over content, thus forcing legislators and judges to seek a balance with other social goals such as free expression. "Fair use" is one such balancing principle, with a long history in the U.S. and elsewhere, but is now challenged by the U.S.' Digital Millennium Copyright Act (DMCA) of 1998, and similar laws in other countries.

The compatibility of fair use with IT-based controls on access to and use of content (aka Digital Rights Management [DRM]) will be probed at ACM's annual public policy conference next April in San Francisco, CFP2002 (http://www.cfp.org).

(3) Three major current campaigns for expanded intellectual property laws were discussed in depth by the panel. One of these, already adopted in Europe, is known in the U.S. as the (proposed) Collections of Information Anti-Piracy Act, or less formally as the database protection bill. It is motivated in part by foreign publishers' displeasure with the U.S.' prohibition (unlike in the UK, Canada and elsewhere) on copyrighting government reports, statistics, etc.

But this measure's scope is much broader, and has drawn sharp criticism for extending copyright- like protection to facts and other material that, by existing standards, is not copyrightable. Opponents argue in part that the bill would exceed Congress' limited constitutional power to grant monopolies, enforced by government, over intellectual property.

(4) The second major ongoing campaign for copyright expansion, typified by the U.S.' DMCA, aims to create a new proprietary right for content owners, the access-control right. The idea of conditional access, while reasonable for extra-cost satellite and cable television services, is far more problematic when applied to pre-recorded tangible media such as DVDs for which a customer has already paid.

More generally, the DMCA's criminal penalties for bypassing access controls can, critics say, create new (and arguably unconstitutional) monopolies that are of unlimited duration, and/or cover subject matter that is neither patentable nor copyrightable. Citing the work of Stanford law professor Lawrence Lessig, members of the panel suggested that such provisions illegitimately delegate law-making power to software designers.

Panelists added that the DMCA's similar penalties for authorship and distribution of "circumvention" software are neither enforceable nor compatible with the free-expression rights of computer programmers and software publishers. (And as for the Russian programmer Sklyarov, it was suggested that given existing rules on cross-border criminal jurisdiction, he should have stayed home.)

Related concerns about researchers' freedom to investigate, publish and openly discuss their findings led ACM (http://www.acm.org), a few days earlier, to file a declaration (http://www.acm.org/usacm/copyright/felten_declaration.html) with the court handling the anti-DMCA lawsuit of Princeton computer science professor Edward Felten.

(5) The third current effort to expand the legal rights of content owners (vs. users of copyrighted works) relies on proposed extensions to contract law, which in the U.S. is mainly a state-level (rather than federal) matter. Regular readers of this column will have noted Bob Ellis' extensive coverage of UCITA, the proposed state statute drafted to achieve this goal.

To avoid duplicating Ellis' material here, it suffices to say that this initiative, too, has elicited fierce opposition from many quarters. For example, since copyright is a federal matter, legal scholars have questioned the extent to which state laws can validly curtail what users may do with copyrighted works they have purchased.

(6) Lest it seem that the panel session focused wholly on legal issues, one should note that time was also devoted to economic, social, educational and other implications of the policy questions discussed. One example arose in considering the economic impacts of DRM, such as the prospect of a pay-per-use model for content access (sought by many copyright holders). This, it was pointed out, would effect a transfer of 'consumer surplus' from the public to content owners: the used book and phonorecord markets (for example) would shrink, since people could no longer freely lend, give, sell, or bequeath unwanted works.

An interesting, related mini-debate among panelists concerned the pragmatic pros and cons (for individual consumers) of owning vs. 'renting' books, movies, etc. One policy question this raises is whether publishers should be obliged to offer a choice of methods (including conventional ownership) by which customers may obtain a work. Similar issues are of course familiar from other contexts, as when IBM, nearly half a century ago, had (for antitrust reasons) to begin offering its computing equipment for sale in the U.S., as well as under lease or rental agreements.

(7) A final economic theme worthy of mention arose from the panelists' consensus view that the DMCA and related measures, insofar as they aim to protect media companies' traditional revenue sources against erosion by disruptive technologies, will ultimately fail (whether for marketing, legal, technical, and/or other reasons). Such scenarios unavoidably present the question of how performing artists, authors, composers, et al. will be compensated in the future.

On this issue the panel was (like others which this writer has heard) notably optimistic that innovative business models will be proven by the time they become necessary. But such views are not yet widely accepted in the entertainment and allied industries, so at future SIGGRAPH conferences it might be worthwhile to examine more closely a broader range of policy options.

One such (partial) answer to the compensation question, today more widely accepted in Europe than in the U.S., entails special taxes on recordable information storage media and/or on equipment used in conjunction with those media (e.g. drives, optical scanners, etc.).

Revenue from such taxes is then parceled out by some formula among copyright holders et al., to offset royalties that presumably are "lost" due to personal in-home copying of such holders' works. There are many valid objections to systems of this sort, including that they unfairly penalize both home video and audio recording enthusiasts (who hold

the copyrights on their recordings), and also fair users, whose copies of commercial works are by definition non- infringing.

Still, this reviewer would welcome a follow-on event that might include (say) first-hand experiences with such alternatives; with the EFF's (http://www.eff.org) Open Audio License (OAL), and/or other innovations.

(8) Another feature of the panel (noted with some regret at the outset by organizer Ellis) was its U.S.-centric makeup. As the session unfolded, though, this was largely offset by evidence of the U.S.' frequent policy leadership in the subjects under discussion (no doubt due largely to the U.S. media industries' huge revenues from overseas markets). Further helping to internationalize the session was the diversity of its audience, including multiple non-U.S. questioners during the generous Q. & A. time period set aside for interaction with the panelists.

Lessig on Copyright

Myles Losch

(Reprinted from Computer Graphics, February 2002)

Stanford computer-law professor Lawrence Lessig has until recent years been best known for work outside the intellectual property field. But of late his attention has increasingly turned to problems of copyright in cyberspace, which (due to its significance for digital imagery) has also been a continuing theme of this column.

In October 2000 he launched what is evolving into an annual autumn event: a series of public debates on digital copyright against Jack Valenti, who for 35 years has been the U.S. motion picture studios' chief lobbyist. The first such debate was at Harvard Law School (where Lessig formerly taught; see http://cyber.law.harvard.edu).

The Annenberg School for Communication at the University of Southern California hosted the second debate, in November 2001 (see http://ascweb.usc.edu), which this observer was fortunately able to attend. It was, as noted below in more detail, a spirited and informative exchange between formidable advocates, on an important subject that has drawn growing public attention.

Enhancing the timeliness of last November's debate was a series of judicial and legislative events that autumn, related to digital copyright. In the U.S. Senate, pressure from the computer industry had derailed efforts (by Valenti and his allies) to force architectural constraints on computers and software, the better to protect against copyright infringement. This initiative was accurately described (by Harvard professor Jean Camp et al.) as the "Turing Machine Prohibition Act," and European analysts warned that it could yet re-surface in the EU or elsewhere.

On the judicial front, several decisions emerged from U.S. lawsuits over the limits of digital copyright. Although far from unanimous, the courts more often than not sided with copyright holders against the free-expression rights of software authors, publishers, researchers, etc.

Because these decisions are appealable (and most if not all of them seemed certain to be appealed), their ultimate significance was unclear. But as this column noted in August 2001, governmental claims of power to control the writing and publishing of software are very broad, extending far beyond copyright issues. Thus all authors of software would be wise to follow closely the further stages of this litigation.

During the USC debate, Valenti often proved himself an unyielding proponent of his industry's economic interests. For example, the duration of copyrights (which Lessig is litigating to shorten) was a major point of contention, and Valenti's preference that copyrights never expire was clear, notwithstanding an explicit prohibition on this in the U.S. constitution (Art. I, Sect. 8).

Lessig, on this and other points, appealed (as do many conservative jurists) to the "original intent" of the constitution's framers as a guide to interpreting that document. But Valenti (a professional publicist and non-lawyer) assailed 'originalism,' as judicial liberals often have.

One of the debate's more entertaining episodes addressed the videocassette recorder, which Lessig saw as a model for technologies that influence copyright policy. He quoted Valenti's decades-ago congressional testimony, analogizing home VCRs to the Boston Strangler, and noted that Valenti's industry now relies on VCR tapes for a significant part of its revenue.

Valenti replied that when the U.S. Supreme Court legalized such machines, it considered their use only for time shifting of broadcast (not cable TV) programs, which would be erased after viewing. He added that infringing VCR tapes cost his industry billions of U.S. dollars annually.

Prof. Lessig's new book is "The Future of Ideas" (published 2001 by Random House; ISBN 0-375-50578-5). Readers are encouraged to seek out examples of Lessig's and Valenti's writings, speeches, etc. for further guidance.

THE PROPOSED FLORIDA TECH STORED COURSE POLICY

Cem Kaner

(Reprinted from Computer Graphics, May 2002)

The October 8, 2001 draft of the "Proposed Policy for Stored Course Materials" (below) is a proposal. Florida Tech has not yet officially adopted this, and adoption will probably come with a few amendments. I predict that the underlying decisions reflected in the document will be preserved in the final document.

I was the main author of the proposal, and much of my role in the university's Intellectual Property Committee was to surface the issues that could or should be of concern to different stakeholders. As we came to understand the different perspectives on the issues, we looked for ways to satisfy everyone, or at least, for ways to avoid unfairly disadvantaging anyone. The policy reflects a lot of tradeoffs. As the senior author, I have a bias--I think we did a good job, and I'm proud of this result. But you might prefer different tradeoffs, and there are a lot of other tradeoff solutions that look very different from this, that I think yield essentially the same net levels of benefit for everyone. The

solution is non-unique. The awareness of the issues and the willingness to look for mutually agreeable solutions is more important than the specific details of the tradeoffs in this proposal.

Here is a summary of some of the issues. If you want more discussion, I can send you a sanitized (of Florida Tech confidential information) discussion memo that I wrote to outline the contributions, benefits and risks from different stakeholders' viewpoints. I think that most readers would find that memo tedious, but if you want it, send me an email at kaner@kaner.com.

A "stored course" is a course that is taped or stored in some other way. It is available for presentation to students in the absence of the instructor who created the course. Such courses are typically offered today as "distance learning" courses, but once the course is on tape (on the web, on whatever), it might be used anywhere by anyone.

The "course" might be used in entirety or in fragments. We don't just store courses. We store individual lectures, or parts of lectures. People might want to reuse any subset of what is stored. In the notes below, when I talk about "stored course materials," I might mean a full semester course or a five-minute clip. The essence of the idea is teaching related intellectual property that was created to be reusable by someone other than the original creator.

A Preliminary Question--Faculty Rights

Should the university own the instructional material prepared by a faculty member? I think the answer most obvious to people who create intellectual property for private employers is that the university should own the instructional material because the faculty member is an employee, the university is the employer, and employers always own the employment-based work products of employees.

This is a bad answer for several reasons, including:

Academic Freedom. If the university owns what you write, it can tell you what to write or what not to write. Even if it doesn't treat you in this ham fisted way, a university that owns your work can still hire someone to revise your material without your consent. Additionally, a university that owns your work can insist that you publish it in the most profitable place. Rather than distributing your material for free on your Website, or putting it in a prestigious but pay-nothing journal, you might be pressured to place your works where the university (maybe with a share for you) can get income from them.

Traditional Agreement. Even though universities have asserted rights to patentable inventions for a long time, they have left books, course notes, and other copyrightable material well enough alone. We faculty don't make the bajillion-dollar salaries that we might expect from private employers. (Speaking as someone who became a professor at the peak of a consulting career, the university pays me between ½ and ¼ of what I would reasonably expect to make as a consultant.) On the other hand, we get to publish what we want, where we want, under whatever contracts we want, so long as that doesn't interfere with our other professorial duties. We get to keep the royalties from our publication, and these can make a significant contribution to our income. Changing the rules that have traditionally governed the treatment of our primary

work products fundamentally changes the nature of our employment

Legal History. I haven't found any recent cases, but old ones placed ownership of course materials and books with the professor (largely out of respect for the longstanding social policies in the United States that favor academic freedom).

I am aware of some universities that don't find arguments like these persuasive, and they assert rights to courses and writings. Happily, I didn't have to deal with that issue at Florida Tech. When I decided to look for a professorship, I also decided to treat the university's intellectual property policies as a gating factor in my employment decision. Florida Tech's Faculty Handbook makes it clear that faculty own all rights to their copyrightable materials, and therefore a possible rights grab by the university was simply not a factor that I had to contend with.

Next Question--University Rights

Should the faculty member own the instructional material created for a stored course? Maybe your first answer is, "of course." But what if the university staff hires a camera crew to tape the course, edit the tapes, pays for stock footage the faculty member wants to use to [enhance] basic lecture shots and spends a lot of other money so the professor can get the course "just so."

What rights should the university have against the professor who licenses other schools to teach from the course tape? The professor makes money, but the university doesn't. After this level of investment by the school, is that appropriate?

What incentive does the university have to invest in making the course excellent? It costs money to simply tape and package a talking head. It costs a lot more to make it more interesting. And more again to retape as needed to keep the course up to date. Distance learning courses aren't showing big profits yet. How can the university afford quality?

Setting a Threshold--Substantial Use

Let's start from the premise that the faculty member should own all rights to "typical" course materials. The university pays her to create and teach from these materials but it asserts no rights to them. So, she owns her lecture notes, her transparencies or slides, the exams and assignments she creates, and any other intellectual property that she creates for the course.

If the university makes a big enough investment, way beyond what it would normally pay to support the course -- we decided that at some level of investment, it should gain some rights in the course. Ultimately, we called this idea, "substantial use." ("We" means several of the individuals who make up the Intellectual Property Committee at Florida Tech. I cannot speak in any official way for the committee, but I also can't take primary credit for developing this idea.) When a faculty member creates stored course materials:

If she did not make "substantial use" of university facilities to create them, she owns the rights to them, just like a book or a journal article.

If she did make substantial use of university facilities, she and the university become joint owners of the resulting intellectual property.

The proposed policy narrows the definition of substantial use by listing several examples of things that do not count toward substantial use. For example, if you use money from a research grant to pay for the materials, that counts as your investment, not the university's. (You got the grant--you get the credit.)

Howdy, Pardner

Suppose the university does invest a substantial amount into your course, with your approval. It now has some rights in your course. How should we define those rights? In a simple situation of co-owned materials, either of the partners could license the material to others, use the material as they want, or revise the materials as they see fit. The policy proposal in front of you starts with restrictions on the rights of both sides. The expectation is that if the professor or the university wants to commercially exploit the course, they should negotiate an agreement. The baseline rules (the ones that apply if no further contract is signed) lay out some minimum rights and responsibilities, just enough to

allow the university to make very basic reuse of the stored course material for a finite period of time, and to

enable the professor to protect the intellectual integrity of his work.

The policy proposal says little about money. If you or the university wants to make extra money from the course materials, make a contract. The policy suggests some terms for that contract, some starting points for negotiation.

Summary

The ultimate effects of the policy should be these:

Faculty will retain editorial and artistic control over their work.

Faculty can develop reusable course materials, within the course of their employment, using facilities at the university, without giving the university any rights to the materials, so long as they don't make "substantial use" of the facilities.

If there is substantial use, the university gains the right to build courses around the materials, without having the authoring professor teach the courses. However, without a contract or other permission from the professor, it can't use those materials for very long.

In most cases, if either party (university or professor) wants to commercially exploit the course it will have to make a reasonable deal with the other.

Proposed Policy for Stored Course Materials
Revision October 8, 2001
DRAFT

INTRODUCTION

The current Florida Tech Intellectual Property Policy as contained in the Faculty Handbook focuses on traditional Copyright and Patent issues. This policy is to create a balance between the goals of creating and disseminating knowledge while deriving revenue from commercially viable inventions. Through this policy faculty, staff, or employed students retain ownership of copyright material while they are required to disclose to the standing committee on Intellectual Property all creations or inventions that have patent potential. The committee reviews each circumstance and recommends a course of action, be it to seek a patent, return the rights to the creator, or some other appropriate process.

The policy also contains a provision where the institution and the creator of copyright material can create a contract for the investment of resources, the control over the product, and the associated rights. As educational material is now frequently created, stored, and reused in a digital format it is necessary to establish procedures to govern this stored course material.

STORED COURSE MATERIAL:

In the digital world, the products of intellectual property create new forms of value and have an extended life that make them commercially viable. These products are changing the format, content and economics of educational delivery. This extension to the Intellectual Property Policy sets out some basic principles for stored course materials that will mutually benefit the creators and the institution. This extension to the Intellectual Property policy does not address patent or trademark rights and it is not intended to apply to traditional printed materials such as books and lecture notes.

A primary concern of this policy is to promote the broadest possible creation and dissemination of knowledge while protecting academic freedom.

With the university's encouragement and support, faculty members are creating course materials that can be reused in later courses. Digitally encapsulated course segments range from simple inexpensive productions to major investments:

. If the stored course material is created by full time faculty in the context of the normal duties and does not involve the substantial use of Florida Tech resources, the ownership of the intellectual property products remain with the creator.

If a substantial use of Florida Tech Facilities is involved in the creation of the product the institution and the faculty member should plan together to enable the institution to recover its investment over time. A separate contract must be developed at the start of the project to cover the concerns and interests of the creator(s) and the institution. This will involve intellectual property rights as well as such matters as initial investments, protections, editorial control, marketing, royalties, extended use, and

eventual disposition.

This policy defines substantial use. Substantial use is a threshold for the investment of institutional resources that require additional planning and preparations to insure the recovery of this investment over some period of time. If use is substantial, the university is acting with the faculty member as a partner in the development of stored materials and will have rights to those materials.

DEFINING SUBSTANTIAL USE

A faculty member makes substantial use of university facilities or funds if the use significantly exceeds the normal and customary level needed to support the teaching responsibilities. The department chair, under the supervision of the dean will determine whether the development of a stored course or stored segment made substantial use of university facilities. The input of service providers whose services were used or are planned to be used is relevant to this determination. Factors to be considered in the determination include the following, and others not listed here:

It does not count toward substantial use, for a faculty member to use an online presentation system like the Blackboard that is offered to all faculty members for normal use in their courses.

The fact that a course will be stored and offered later or offered remotely by the university does not affect a determination of substantial use.

Use of any materials or services that are paid for out of an external grant to the faculty member does not count toward substantial use.

Use of the university's Technology Enhanced Content (TEC) facilities is not substantial use if it is intended to provide the faculty member with basic training in multimedia course development.

Use of the university's TEC facilities is not counted toward substantial use if the faculty member reimburses the university at the university's then-current rate for use of the lab.

Unreimbursed use of the university's TEC facilities is presumed to be substantial if the TEC facilities staff say that, in their opinion, it will be substantial or that further effort would make a use substantial.

Use of the library is not normally substantial, but extensive use of the library staff as research assistants could contribute toward a determination of substantial use.

Use of the faculty member's regular time at school DOES NOT count toward substantial use if the faculty member is developing and teaching this course or a live equivalent as part of her normal teaching responsibilities and without a compensatory reduction in teaching load or significant additional teaching or support staff to support this course. A determination that a use of university facilities is or is not "substantial" is not a determination that a proposed use is reasonable or within the capacity of the university's service providers. Service providers (such as the library or the TEC facilities)

have limited bandwidth. Whether or not a use is deemed "substantial" under this definition, the service provider may advise a faculty member that a proposed use is significant, that it must be approved by the department chair or dean, that extra funding will be required to provide the level of service requested, or that the service cannot be provided in the time frame requested.

NOTE: The TEC facilities are currently (2001) those facilities provided to develop technology-enhanced content by Florida Tech Information Technology and these currently include a multimedia studio, a training center, a camera crew and related services. However, this is an expanding role in terms of services and service providers. TEC is subject to competing demands for limited resources and is required to maximize the use of institutional resources in achieving Florida Tech's educational and research goals.

WHEN THERE IS NO SUBSTANTIAL USE

If a faculty member does not make substantial use of university facilities in the development of copyrightable course materials, the copyright to those materials will belong to the faculty member, not to the university. The university may not make use of these materials in other courses without permission of the faculty member. The faculty member has the same rights to use these materials in other courses or at other schools, as he or she would have if they were written lecture notes.

WHEN THERE IS SUBSTANTIAL USE

If a faculty member does make substantial use of university facilities in the development of copyrightable course materials, the university will have rights to those materials. The faculty member and the university should enter into a contract at the start of the project, before development of any materials.

If there is no written contract between the faculty member and the university, a contract will be implied and it will include the following terms:

The faculty member will own the copyright to the materials, but the university will have a license to use the materials.

The University may use the materials in courses not taught by the faculty member for one year after the end of the first course that uses the materials, even if the faculty member leaves the university before this year has ended. The university may continue to use the materials indefinitely if the faculty member does not instruct the university to stop using the materials.

The faculty member will have artistic and editorial control over the materials, subject to constraints that the university may impose on the nature and level of its investment.

The faculty member may revise the materials. Normally, the university will make reasonable efforts to work with the faculty member to revise the materials in a reasonable time. However, the university shall accelerate its efforts if the faculty member believes, in good faith that continued use of some segment(s) would damage her or his

reputation or expose the university or the faculty member to a successful lawsuit. In either of these cases, the university shall make its best efforts to work with the faculty member to promptly revise the materials in a way that is satisfactory to the instructor.

The faculty member will deposit a copy of the materials with the university library, which will hold them as non-circulating reference materials for local use only. They may not be loaned out on interlibrary loan.

In the event of a lawsuit, the same rules for liability allocation apply to stored course materials as to live materials. However, (a) If one of the parties (the university or the faculty member) uses the materials without revision, after being advised of a legal risk by the other, the using party assumes all risk, indemnifies and holds the other party harmless, from all legal claims arising out of the matters warned about by the other party. (b) A party sub-licenses at its own risk. For example, if the university subs licenses materials to a third party, then as between the faculty member and the university, it is the university that takes on the risk of any liability that arises out of or in connection with the third party's use of the materials. (c) If one of the parties uses the materials outside of their geographic scope, that party assumes all risk, indemnifies and holds the other party harmless, from all legal claims arising out of differences in legal rules in the out-of-scope geographic area. (The normal geographic scope is the country in which the faculty member teaches for the university. For example, if the university is based in the United States, then Canada is outside the geographic scope.)

A typical contract will include additional terms, for example:

The University will normally be granted a longer term, at least two years after the end of the first course that uses the materials, during which it can use the materials.

In the absence of a contract, the university will not owe the faculty member a royalty or fee for using the materials in courses not taught by the faculty member. The contract may specify such a royalty or fee.

The university will normally be granted a right to sublicense the materials to other institutions, and the contract will specify the maximum term of the sublicense that the university may grant. In the absence of a contract, the university may not sublicense the materials.

If the university sublicenses the course materials, the license fee will normally be divided equally between the university, the faculty member's department, and the faculty member.

The faculty member may be granted a right to sublicense the materials to other institutions. The contract will specify the maximum term of the sublicense that the faculty member may grant, and the royalty or fee due the university. In the absence of a contract, the faculty member may not sublicense the materials.

The faculty member may be granted the right to market and use these course materials in courses presented independently of the university. If so, it will specify the royalty or fee due the university for such presentations. In the absence of a contract term, the faculty member many not market or use these materials outside of the

university without permission of the university.

The university may be granted the right to modify the course materials. In the absence of a contract term, modifications may not be made without the approval of the faculty member.

Digital Copy Protection

Robert Ellis
April 2001
Revised March 2002

This is a collection of articles that have appeared in the SIGGRAPH quarterly, Computer Graphics. The first article provides an overview of the topic. The second article is a review of a special section of the Communications of the ACM (CACM) on digital watermarking, which is a technique that may be used to provide copy protection. The third article reviews the situation with special focus on music, which many see as a precursor to issues associated with motion pictures. A section on recent developments covers material for which no reprints exist.

Digital Copy Protection
Bob Ellis

(Reprinted from Computer Graphics, August 1998)

I've recently become aware of digital copy protection as an issue with impact on non-commercial digital recording. It was mentioned several times by attendees (there wasn't anything on the program) at the CFP98 Conference (reviewed in my last column). Member Myles Losch also brought it to my attention. I thought it might be an issue of interest to SIGGRAPH members. One comment made by a CFP attendee suggested that DAT devices have not been good sellers because the copy protection mechanisms limit their potential usefulness

Myles provided me with two useful references. The first discusses digital video standards to control intellectual property on DVD's and IEEE 1394 FireWire broadband links. Please see the DVD FAQ at http://www.videodiscovery.com/vdyweb/dvd (this discussion refers to the April 7, 1998 version that will probably have been revised when you read this). Myles says to note especially items 1.10 and 1.11, plus 2.10 on DiVX triple-DES cryptography and to also note items 1.12 and 3.6 on related audio work.

The second reference is at www.hrrc.org, a web site run by the Home Recording Rights Coalition. The HRRC provides information about legislation that addresses copy protection on recording devices. The HRRC was founded in 1981 at the time of actions relating to the legality of using a VCR to "time shift" broadcast television programs. It is frequently updated so I won't refer to specific items.

The advent of digital recording devices such as Digital Audio Tape (DAT) and Digital Video/Versatile Disc (DVD) has caused the owners of recorded intellectual property such as motion pictures and music to renew their concerns about unauthorized copying.

Many you may remember the similar issue rose when analog audiotape recorders and VCRs first became available. Digital recording devices are an even greater problem for them because of the ability to make perfect copies, without the loss in quality when making analog copies.

Typically, technical mechanisms are developed in industry standards committees to prevent copying and then legislation is proposed which would make it a crime to provide mechanisms to circumvent copying, rather than the actual act of copying. The problem comes when an authorized copy is to be made (for example, of material whose intellectual property rights are owned by the copier or copies made under fair use). If you make copies for a living, then you have an incentive to go through the hoops to effect the copy protection.

But if you are simply making a copy of your home movies, or results illustrating your computer graphics research, it might not be so easy. While many of the organizations do not want to prevent this type of copying, it is not their first priority.

Aspects of international treaties complicate all of this. Treaties in effect and proposed at the World Intellectual Property Organization may be much stricter in their interpretation of unauthorized copying than we are used to under current US law which has strong protections for fair use copying.

Note particularly, that some proposed legislation in the US prohibits the sale, manufacturing or use of any device that can be used to defeat copy protection. (This legislation has been passed as the Digital Millennium Copyright Act.) Current laws are directed at the actual act of unauthorized copying. Due to the rapidly changing situation, it's really not feasible to go into the legislative process in any greater detail here. I urge you to look at the references (particularly the HRRC site) and their links for the latest information.

USACM has been involved in this mostly as it relates to their stands on intellectual property and implementation of the international intellectual property treaties.

The DVD FAQ site has excellent descriptions of DVD technology in general. Section 1.11 describes four forms of copy protection used by DVD. Any or all of the schemes may be present on any particular DVD media.

The Analog Copy Protection System by Macrovision adds colorburst signals and pulses in the vertical blanking signal to prevent copying using composite video and s-video outputs. The copy generation management system (CGMS) embeds information in outgoing video signals. The content scrambling system (CSS) and Digital copy protection system CPS) both use encryption to prevent unauthorized copying.

Section 1.10 describes "regional codes", which can be used by content originators to control which parts of the world a DVD may be played. This means that a DVD purchased in one country might not be playable in another.

Section 2.10 presents a description of DiVX proposed by Circuit City. DiVX would permit the purchase of a DVD at a cost just above a one-time rental and then play it once (perhaps with a time limit). Additional plays might require payment of additional fees. To

effect the payment of additional fees and authorizations, a telephone connection to the player would be required. (DiVX proved to be unsuccessful and was withdrawn from the market.)

Like the legal situation, the technical situation is constantly changing, although not so rapidly. Still, it's not reasonable to go into greater detail here; again, I urge you to check the reference for current information.

Digital Watermarking
Bob Ellis

(Reprinted from Computer Graphics, February 1999)

Digital watermarking is the subject of a highly recommended (by me) special section of the July 1998 issue of the *Communications of the ACM (CACM).* Quoting from the Guest Editor's (Minerva M. Yeung) introductory article we see that "Digital watermarking is the embedding of unobtrusive marks or labels that can be represented in bits in digital content. The embedded marks are generally invisible (or imperceptible) but can be detected or extracted through computing operations and is why they are called "digital watermarks". The watermarks are bound to and hidden in the source data, becoming inseparable from the data (such as images and audio and video clips) so they can survive operations that do not degrade the data beyond its utility value in the intended applications."

"Data encryption and scrambling technology offer security for content delivery, as well as the means for controlling access and collecting revenues. But a key (in the cryptographic sense) to decoding or descrambling the encrypted or scrambled data will be available only to the content's (paying) patrons... Unfortunately, there is little, if any, protection for decrypted or descrambled content..." Thus digital watermarking is complimentary to encryption because it can protect non-encrypted material.

"Watermarks can also be used to communicate copyright, ownership, and usage-control information - even after format conversions and compression. Watermarking technology, if designed properly, can be used for proof of ownership, as a content authentication tool, and as a means of imprinting fingerprints into the data to allow tracing of the recipient should the data be misappropriated."

Individual papers in the issue cover topics such as: techniques, applications, needs of the content owner, content user, and attacker, benchmarking, performance evaluation, standardization opportunities, the business case, and market perspectives. While I believe that the technology is not yet fully developed, it shows significant promise, and all who are concerned about the identification and protection of digital media should follow its progress.

In an ideal juxtaposition of topics, the July 1998 issue of *CACM* also has a special section on Web Information Systems. Although perhaps not as much of interest to computer graphics professionals as digital watermarking, it does provide a timely overview of the subject in a series of short articles. Again, I highly recommend it.

Digital Copy Protection
Myles Losch

(Reprinted from Computer Graphics, August 2000)

Digital Copy Protection

Legal and policy disputes over protection of copyrighted works continue to slow the growth of digital television services, an important potential market for computer-generated imagery. Our last column noted a sharp increase in copyright lawsuits by music and movie suppliers, and this trend continues.

Many of the issues are the same for music as for visual content, and seem likely to be addressed sooner for audio, as we explain below. Graphics specialists would thus do well to follow closely the current "music wars."

Contributing to music's importance as a policy trendsetter are several factors:

1) Compressed audio can be transmitted and stored (at acceptable quality) using far fewer bits than video of equal duration.

2) Most popular music consists of brief songs, much shorter than typical video and filmed entertainment. This further reduces the technical difficulty and cost of handling such audio content.

3) A typical consumer's in-home access to the Internet will, for some years to come, be through relatively slow dial-up phone modems. Thus, online transmission is today more attractive (in general) for music than for visual entertainment.

One technically interesting byproduct of the litigation noted above, is a new generation of 'serverless' software for Internet distribution of audiovisual and other content. These decentralized systems (e.g. Gnutella) seem designed to present few attractive targets for potential copyright lawsuits.

But given the widespread infringement attributed to such products, the effectiveness of this strategy remains to be seen. And as for the ongoing court cases, few have yet produced clear policy results.

One possibly relevant exception, though from cases unrelated to copyrights or other intellectual property, is the view of a growing number of U.S. federal appeals judges that computer software is a form of free expression entitled to strong constitutional protection. If upheld in future decisions, this result could impede attempts to suppress controversial programs, or to mandate the features of software (especially freeware).

For more policy materials on digital copy protection (particularly of music, but also relevant to visual works), readers may find these online analyses helpful:

a) (From an Internet news service) http://news.cnet.com/news/0-1005-201-1757865-0.html

b) (From Newsweek magazine) http://www.msnbc.com/news/413376.asp

c) (By Harvard law professor William "Terry" Fisher) http://www.law.harvard.edu/Academic_Affairs/coursepages/tfisher/Music.html

Recent Developments

Proposals for more types of protection continue to surface. Some recent examples follow.

New initiatives continue to be developed and promoted. The Secure Digital Music Initiative (SDMI) under development by contractors to the recording industry would provide copy protection to a wide range of consumer music devices. SDMI uses a watermarking technique which records a signal over the music content that is supposed to be imperceptible to human listeners but would be detectable by electronics and prevent copying of material so marked. A recent challenge to break SDMI has resulted in claims and counterclaims. Several research groups have claimed to break the technology, but SDMI supporters are not willing to agree that the copies have not been altered to human hearing. The departure of the effort's Executive Director in January 2001 has lead some observers to suggest that the initiative has failed, but not all agree.

The Content Protection for Recordable Media (CPRM) development includes computer, storage and peripheral manufacturers and would place copying from and to **any** recordable media under the control of copyright holders. This technology, currently in development by committee, would make it possible for software, music and video publishers to prevent any copying whatsoever internally or externally to the user's computer. It would require a Globally Unique Identifier (GUID) to be encoded on all protected devices and would not permit content to be copied to any device with a GUID different from the one registered by the customer.

Recently U.S. Senator Hollings proposed the Consumer Broadband and Digital Television Promotion Act (CBDTPA) that used to be the Security Systems Standards and Certification Act (SSSCA). The act would require that **all** digital electronic devices have systems that would restrict copying. Hearings on the earlier bill pitted the movie and recording industries against the computer and consumer electronic industries. While the current proposal is unlikely to become law in the near future, readers should be aware that this bill, or ones similar to it, will undoubtedly surface pretty continuously in the future. See the references for additional information.

Another recent development is the arrival of copy-protected music compact discs. Copy protection is accomplished by intentionally violating the “Red Book” standard for CD-Audio that makes them unplayable on many computers and even some CD players. Phillips, which owns the copyright for the standard has threatened to prohibit the display of the CD-Audio logo on copy-protected discs and/or require warning labels. The recording industry has not perceived this as much of a threat. It remains to be seen what effect this will have on their popularity, which was established before the discs were copy-protected.

Yet another proposal, this time for digital television, would introduce a “broadcast flag”. This mechanism would permit digital recordings of DTV shows but would prevent playback on all devices except those associated with the ones that made the original recording. This would, for example, prevent a consumer from taking a digitally time-shifted recording of a television show over to someone else’s house for playback. One reason for this capability is said to be to “keep free DTV shows off the Internet”. Of course this could also inhibit the purchase of such equipment.

This is being written in March 2002. By the time you read this there may well be even more proposals. If this is an area of concern I recommend that you pay close attention to reports of technologically oriented public policy developments. Good places to look include the popular press, trade press and Internet.

Convergence of Computing and Television

Myles Losch
Robert Ellis
April 2001
Revised March 2002

Convergence of Computing and Television: Food for Thought

Myles Losch

"... People will be canceling their Internet accounts because they can get most of what they want on interactive TV…"

Mark Snowden, Gartner Group senior research analyst for Internet and new-media businesses (quoted in "Daily Variety" for April 20, 2001 - page A2):

In this part of the course, we examine the idea that computing and television are on converging paths. But our opening quote reminds us that some (e.g. in the entertainment industry) don't see open platforms and networks (as in the PC and Internet models) meeting the needs of their audience.

Although the 'Net may be (as a U.S. court noted) "the most participatory form of mass speech yet developed," others see it and the PC as the Wild West, full of disturbing content, buggy and crash prone, user-hostile, beset by email spam, copyright "piracy" and computer viruses, and ill-suited to deliver a consistent, high-quality in-home experience, be it for shopping, entertainment, education, etc.

To such observers, open platforms and networks may ease development and testing of new mass market services and concepts, but will not (and should not) achieve the near-ubiquity of the telephone, refrigerator, radio broadcast receiver, and similar home appliances. Instead, such people look for a carefully controlled introduction of computing technology into traditional product categories, yielding "smart," more functional, and easier-to-use devices.

Let's keep that school of thought in mind as we begin a brief survey of computing-TV convergence.

Visions of Convergence

The uses of television technology are very diverse, e.g. as a scientific and engineering research tool, mass media entertainment, industrial monitoring, security surveillance, theatrical motion picture production, medical diagnosis and therapy, business and personal communication, education, etc. For each application area, much could be said about the convergence of video and computing technologies, but in this brief course, we

focus mainly on entertainment TV (whether viewed at home or elsewhere), because:

1) It is of professional and/or personal interest to most S2001 attendees, and

2) As a potent mass medium, its development interacts with many facets of public policy.

Within the realm of video entertainment, we again find many applications and usage scenarios, e.g. video gaming, on-demand viewing of user-chosen films from a library, portable and mobile uses (e.g. with displays built into airliner seatbacks), and in-home networking (with, e.g., video recording and broadband access devices shared among TVs, PCs, local wireless displays, etc.).

A key element in most of these examples is the freedom to transparently use a single display for any purpose, from bill paying to movie viewing, and in any location. This has posed a technical challenge because traditional TV images and displays are not only analog, but vary in their technical standards from country to country, while computer monitors, too, diverge in their resolution and other specifications.

Moreover, there have historically (and in part for good reasons) been key differences between computer and TV displays as such, with the former using square pixels and a progressive (sequential) scan to 'paint' CRT screens, while the latter used non-square (rectangular) pixels and an interlaced scan of the video raster.

Motives for Convergence

As we just saw, the technological obstacles to achieving "universal" consumer displays have been substantial -- but so too have been the incentives to pursue that vision. For example:

1) Cost: Since the 1950s, engineering and manufacturing advances have sharply cut the cost (and raised the quality and service life) of home television picture tubes. Since the 1980s, home PC displays have followed a similar trajectory. But in response to these trends, U.S. consumers have increasingly purchased large and costly 'home theater' displays, for a more immersive TV viewing experience.

Likewise, PC buyers have acquired growing numbers of portable computers that use costly liquid crystal flat-panel displays. Thus customers, instead of simply 'riding the CRT cost curve' downward (and pocketing the resultant savings), have often "traded up." That in turn boosts the economic incentives for industry to work toward all-purpose or 'universal' electronic displays, which let customers realize greater value from their investments in display hardware.

Nor are displays the only costly item driving convergence. Upgrading the world's telecom networks to support 'last-mile' broadband access from homes and small businesses is hugely expensive. By allowing these networks to carry multiple service types concurrently to a household (e.g. entertainment, telework, distance learning, etc.), more revenue streams can be generated to recover network upgrade costs faster, thus speeding the broadband rollout. Contrast this scenario with the historic single-service telephone and cable TV networks.

2) Physical Space: In densely populated Europe and Japan, household living quarters are

often far more space-constrained than in North America. Thus even if cost were not a factor, the space saving benefits of 'universal' displays would give convergence a further, powerful appeal.

3) Energy Efficiency: Even if display cost and size did not weigh in favor of convergence, operating cost would. And given global resource, logistical and environmental concerns (including climate change), economizing on power consumption is yet another goal that favors versatile displays.

4) Visual Realism: Turning from economic to functional considerations, the history of electronic displays (for both TV entertainment and home computing) has been marked by a continuing quest for more vivid, detailed, and indeed photorealistic imagery. Apple Computer's new OS user interface well illustrates this trend on the computing side, as does HDTV for entertainment (with its crisp, wide-screen picture format).

Nor is this a recent departure. The evolution of computer displays from text-only monochrome to bit mapping and color, and TV's move from black-and-white to color (and perhaps someday to stereoscopic 3-D) parallel earlier changes in theatrical motion picture exhibition. Corresponding audio improvements are omitted here for brevity's sake.

As the technical challenges mount to achieve successive quality upgrades, and as the perceived results converge, it makes ever more sense to avoid 'reinventing the wheel' by sharing technologies and standards between the worlds of TV and computing.

5) User Control: The vast field of human factors engineering, and in particular user-interface design for electronic systems and services, has shifted decisively toward software-based models (that exploit visual displays) over recent decades. Commercial document-copying machines are a noteworthy example.

This is equally true for home entertainment products like TVs and VCRs, for the banking industry's automated tellers, for some motor vehicles, and for sophisticated public telephones. By moving from physical to virtual pushbuttons, control knobs, slide switches, etc., and by making other systemic changes (e.g. VCRs that self-set their internal clocks from a time signal), ever more intricate features may be managed by ordinary users while manufacturing costs are kept in check.

In consequence, growing amounts of computer technology are becoming embedded in devices that in other respects differ greatly from "computers." And while these are far from being "open platforms," they can allow for meaningful personalization while remaining immune to "malware" and other perceived drawbacks of general purpose PCs. Here, then, is still another front along which TV-computing convergence is advancing.

Roots of Convergence

1) Japan's Analog HDTV: We previously noted the technical evolution of home entertainment television, which began in the 1930s with monochrome BBC broadcasts at barely 400 lines of resolution, to the modern (1960s) European 625-line color signal formats (vs. the U.S.' older 525 line NTSC standard).

But as the underlying technologies continued to mature, it became clear that still further advances in image realism were within reach. Thus Japan's public TV network NHK three

decades ago launched its HDTV development project. By the early 1980s this had yielded thousand-line TVs, cameras, and other studio equipment, which was widely demonstrated to appreciative audiences.

Then in mid-decade "Japan, Inc." sought global standardization for its system, but European governments balked for protectionist reasons. As with aircraft (e.g. Concorde and Airbus), Europe considered it vital to retain a large internal manufacturing base for consumer electronics, and to avoid the fate of the U.S., whose once-healthy TV makers had, thanks to Japan's success in that field, been either bought by foreigners or forced out of business.

So Europe tried to hastily develop its own (incompatible) HDTV system, and in the previously complacent U.S., FCC officials in self-defense launched a search for alternative technology with which to block potential foreign domination of the (assumed) future U.S. HDTV market. Then to everyone's surprise, the FCC effort by the early 1990s yielded an engineering breakthrough: proof that a fully-digital HDTV system was not only possible, but could offer cost and versatility benefits over previous (analog) TV systems of equivalent resolution.

The FCC then sponsored development of a full, digital TV system that supported both HDTV and standard-definition image formats. And this in turn led to a largely successful effort by the computer industry (including SIGGRAPH - see appendix) to incorporate "computer-friendly" features (square pixels and support for progressive scan) into the new system.

2) Digitization of Electronics: A second historical trend contributed hugely to computing-TV convergence. From the 1930s (and into the 1960s), analog computers played a valued role in the solution of certain scientific and engineering problems. But before World War II, researchers realized that an electronic digital computer could potentially far surpass their analog machines. Wartime military funding made it possible to build the first such machines, thus launching the modern computer industry (and with it ACM, SIGGRAPH's parent organization, founded in 1947 as "the first society in computing").

About a decade later, Bell Labs' invention of the transistor found its way into computers, paving the way for the eventual spread of digitization to the broad range of electronic equipment, whether industrial, medical, telecom, military, consumer, etc. In the latter category, the first success took a further quarter-century, until the audio compact disc reached the market in the 1980s. But as noted above, yet another decade was needed before video could hope to "join the parade."

Forms of Convergence

1) Program Origination: Production and Post-Production

Many early TV shows were produced on motion picture film, due both to entertainment professionals' familiarity with that medium and to the absence (until the late 1950s) of videotape recorders for studio use. Film also had high spatial resolution, and was available in color, thus allowing shows that initially were broadcast in black-and-white to be "future-proofed" for reruns in TV's coming all-color era (widely foreseen by industry pundits).

Similar future-proofing goals led the music recording industry, in the late 1970s, to convert to digital master-tape technology for studio sessions, thus anticipating the audio CD releases of the 1980s. So it isn't surprising, given Japan's early HDTV work, that a growing quantity of broadcast video content was produced in HD even before HD broadcast standards were set.

Adding to this trend is the recent introduction of "24P" HD studio cameras. Their progressive scan and 24-per-second frame rate were designed to mimic the esthetic qualities of movie film (which uses the same frame rate), thus gaining acceptance by a number of filmmakers whose work is destined for theatrical exhibition.

In post-production, the key computer-based innovation (which took hold during the 1990s) was the introduction of Non-Linear Editing (NLE) systems. This was truly a revolution in film and video editing, which permitted sharp reductions in the elapsed time for the editing process.

2) Delivery: Pre-Recording: Transmission: As with analog video, one can obtain digital video both live and pre-recorded. But here the parallels remain incomplete, due largely to public policy issues, which are more fully described below and elsewhere in this course.

For example, while DVDs are indeed digital video recordings, one cannot (without violating copyright law) view them digitally from stand-alone DVD players, even if one has a digital TV. Nor can HD yet be viewed from DVDs (due to hardware technology shortcomings).

Digital broadcast transmission over-the-air works fairly well (the FCC having turned back an engineering challenge to its standard radio signal format), but not (in general) via cable, since no rule requires it.

3) Reception and Viewing: As noted above under "Motives: User Control," computer-like user interfaces, based on firmware or software, are common in consumer devices for use with TV content (digital or analog), and contribute powerfully to ease of use and functional versatility. But with respect to time-shifting, archival, space shifting, capture of screen-shots and video clips (e.g. for personal home use, criticism, study and comment), digital video remains at a substantial disadvantage to its analog predecessor.

As noted below and elsewhere in this course, the reason for this discrepancy is that the foregoing 'fair uses' in the digital realm remain clouded by public policy controversies over the reach of copyright. When combined with equipment costs (slowly declining but still dauntingly high) and, as also noted above, a lack of pre-recorded and cable-delivered DTV programming (whether HD or standard definition), the consequence has been to slow DTV adoption to a crawl.

Two promising initiatives may address the problem of high receiver cost for DTV (and especially for HD). One of these, a possible regulatory mandate on TV manufacturers, will be considered below under governmental roles in technical standard setting.

The other approach is to exploit the installed base of HD-capable computer monitors, by using PCs as personal DTV sets. One firm, AccessDTV (www.accessdtv.com) sells $480 upgrade kits for desktop PCs, including DTV tuner cards and video recording capability via the computer's hard disk drive. But the copyright concerns noted above, led the vendor to block DTV playback through any other tuner card than the one which made a

given recording. Thus, emailing of video clips (captured from free, over-the-air DTV broadcasts) is not supported, despite its apparent lawfulness and potential value as a form of "viral marketing" for the DTV viewing experience.

Enablers of Convergence

Note: The history of digital TV (including mention of key technical standards that support "computer-friendly" imagery) was sketched above, in the "Roots" section. Our focus here will be on other factors that contribute to the potential for convergence of computing and television.

1) General Purpose Computers and Software (Open Platforms): Although multipurpose consumer appliances (whether electronic or not) have achieved modest success, most appliances are highly optimized for a narrow set of tasks, and cannot easily be turned to uses their designers failed to provide for. This tight focus brings clear benefits including ease of use: wired home telephones, for example, are said to be designed for five-year-old children.

If home computers were of this nature, it would be absurd to imagine (as previously mentioned) turning them into TV sets with built-in video recorders. Indeed, the history of (e.g.) dedicated word processing machines (in offices during the 1970s, then adapted for homes in the 1980s) makes it clear that computers' versatility has not always been regarded as a virtue.

But general-purpose computers are not merely versatile in the manner of a food processor or electric hand drill; they are (especially when built with option-card slots and loaded with suitable operating systems) truly "open platforms," or (to quote a 1980s advertising slogan) "power tools for the mind." And whether that mind is brilliantly creative or warped and destructive (or perhaps a little of both), the consequences of such openness can indeed be profound -- and inspiring to some, while alarming to others.

This characteristic, and people's diverse attitudes toward it, directly underlies a number of ongoing public policy debates, as the content of this course demonstrates. Whether the issue is cyberwar, digital copyright, covert employee surveillance, etc., open platforms provoke a mixture of excitement and concern to which older technologies seldom gave rise. (And as we'll see later, one response has been proposals to rein in or cripple computers and their networks.)

2) Integrated Microcircuits and Moore's "Law": While the potential for digital computers to process audiovisual information has always existed conceptually, it could never have become practical (let alone affordable in the home) without the striking advances (particularly since the 1970s) in ever-faster, ever-smaller, low-power electronic circuitry. Although this brief course cannot supply many details, the convergence we examine here is crucially based upon today's remarkable microchips.

3) Open Networks: What modern computers signify for individual users, the Internet (and any other networks with similar architecture) means to society at large. The "end to end" principle of the 'Net's design means that it, too, is an "open platform" on which geographically distributed applications (including entertainment distribution) can in principle be built by anyone, even if never specifically envisaged by the "fathers" of the Internet.

And for individuals, online software distribution allows one to benefit easily from the work of distant software authors, with no need for physical contact. Since that holds equally for "transgressive software," the policy issues arising from open platforms (as previously mentioned) become all the more contentious in a networked context.

Constraints on Convergence

1) Global Standardization: In computing, technical standards are generally uniform worldwide. That is in part a result of decades of commercial dominance by a handful of U.S. firms, beginning with IBM. But a second related cause is the scarcity of governmental attempts to set such standards. In television, however, the opposite has been true, and this difference has clearly slowed convergence initiatives between these two fields, by multiplying the cost and engineering effort needed, impeding the cross border flow of video content, etc.

As previously mentioned, one reason for such technical differences in television systems is that different countries (or coalitions thereof) launched new services (e.g. color TV) at different times, and understandably wanted to benefit from the latest technical advances when doing so. Another reason for diverse standards has at times been...

2) Protectionism (Industrial, Cultural, Political): In recounting the history of HDTV, we previously noted how Europe (and later the U.S. also) rejected the Japanese analog HDTV system, fearing that it would entrench foreign dominance of their important consumer electronics industries. But television is more than a large, job-rich manufacturing industry; it is even more significantly a powerful mass medium.

As such, it has potential to dilute and debase a nation's culture, or alternatively to refine and elevate that culture. Countries that feared cross-border TV reception (and flows of TV content) as a threat to the survival of their national languages; as a bearer of alien religious teachings and cultural attitudes; or as a source of subversive political notions, thus had reason to head off such asserted evils by erecting artificial technical barriers along their borders.

Other means of 'defense' were even more popular, e.g. local-content quotas and language rules. The conceptual contrast with (relatively) standardized computers and a global Internet was clear.

3) Transmission Infrastructure (Wired and Radio): Since early television systems depended on broadcasting to reach viewers, governments' traditional control over radio transmitter licensing, siting, power levels, etc. brought with it crucial leverage over flows of broadband content to viewers. The introduction of new computer-friendly digital TV services in a country usually required new frequency allocations, thus (in theory) increasing governments' leverage.

In the U.S., one result of this process was that analog TV broadcasters got new digital frequencies (channels), coupled with a requirement to give back their analog channels after a transition period. But no rules ensured that the transition would in fact end, thus placing in doubt the entire strategy.

In principle, these broadcast issues should not have mattered greatly, since most U.S. households use cable television for their TV reception. But government regulators did not

require cable operators to carry DTV, so few did, and many a consumer's strongest incentive for buying HD (or at least DTV) equipment all but vanished, taking with it some of the better prospects for an early U.S. convergence of computing and television.

Cable operators, to be sure, faced limited channel capacity on their networks, thus biasing them against early DTV carriage. This conundrum makes clearer the U.S.' lack of a viable DTV migration strategy, due in part to a political deadlock between government and the affected industries.

4) Copyright Issues: These are extensively covered elsewhere in this course, and to some degree both earlier and later in this "Convergence" section. Accordingly, we focus here on the relationship between copyright concerns and the "open platform" concepts previously presented under "Enablers of Convergence."

During the early stages of planning for Internet distribution and PC delivery of copyrighted content (including some video via broadband links), copyright holders have sought to deploy punitive laws against even arguably legitimate 'fair-use' copying of digital works. Concurrently, encryption and other access-restricting technologies have been applied to such works.

But the copyright industries now seem to believe that such measures will ultimately fail to yield the control over user behavior (with respect to copyrighted works) that they seek. Thus further restrictions are being sought, in the form of architectural changes to both PCs and the Internet, that would give both the ability to serve as hardware-based "trusted systems," immune to software hacking or subversion.

Such changes could convert PCs from true general-purpose machines into high-end appliances, with artificially crippled functionality. Some PC makers, however, apparently believing that their customers would reject such "dumbed down" machines, have refused to accede to "trusted system" changes. Unless laws are passed requiring such machine features, it thus seems doubtful that they will become standard anytime soon.

And so copyright interests are pursuing concurrently a 'fallback' strategy, based on the idea that if PCs are able to make unlicensed copies (however lawful), then valuable works must be offered only in digital formats and media that are artificially incompatible with PCs at the hardware level. Early examples are high-end optical audio disc formats, with HD videodiscs known to be under development.

This of course is exactly the reverse of the established approach, in which audio CDs and CD-ROMs (or video DVDs and DVD-ROMs) are, in computers, mostly interoperable members of a single storage-media family. Thus far, consumer response to this incompatibility strategy is too sparse to evaluate.

Governmental Roles in Convergence

1) Radio Spectrum Allocation: As previously discussed, advances in TV-computing convergence are linked to a transition of television technology from analog to digital. Whereas terrestrial radio broadcasters are expected to eventually achieve this by using "spare" capacity in their existing frequency assignments (to offer simultaneous digital and analog content), TV stations cannot do likewise, because of technical differences between the two media. Thus arose the U.S. arrangement (also noted previously) whereby TV

stations would "temporarily," and free of charge, have use of two channels.

But although the FCC expects to auction TV's current analog channels for other (and increasingly urgent) needs of non-TV services, no plan as yet exists to ensure that analog TV's viewers will adapt their equipment for digital reception within some reasonable number of years. Until they do, it is politically infeasible for the stations' transition to physically complete, and for the analog channels to be vacated. We'll note below a promising idea for resolving this difficulty, which is a main (though not the only) roadblock for U.S. DTV service.

But financial problems also dog the DTV transition plan. For one thing, converting a TV station requires costly equipment purchases, from cameras to switchers, transmitters, etc. And while many of the prosperous urban commercial broadcasters have already equipped themselves, numerous small rural stations warn that they can't afford it. Worse yet is the financial picture for non-commercial public TV, except in a few major cities.

Nor is equipment the only financial drain. For HDTV origination, new and costlier scenery and stage sets, props, costumes, etc. are often needed too. That's because lower resolution analog TV (and to some extent digital Standard Definition TV (SDTV)) "hides" visual flaws that HDTV will reveal, negating in the minds of viewers the illusions that help to create the "suspension of disbelief" that's integral to effective storytelling. (And this isn't only an issue for drama and other performing arts; TV newsroom sets, etc. often give rise to similar problems.)

2) Technical Standards Adoption: As previously noted, FCC sponsorship was instrumental in the development not only of the U.S. DTV system, but of basic DTV technology that's now headed for worldwide implementation. This show of governmental initiative stands in contrast to, e.g., the FCC's refusal during the 1980s (under the influence of a dubious anti-regulatory ideology) to help the cellular telephone industry plan an analogous transition to digital services. (That contributed to a standards war that Balkanized the U.S. digital cellular market, unlike that of Europe and other world regions, to the detriment of everyone concerned -- including the public.)

Skeptics rightly note that despite the above, it has yet to be proved that viewers will actually pay to equip themselves to watch DTV. But incoherent transition planning seems to have contributed more to that, than any clear rejection by the public. Now, though, an idea has finally surfaced to make DTV happen in the U.S. without needless pain for the viewer.

This proposal would have the FCC require new TV sets (at first only the costlier, home theater models) to include DTV tuners. As economies of scale in tuner manufacturing brought down unit costs, that requirement would be extended in stepwise fashion to smaller and less-expensive TVs, until all new sets could display DTV (though not necessarily HD).

Among the advantages seen for this approach, is that it resembles the way in which, decades ago, UHF television broadcasting was successfully launched in the U.S. by requiring new TV sets to receive it in addition to the original handful of VHF channels.

3) Transmission Regulation: Governments have long imposed regulatory mandates on broadcasters with respect to program content and other criteria, whether the stations were profit-seeking or not. In some countries this included actual censorship, while elsewhere it

focused on (e.g.) transmitter power and siting, community service, operating schedules, reducing children's exposure to content judged harmful, etc.

With the rise of cable television (through which over two-thirds of U.S. households now receive TV), comparable regulatory regimes were devised for the cable TV industry. And as previously noted, the issue of DTV carriage over cable remains unresolved in the U.S., where it creates a major obstacle to the planned phase-out of analog broadcast TV services.

Perhaps the best resolution of this quandary may come through trends in transmission technology, and in particular a widely expected movement by cable operators toward hybrid fiber-coax (HFC) network architectures. By placing optical fiber terminals in served neighborhoods to feed the "last mile" (or less) of existing cable plant, HFC sharply raises the channel capacity of older cable systems. That in turn enables new digital TV services to be offered with less need to make room for them by displacing older analog channels, many of which are valued revenue sources to the cable industry.

HFC is also an increasingly important platform for the provision of broadband Internet access via cable modems, so its spread seems likely to be rapid despite the substantial associated costs for fiber terminal equipment and construction.

4) Copyright Policy Setting: Traditionally this governmental activity has been dominated by the industries directly affected, with little direct participation by, or obvious impact on, the public. But with the spread of digital media, public impacts are growing, and in democratic societies it is increasingly likely that public participation will follow, even if (in some countries) mainly through informal means such as marketplace behavior.

Other parts of this course, and earlier comments in this TV-computing convergence section, have sought to illuminate some of the relationships between copyright policy and modern information technology. Without trying to repeat that material, it can fairly be said that the quest for balanced policies, that suitably take into account the needs of all impacted segments of society, will be a long and challenging one, involving courts as well as legislatures and other organs of government. Much will depend on the outcome.

5) International Coordination: The relatively seamless global character of the Internet, and the history and traditions of the computing field, are notably at odds with television's basis in technical standards (not to mention content rules) that often differ substantially from country to country, and from one world region to another.

As previously mentioned, television has clung to this Balkanized tradition, mostly for various historical and protectionist reasons, in charting its transition toward a digital future. But some analysts expect this approach to be seen as increasingly anachronistic. If so, forward-thinking governments may figure importantly in moves to rationalize and coordinate possible TV advances (e.g. toward stereoscopic HD) across borders and oceans, at least with respect to non-cultural issues.

Intellectual Property Protection and the Impact on Convergence (Ellis)

Although most would probably put the following in a section on intellectual property (copyright) or free speech, we choose to include it here as a rather ominous portent of the future restrictions on DTV and hence a negative impact of the very important convergence

of computing and television.

You should also refer to the section on Digital Copy Protection section for descriptions on new initiatives such as the Consumer Broadband and Digital Television Promotion Act and the proposed “broadcast flag”. Most of these initiatives share the characteristic that they are proposed to promote digital and high definition television, but may in fact have the opposite effect.

Digital TV Before the Court: Clashing Principles

Myles Losch

(Reprinted from Computer Graphics, August 2001)

This past May in New York, a three-judge panel of the U.S. Court of Appeals for the 2nd Circuit heard oral argument in a case that could significantly affect an issue (copyright "rules of the road" for digital works) that others and we have long seen as delaying the replacement of analog television by a computer-friendly, digital successor. [Following is one observer's (Mr. Losch's) response to the court session, with no attempt at a full account or analysis.] Formally, the question that day was whether to partly or wholly lift a lower court's order last year (sought by the movie industry) that 2600 Magazine cease publishing on its website the DVD decryption utility DeCSS, and also remove hyperlinks to other sites where that program can be found.

Among the copyright issues presented, were the degree of control that copyright holders may exercise over uses of their digital works that, by long-standing public policy, need no licenses and the extent to which technology may be used to create "perpetual" copyrights in such works. But as the parties (and other groups* who earlier filed briefs in the appeal) made clear, this is more than just a copyright case, for also implicated [as in other, non copyright U.S. cases during recent years] was the scope of legal protection for computer software as free expression (scientific, artistic, and/or political).

And from a broader policy perspective, Prof. Jessica Litman, alluding in a recent book (www.digital-copyright.com) to the statute under which the case arose (the Digital Millennium Copyright Act [DMCA] of 1998), asserted that "... If current trends continue unabated ... we are likely to experience a violent collision between our expectations of freedom of expression and the enhanced copyright law..."

In addition to the two parties in the original case, the appeal included oral argument by the U.S. government, which intervened to defend the DMCA's constitutionality. The government's position featured broad claims of authority to act against not only the use, but also the writing and/or publication of any software with harmful potential. On such a view, prior government licensing (akin to that imposed on medications) could presumably be required of anyone who creates or publishes a computer program.

And as for the lower court's injunction in the case at hand, the government lawyer would have toughened it. Yet curiously, neither he nor his movie industry colleague directly addressed the defendant magazine's response to the order, namely, converting the banned hyperlinks into ASCII text URLs (which for many Web surfers are nearly as useful). One suspects, though, that if the injunction's ban on linking survives judicial scrutiny, the URLs may be targeted next.

By a wide margin, the most memorable advocacy that day was presented on behalf of the defendant magazine by Kathleen Sullivan, the dean of Stanford Law School and a noted constitutional scholar. But no inference should be drawn from this, since Dean Sullivan also bore the greatest burden (arguing as she did for reversal of the lower court's decision), whereas her opponents merely sought to protect the status quo. Adding to Dean Sullivan's burden was the 17-year-old magazine's reputation, especially in law enforcement circles, for complacency (or worse) toward computer crime.

For software developers, perhaps the most noteworthy argument was not made in court, but in a computer scientists' brief filed earlier. These researchers took the view that software (which for copyright purposes is a type of literary work), when considered apart from computers (e.g. on the printed page, or other nonvolatile medium) is as innocuous as a cake recipe (without ingredients or baker), or sheet music (without musicians or instruments). Presumably, from this perspective, U.S. courts would treat original computer programs as non-functional, pure speech, and no more regulable than (say) a poem or essay.

The judges requested post-argument briefs from all parties and, in a later clarification, identified a number of specific questions (most bearing on free expression) to be addressed. But again, no reliable conclusions flow from this (other than the court's apparent wish to seriously consider the constitutional questions associated with the case).

What might be the practical impact of this case? Events of recent years suggest caution in one's assessment. Few analysts suppose that courts can in fact suppress DeCSS. One of the judges suggested that the true target was future DeCSS-like programs, but the actions of copyright-based industries cast doubt on this, or at least call into question whether any different outcome could realistically be expected.

These industries accordingly seek to alter the hardware architectures of personal computers (and the Internet's design) to support restrictions (that cannot be sidestepped by software) on the use of copyrighted digital works. But this strategy too appears questionable, and so parallel efforts are well underway to create artificial technological incompatibilities between PCs and emerging entertainment media formats.

The shortcomings of that idea are apparent as well, and needn't be restated here.

From a legal standpoint, the 2nd Circuit, although influential, covers only a few of the 50 U.S. states; there are a dozen other such circuit courts, some of which may take a different view on key issues. (The 6th and 9th Circuits, in cases unrelated to that described here, have been relatively supportive of software authors' rights to create and publish as they see fit.) Divergence among circuit courts increases the likelihood of Supreme Court review. Whatever the outcome of this appeal, it will likely be analyzed with care, and appear again in this column ...

* (Including [non-SIGGRAPH] ACM entities with a public policy focus, e.g. USACM)

[Author's Disclosure: The preceding report was written by a long-time member of the Electronic Frontier Foundation (http://www.eff.org), which represented the defendants in the case described.]

Appendix

Robert Ellis

SIGGRAPH letter to the FCC

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of Advanced Television Systems and Their Impact Upon the MM
Docket No. 87-268 Existing Television Broadcast Service

FCC 96-207 -- FIFTH FURTHER NOTICE OF PROPOSED RULE MAKING

COMMENTS OF ACM SIGGRAPH
1515 Broadway
New York, NY 10036

July 10, 1996

ACM SIGGRAPH files these comments on July 10, 1996, in the FCC's Fifth Further Notice of Proposed Rule Making in the matter of Advanced Television Systems, MM Docket No. 87-268.

ACM SIGGRAPH is the Special Interest Group on Computer Graphics of the ACM. Our membership consists of approximately seven thousand professionals representing all aspects of computer graphics technology and applications.

Our primary comment consists of a copy of a letter written on behalf of ACM SIGGRAPH by Thomas DeFanti to Robert Sanderson dated October 18, 1993 (copy attached). The comments expressed in the letter regarding the desirability of progressive scan to support the graphics information on the NII are still valid.

What has changed is that the NII of three years ago has now become the Global Information Infrastructure (GII) whose graphics interface, the World Wide Web, has been responsible for millions of consumers gaining access to this communications medium of the future. If anything, compatibility with the graphics data on the GII has become even more essential in support of the convergence of television and computing that is rapidly occurring in the consumer products industry.

Submitted by:

Robert A. Ellis
Chair, ACM SIGGRAPH Public Policy Committee

Letter from Thomas A. DeFanti

October 18, 1993

Robert Sanderson
Chairman, Joint Experts Group on Interoperability
Eastman Kodak Co.
Bldg. 5, 4th Floor
1447 St. Paul St.
Rochester, NY 14653-7102

Dear Mr. Sanderson:

As you know, I represented ACM SIGGRAPH at last week's ACATS Interoperability Review in Washington D.C. I found the meeting to be extremely informative.

The ACM SIGGRAPH committee on ATV is adamantly opposed to any form of interlace digital HDTV output on consumer-level devices. We believe that progressive scan devices are the only feasible displays for information coming from the National Information Infrastructure (NII) and other computer-based services. We do not believe that interlace sets can be used in this context because one would either have to view a display with horrible interlace flicker (which is enough to make one turn one's head away) or halve the vertical resolution, yielding an impractical 32x9 aspect ratio for text and computer-generated image use. Furthermore, we believe that an interim standard allowing interlace would greatly impair the access to the NII by the segment of Americans who cannot afford both a computer display and a digital HDTV set. Thus, we are firmly against any interlace standard for even an interim period.

The Grand Alliance does not directly address the NII compatibility issue other than to point to the optional other progressive standards it is embracing. Allowing any interlace option is tantamount to eliminating the other options for our lifetimes, since a cheaper, non-compatible standard is embraced and produced first. The computer community I represent has spent the past 20 years suffering with the incompatibility of interlace television and computers. Now is the time to fuse computing and television by adopting progressive scan as the one acceptable method of display.

Requiring progressive scan on a consumer set does not, however, necessitate progressive scan cameras or broadcast. The consumer set will have enough memory inside it to scan out video in any way from signals received in any order. The consumer set simply has to display in progressive format so that it doesn't flicker unacceptable with NII-type information. Virtually all computers put out progressive scan and, eventually, cameras and broadcast equipment will follow. Consumer videocassette recorders (VCRs) could similarly feed a variety of compression techniques (including interlace) into progressive scan consumer sets, although interlace would destroy or cause any NII-type information to flicker.

We believe that achieving consensus on progressive scan and NII compatibility is so critical that any additional time spent debating the issue is well worth it. We urge you to continue the debate in good faith and examine all the issues, including the new ones brought up last week. This is not a time for haste.

Sincerely,

Thomas A. DeFanti
Chair, ACM SIGGRAPH Committee on ATV
Professor and Director
The Electronic Visualization Laboratory
Electrical Engineering and Computer Science Department
University of Illinois at Chicago
851 S. Morgan St., Room 1120
Chicago, IL 60607-7053

cc: Richard Wiley
Wiley, Rein & Fielding
1776 K Street NW
Washington, DC

Congressman Edward J. Markey
2133 Rayburn House Office Bldg.
Washington, DC 20515

Mary Whitton
Chair, ACM SIGGRAPH

Research Support

Robert Ellis
April 2001

Introduction

This topic was covered in the overview document. Here we present the definition of the proposed NRC CSTB study that was written by Jerry Sheehan (NRC), Mike McGrath and myself. The SIGGRAPH Executive Committee has approved seed funding from SIGGRAPH in the amount of $50,000.

Research Challenges in Computer Graphics

Computer Science and Telecommunications Board
National Research Council

SCOPE

This project will identify areas in which additional research is needed to make computer graphics a more capable medium for supporting a growing body of work in areas such as health care, entertainment, product design and manufacturing, scientific visualization, and education. It will bring together computer graphics researchers with users from a range of application areas to derive a set of research needs and will attempt to identify key remaining problems to be solved in the field. In order to ensure broad input from the computer graphics community and user communities, the project will solicit participation through workshops, white papers and briefings. Indeed this process has already started: the final form of this document is the result of a review by key members of the computer graphics research community.

CONTEXT

Policy Context

Computer graphics is becoming a ubiquitous tool for interacting with information technologies. Although many feel that entertainment uses in video games, feature-length films, and Web pages dominate, computer graphics is increasingly being used to help doctors plan difficult surgeries, to enable engineers to create virtual mock-ups of large engineering projects, to help scientists interpret the results of scientific simulations, to help educators illustrate key concepts for their students, and to help monitor natural resources and environmental conditions. Graphics provides an accessible medium for users to interact with computing and communications systems and interpret data.

As the capabilities of computing and communications technologies continue to increase, improvements in generating, manipulating and displaying computer graphic images will continue to grow, enabling them to be used in an ever-broader range of applications.

Advances in this field will play an important role in the diffusion of information technology throughout society.

Despite the more widespread use of computers and the Internet by the general public, certain groups of citizens are underrepresented, creating what has been referred to as a "digital divide". There are many dimensions to the Digital Divide, but computer graphics has the potential to help many more people use computers and the Internet effectively by creating more capable users and modes of accessing information (SIGGRAPH 1997).

Ensuring that computer graphics capabilities will keep pace with advances in hardware and software will require continued research. As in the past, industry, academia, and government will have important roles to play in supporting this work. Industry supports considerable research and development in graphics, especially in support of entertainment, graphics production, and computer-aided design. But industry is generally not well equipped to support fundamental research that will develop broad graphics capabilities that may not mature for a decade or more. Industry's goals, traditions, and mechanisms for selecting R&D projects tend to select research that is more closely tied to immediate needs. Ensuring continued effort in fundamental graphics research would therefore require continued federal support of university research.

Federal funding has historically played a significant role in advancing computer graphics research. The Department of Defense provided critical, early support for university research in the basic techniques for modeling solid objects, shading, and virtual reality that are used today (CSTB 1995). Other federal agencies, such as the Department of Energy, National Aeronautics and Space Administration, and the National Institutes of Health have supported projects to extend computer graphics capabilities into particular mission areas, such as weapons simulation, scientific visualization, biomedical imaging, manufacturing design and analysis, and the global information system. The National Science Foundation has also funded computer graphics and in 1991 established a Science and Technology Center for Computer Graphics.

To date, most federal support for computer graphics has been provided on an ad hoc basis, with little long-term program support or planning. Perhaps in part because computer graphics is frequently not seen as a real branch of computing research, each agency has tended to sponsor work in its own area of interest. As computer graphics expands into a widening range of application areas, such fragmentation of support is likely to proliferate, leading to the possibility that the potential benefits of computer graphics will not be fully realized. Indeed, a 1997 review of the National Science Foundation's Science and Technology Center in Computer Graphics (NSF 1997) recommended that the NSF work with the National Research Council to identify the broader scope of research that remains to be done in computer graphics and to communicate this information to policy makers, but this recommendation has yet to be implemented. The surge in information technology applications since that time makes the need even more compelling today.

Technical Context

Research in computer graphics encompasses a broad range of topics, including modeling, rendering, interactive techniques, and graphics hardware. *Modeling* consists

of techniques for creating computer-based representations of objects and scenes to be depicted. *Rendering* is the process of producing images for display on a monitor or printer. *Interactive techniques* include tools and physical devices that permit the development of applications that allow human users to interact with graphical representations in real time. *Graphics hardware* consists of specialized and general-purpose hardware for creating and displaying computer graphics. It ranges from high-end workstations and desktop PCs augmented with graphics accelerator cards for carrying out graphics calculations to specialized user interfaces, such as helmet mounted displays for virtual reality or augmented reality experiences.

Advances in these core areas will be needed to enable faster, simpler development of realistic and complex computer graphics images such as those found in increasing abundance in the growing collection of digital libraries. Research will also be needed to help tailor these fundamental advances to particular application areas, whether healthcare, entertainment, or scientific research. Such efforts will require collaboration between computer science researchers and those in other disciplines such as art, engineering, and medicine. We have specifically not defined the scope of computer graphics in detail in order to allow study members great latitude in their work.

In addition, future research in computer graphics will respond to new opportunities created by the increasing capabilities of computing and communications systems. For example, work on the virtual reality markup language (VRML) is enabling the creation of three-dimensional images that can be incorporated into pages and shared over the World Wide Web. Future work could extend these principles to allow large-scale virtual environments to be shared via the Internet. Image-based rendering techniques, which incorporate real-world or synthetic imagery into 3D databases, will provide more complex and realistic computer graphics and may transform rendering, modeling, and graphics hardware. Virtual reality and augmented reality systems will be experienced through all our senses, including sight, sound, and motion or touch.

Similarly, work on automatic data simplification and database re-targeting will produce the capability to take models created at a high level of complexity and deploy them at a lower level of complexity commensurate with available computing resources. Hence, a model created on a high-end workstation can be deployed on a notebook computer. Such work is particularly important with the advent of the World Wide Web where bandwidth is limited and complex models might overwhelm the infrastructure. While itself a research issue, development of the Next Generation Internet promises to allow increased collaboration among researchers in different disciplines and countries, many of whom will share graphical images and simulations.

PLAN OF ACTION

Statement of Task

A group of experts in computer graphics and its varied applications will identify compelling research needs in the field, highlighting those that promise significant returns due to the scope, scale, or breadth of their potential applications. The group will examine research needs in both core areas of computer graphics (such as modeling and rendering) and in application areas such as defense, entertainment, medicine,

manufacturing, and scientific visualization to identify those research areas that can be leveraged broadly. The results will inform research-related activities in government, universities, and industry and provide guidance on the roles each entity can play in achieving the research objectives. We do not mean to imply that such a study entirely replaces the traditional bottoms up proposal driven method of defining research areas.

Responsible Body

CSTB will assemble a study committee of 12-15 members to conduct this study. Membership will be drawn from industry and academia, and will include recognized experts with strong knowledge of core computer graphics disciplines and a diverse set of application areas. It will attempt to combine the perspectives of computer graphics researchers, artists, scientists, engineers, and others who use graphics systems to create different forms of imagery or content. Suggestions for committee membership will be solicited from CSTB members and staff, other relevant groups within the National Academies, the computer graphics research community, potential sponsors, and from recognized leaders in interesting application areas.

Although such a group cannot possibly represent all of computer graphics research and applications, committee members would attempt to solicit a wide range of input to help them identify the most pressing technical needs and biggest research challenges.

Preliminary Work Plan

Based on consultations among Board members, CSTB committee members, and the sponsors, CSTB will seek nominees for the study committee and suggestions for topics to address. The study committee will meet approximately five times over the course of the study to plan its work, meet with the sponsors and other relevant parties, prepare a summary report, and respond to review comments.

A workshop or series of smaller data-gathering sessions will be convened to solicit input on research needs from diverse communities of users. Should timing allow, a meeting or small workshop could be held in conjunction with the annual SIGGRAPH conference to facilitate broad participation of the computer graphics community. Additional efforts will be made to solicit input through white papers, briefings to the committee, and the Internet.

The committee would consider such questions as (1) How will advances in computer graphics enable significant breakthroughs in fields such as entertainment, health care, engineering design, manufacturing, and scientific research? (2) What technical advances and research are required to enable computer graphics to serve a growing range of needs? (3) What unsolved problems remain within the field of computer graphics and are they being adequately addressed? (4) What new capabilities do advanced computing and communications provide that may drive computer graphics applications? (5) How can the most promising research issues be best addressed? (6) What are the complementary roles of industry, government, and universities in meeting future challenges? (7) What are the benefits of research in different areas of computer graphics? To the extent possible, the committee will attempt to identify research topics of enduring interest and value and those with broad applicability.

Product and Dissemination Plan

The principal product of this project will be a report summarizing the findings of the study committee and articulating its recommendations. The report will be subject to NRC review procedures to ensure its accuracy, balance, and rigor. Dissemination will be targeted toward government policy makers, members of the computer graphics research community, and key users of computer graphics systems in industry, academia, and government. The report will be made available on the National Academy of Sciences World Wide Web server, as well as in paper form. Additional efforts will be made to disseminate the report's conclusions through briefings to interested parties in government, academia, and industry; through participation in high-level government and industry conferences; and by publication of summary articles in relevant journals, as appropriate. Funds for dissemination are included in the budget. In the final analysis, the success of this project will be determined by whether the daunting goals of increased awareness and funding for important elements of computer graphics research happens.

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Overview the Public Policy Process

Robert Ellis
With
Laurie Reinhart
David Richard Nelson
April 2001
Revised March 2002

Introduction

This is an overview of public policy in general: how it is implemented and influenced, the roles of various players and the area of professional public policy activities.

How Public Policy is Implemented

The implementation of public policy obviously varies greatly among political entities. But certain fundamentals tend to be universal. Generally public policy is a statement of goals and directions. There is no concrete effect until the stated policies are actually implemented. Implementation generally means reducing the general statements of policy to concrete form, usually as laws or regulations.

In most political entities, there are three ways policy statements get transformed into laws and regulations. The most direct is by legislative action. The political body responsible for enacting laws introduces prospective laws (frequently called *bills*) and then by deliberation and voting, turns the prospective laws into actual laws. In this process, the prospective laws are likely to be changed considerably.

The administrative part of a political entity is generally responsible for carrying out the directions in the laws passed by legislation. This may take the form of developing regulations for the conduct of personal and public activities. In many places, the administrative entity also may initiate the passage of new laws. This generally takes the form of developing new policies and then getting them introduced into the legislative process.

There is also a third entity responsible for setting policy. The courts interpret the laws and as such, may effect drastic changes to the content or interpretation of laws and regulations.

How Public Policy is Influenced

The political entities described above do not operate in a vacuum. In many governments, the citizens elect some or all of the people constituting the three political entities. Some may also be appointed possibly with the consent of citizens or one of the

political entities.

It is important to remember that representative forms of government were developed because the size of the represented group is too large to function effectively as a committee of the whole. As much as we might admire the direct democracy of ancient Greece or the New England town meetings, they are not generally a very efficient way to govern. This means that representation works in the other direction: elected representatives simply do not have the time to listen to everyone they represent.

Elected representatives generally listen to three types of people: campaign contributors, representatives of organized groups and constituents. All of these categories are important and if you are attempting to influence policy you must determine in which role you can operate most effectively.

The role of campaign contributors in influencing public policy is well known. As the cost of getting elected continues to increase in many countries, most elected representatives must spend considerable time soliciting funds. The contributors of these funds get listened to. This is not necessarily bad, but it can lead to abuse.

Representatives of organized groups get listened to because of the size and importance of the groups they represent and the quality of what they have to say. Most organized groups have a bias. This too is not necessarily bad and is usually easily recognized by the people listening to them. Quality information can frequently be presented by even the most biased of groups.

Constituents are probably the most influential of all the groups. No matter how much campaign money an elected representative has or how many powerful groups they please, they must ultimately get the approval of the people they serve. Although this idealized concept may be somewhat distorted in practice, constituents still have a lot of power.

Meetings with policy makers and/or their staffs are generally the most effective way to influence policy. This may require the use of public policy professionals (see below) to gain access. Telephone calls letters and faxes are also effective, although unless the caller is an important person, the communication will probably be received and acted upon by a staff member. The effectiveness of the communication is generally directly proportional to the effort and thought that went into it.

Massive email campaigns are generally not effective. After all, policy makers, like most of us, do not like to be overwhelmed by unsolicited email. However, email can be an effective tool for following up previous contacts.

Finally, the most important aspect of influencing policy is to remember that timing is everything. Contact before an issue is under active consideration is likely to be ineffective. Contact after an issue has been decided is most definitely a waste of time.

The Role of Technical and Professional Societies

Technical and professional societies such as ACM and SIGGRAPH can play an important role in the public policy process. They can inform their members, which

presumably have common interests, of policy issues that might affect their professional and personal activities. These societies can also provide information to policy makers, although this requires more capability and effort than informing their members, something they usually regularly do.

It is possible that these societies can also take and advocate positions on policy issues. However, they must be careful to make clear whether they are representing the members of the organization or not. If the organization membership is fairly homogeneous and the organization's positions are well know, it is probably reasonable to develop positions on a rather informal basis. An organization might also have a body that develops positions. Finally an organization may have its members vote on the positions to be taken. On the other hand, officials of an organization may take a personal position based on their knowledge of the subject matter and general knowledge of the membership, although they should be careful to make this clear when presenting these positions.

The SIGGRAPH Public Policy Program has done a series on on-line member surveys. Such surveys have the disadvantage that the respondents are “self-selected” and therefore we cannot claim that the results are statistically valid. However, the number of respondents was small enough that we did not see evidence of respondents doing the survey multiple times or other problems. Of course we have no idea if the respondents are a representative sample of our membership or the computer graphics community.

The most recent survey was reported in the Public Policy column in the February 2001 issue of Computer Graphics (http://www.siggraph.org/pub-policy/CGColumn-02-2001.html#Third On-Line Survey). It is interesting that 85% of the respondents who told us their country of residence said it was the United States. It was also interesting that 1/3 of the respondents left their email address in the absence of any privacy statement on our website (since rectified). Quoting from the article:

“Most of the responses were fairly middle of the road. It was not surprising that user access was listed as the most important policy issue facing computer graphics. We did not break this down as to user interface issues or access to computing and the Internet issues. Other highly ranked policy issues for computer graphics were free speech and intellectual property/copyright. We were surprised that digital copy protection, telecommunications, and television/computer convergence did not rank higher. Perhaps this last issue should have been titled “availability of digital television“.

“Respondents also thought that intellectual property rights statutes were about right, favoring neither the owner nor user. A possible confusion over this question was whether we were referring to pre- or post-DMCA, a law that greatly strengthened the rights of copyright holders.

“Respondents indicated no enthusiasm for changing the regulatory status of either cable or DSL services, keeping them both as essentially unregulated services. Respondents did indicate a fairly strong interest in encouraging the availability of competitive services although without any choice of mechanisms, the question doesn’t have a lot of meaning.

“Respondents felt that the use of strong digital copy protection mechanisms would limit rather than hasten adoption of the technologies. A 1.98 result is one of the strongest

responses we've seen in any of our surveys.

"Responses to the final set of questions seemed to indicate fairly limited support for public policy activities by ACM and SIGGRAPH, even educational efforts, and little support for funding it. We do not know how many respondents were members. Respondents were strongly opposed to funding policy activities by either increasing dues or shifting support from the more traditional services. In fact, the only acceptable form of funding was outside grants, but of course who wouldn't be in favor of such a funding source!"

Other society activities include establishing professionally staffed policy offices, usually in capital cities. ACM has had an office in Washington D.C. for some time, but recently the staffing levels have been increased and the office has become more active. See Appendix IV for more information.

Societies may also provide timely information on policy issues that affect their members. For example, the ACM Washington office distributes an email newsletter (see Appendix IV) and the SIGGRAPH Public Policy Program has an email list (see Appendix V for more information).

The Role of Professionals

Professionals in a field can make an excellent source of information for influencing policy makers. Unless the professional is a widely recognized expert in the field, they will be unlikely to gain direct access to policy makers. The best way to make your expertise known is to work with some group and/or policy professionals to gain the appropriate access. You may only be able to be heard by the people in your group, but timely and accurate information is always welcome. Recently UCITA was introduced into my home state legislature. The story of my involvement with a local group of people and organizations is contained in Appendix I.

Formal testimony is always an important role for professionals. It requires careful analysis and presentation. Effective presentation skills are also necessary. People selected for presenting testimony are usually recognized experts in their field.

One other activity for a professional is to perform outreach to the general public. Appendices II and III contain some material I've used in this activity. My experience is that this is most effective when you can get yourself on the program of an existing organization that has regular meetings. Like everyone, most members of the public are busy people and the subject of your concern may be pretty far down on their list of things to worry about! Just talking with your friends, neighbors and relatives can be very effective. Remember to make your comments relevant to their interests and be sure to listen to their comments.

The Role of Citizens

All professionals are also citizens and unless you're a widely recognized expert, this is likely to be the most effective hat to wear when contacting policy makers or commenting on an issue. In writing a letter to the editor of a general interest publication such as a magazine or newspaper, this is also an effective role to play. When writing a letter to a

publication remember that the letters most likely to get published are those that are responding to something that previously appeared in the publication.

Public Policy Organizations

As you might expect, public policy has become a business complete with specialized organizations and its own set of skilled professionals. Many of these organizations focus on a single policy topic, but others cover several related topics. Others are organized primarily for non-policy purposes, but do policy work as a related activity. These organizations represent individuals, businesses, industry groups, special interest groups and other categories too numerous to mention.

Many of these organizations have a strong presence in capital cities and many have a staff of policy professionals. These professionals come from many backgrounds such as the law and political science. Some are registered lobbyists, but many are not. Their job is to establish contacts with policy makers, track policy and governmental activities and decide on the best time to contact policy makers on specific issues. They can be a valuable resource to those of us who work on policy part time.

ACM has a small office in Washington DC which represents ACM's US Technology Policy Committee. It has a small staff. SIGGRAPH has no office anywhere and only volunteer participants.

Web Resources

As with so many other topics, almost everything worth knowing about most public policy issues is available on the web. Most government entities and organizations working on policy have active web sites. Putting a search term such as "Privacy" or "UCITA" in a web search engine will turn up pointers to many worthwhile governmental, organizational and news sites.

As with any other website, it's very important to know exactly who is behind the site. For example, the Home Recording Rights Coalition sounds like it might be a consumer organization, but it is primarily sponsored by companies that make consumer electronics products who believe that being able to make copies of digital content is important to the success of their businesses. In many ways, this is aligned with the desires of consumers, but not always.

Disclaimer

The author is not an attorney and the material in this work should not be considered legal advice. The material is the personal opinion of the author. References to certain URLs contained in this work are provided as a service to the reader. Their presence should not be interpreted to mean that the author either supports or endorses the referenced material. Due to the dynamic nature of the Internet, the author cannot guarantee that these URLs are still valid at the time of this reading.

The author has made a best effort to determine the validity of the material at the time of writing, but makes no claims as to its continued validity.

About the Author

Robert Ellis retired in 1993 as Sun Microsystems' representative on the Technology Committee of the Computer Systems Policy Project (CSPP - an industry policy study organization) and co-manager of Sun's university research program. Previously, he held computer graphics software development and management positions with Sun, GE-Calma, Atari, Boeing and Washington University (St. Louis, MO). He received BS and MS degrees in Electrical Engineering and Computer Science from Washington University (St. Louis). Ellis currently does work as a volunteer for technical societies; he is a member of the Association for Computing Machinery's (ACM) US Technology Policy Committee (USACM) and serves as the Chair of the Public Policy Program of ACM's Special Interest Group on Computer Graphics and Interactive Techniques (SIGGRAPH).

Appendix I
UCITA Diaries

UCITA Diary #1
Bob Ellis

(Reprinted from Computer Graphics, May 2001)

(http://www.siggraph.org/pub-policy/CGColumn-05-2001.html#3. UCITA Diary #1)
(http://www.siggraph.org/pub-policy/CGColumn-05-2001.html#Why UCITA is Bad for All Consumers)
(http://www.siggraph.org/pub-policy/CGColumn-05-2001.html#A Letter from a Constituent)

The Uniform Computer Information Transactions Act (UCITA) was featured in the November 2000 and February 2001 columns. Just to remind you, UCITA is the model law that would make "shrink-wrap" and "click-on" software licenses enforceable. Even though most software "sold" today is already licensed, these licenses have not had a good track record in the courts of being held enforceable. This is because these licenses are contracts and a requirement for a binding contract is that all parties must agree on the terms first. When software is purchased under these licenses, the customer typically does not have an opportunity to agree to the terms before making the purchase.

UCITA originally started as an update to the Uniform Commercial Code (UCC) called UCC2B. The UCC is a set of model laws, which if passed by all the states, insures that commercial transaction law is uniform throughout the U.S. The UCC is the responsibility of the National Conference of Commissioners on Uniform State Laws (NCCUSL - http://www.nccusl.org) and the American Law Institute (ALI - http://www.ali.org). The ALI did not agree with UCC2B and withdrew its support. NCCUSL then renamed the model law UCITA and proceeded to work towards its passage in all 50 states.

Because of a number of restrictions on the licensee, UCITA has been generally been opposed by almost all users of software and supported primarily by the software publishers. The history of UCITA in the states has been checkered. At this time, only two states have passed UCITA: Virginia and Maryland. Both states have made changes, which means that it's not uniform any more. Several states have declined to pass UCITA

and several states are currently considering it.

While personally opposed to UCITA, we do not take positions on policy issues in the SIGGRAPH Public Policy Program, so our activities have been limited to education. Other groups, such as the IEEE-USA, have actively gone on record as opposing UCITA and have mounted a campaign to oppose its passage (http://www.ieeeusa.org/forum/grassroots/ucita/index.html).

I was roused out of my rather passive approach to UCITA when it was introduced into the current legislative session of my home state. These "UCITA Diaries" will be my reports on what has happened. I'm not going to identify the state in order to give me more freedom to discuss the activities here.

While thinking about what I could do, I received an email from Barbara Simons, ACM Past President and Co-Chair of USACM informing me that an organizing meeting was scheduled. This was good news. In affecting public policy, timing is everything. If you approach policy makers too early, they aren't worried about it yet. If you get to them too late, there's nothing anybody can do about it. It's a full time job that requires special knowledge (access to the right people doesn't hurt either) to track the progress of prospective legislation and provide appropriate information.

The local group consists of attorneys, lobbyists, representatives from government organizations and government affairs people from companies and associations. Because I'm retired, I don't represent anybody but myself. While many of the others are highly informed about the implications of UCITA, only one other person beside myself has a technology background.

Because the others all represent "special interests", I decided to represent the only group of which I was an obvious member: consumers. The only other consumer representative is the attorney general's office. The other members of the group welcomed this position because a "concerned citizen" offered a contrast to the others with their paid status.

Policy makers love to hear from the people. Unfortunately for most individuals, they like to hear from three types of people: campaign contributors, representatives of groups, and constituents. This means that the doors get opened to people from one of these groups. The group opposing UCITA is in the process of having meetings to present our information and position. Having your facts in order is essential. A policy maker may need to be convinced of your position; or, one already convinced needs material to help them convince their peers. At any rate having definite data at hand will convince policy makers that you are worth listening to. Fortunately, our group has some very knowledgeable and effective people.

What we've found so far is that once the full set of UCITA issues are presented it takes very strong proponents to keep UCITA alive. In Virginia, for example, it was passed (and then only with modifications and a one year delay to study the implications) because of the desire to make the state a good place to do business for software publishers. Having AOL located there didn't hurt either. Most states don't have very many prominent software publishers, but they usually have many large businesses that use software and who are opposed to UCITA. Libraries would face special problems under UCITA and are very strong opponents. Finally, consumers are a big force in the economy and, if united,

can present a very strong position.

Because policy activities are greatly aided by brief written materials, I've prepared three pieces. The first is a "talking points" document that lays out the problems with UCITA from a consumer perspective. The second is a letter from constituent to legislator. The third is a model letter to the editor that is currently under development. The first two appear below.

The consumer "talking points" document focuses on four problems with UCITA. First, UCITA turns what consumers typically think of as a simple purchase agreement into a complex contract that consumers do not have the ability to negotiate. Second, the "self help" provision of UCITA, which requires licensees to provide a back door into their computers so the software publisher may disable the software if some provisions of the license are violated (for example, failure to make a periodic license renewal or update), presents unacceptable security risks to the typically technologically naïve consumer. Third, UCITA can prevent full disclosure of the software product by not requiring the publisher to document defects already known to exist and by including terms that forbid the publication of reviews of the software without prior approval. Finally, UCITA provides that the software publisher can choose the venue where a licensee must bring action against the publisher; this might preclude the consumer from getting maximum assistance from their state's attorney general's office and would entail substantial personal expense. Legislators like to hear from constituents. Unfortunately none of my legislators are members of the committees that will hear the bill. Nevertheless, I have written a letter to all of them outlining my position. I modified the model letter provided by IEEE-USA.

Letters to the editor of newspaper can be an effective policy tool. While many papers will print letters that are not in response to something that has appeared in the paper, they like the other kind better. UCITA has had no exposure in the press here. In part, it's because the only legislative action taken to date has been to assign the bill to committees. No hearings have yet been held. Also, many people think of UCITA as both dull commercial legislation and not something of interest to the general public or esoteric high tech stuff. Little do they know! Sooner or later, this will hit the press (perhaps because of the activities of the lobbyists) and I need to have a letter almost ready to go. As the title suggests, this is the first in what I hope will be a series of reports on my activities. Stay tuned.

UCITA References:

Americans for Fair Electronic Commerce Transactions -
http://www.4cite.org/
Association of Research Libraries -
http://www.arl.org/info/frn/copy/ucitasum.html
Bad Software -
http://www.badsoftware.com/
Computer Professionals for Social Responsibility -
http://www.cpsr.org/program/UCITA/ucita-fact.html
Digital Commerce Coalition -
http://www.ucitayes.org/
Institute of Electrical and Electronics Engineers (IEEE) on UCITA -

http://www.ieeeusa.org/forum/grassroots/ucita/index.html
Federal Trade Commission -
http://www.ftc.gov/be/v990010.htm
National Conference of Commissioners on Uniform State Laws -
http://www.nccusl.org/
UCITA News -
http://www.ucitanews.com/
UCITA On-Line -
http://www.ucitaonline.com/
USACM on UCITA -
http://www.acm.org/usacm/IP/#ucita

Why UCITA is Bad for All Consumers

Bob Ellis - Concerned Citizen
February 2001

Summary

While there are many problems with UCITA that affect all users of software products, consumers are particularly hard hit. This bill, if enacted, can legally prevent consumers from learning about a prospective software purchase including any defects known to the software manufacturer. UCITA places expensive, if not impossible, requirements on consumers seeking redress for problems with the software.

Currently, when many consumers purchase software, they believe that they own the software, subject to copyright laws. After all, they do not license the right to read a book, listen to a CD or watch a videotape; they purchase those items outright. In fact those consumers have only purchased a license to use the software. Typically, if the consumer does not violate copyright laws, the difference is not distinguishable. Under Representative XXX's bill (HB XXX, "U.C.I.T.A."), the laws concerning software licenses will dramatically favor the software companies. This is particularly offensive given that the average consumer does not have the means to negotiate fair terms. Additionally, consumers are not generally technologically sophisticated and are unaware of the privacy and security issues that will be significantly impacted when using software if HB XXX becomes law.

UCITA makes what consumers think is a sale into a complex contract

The fundamental problem with UCITA is that it permits enforcement of "shrink-wrap" and "click-on" licenses (called "mass-market licenses" in UCITA). UCITA turns what many consumers believe is a simple purchase arrangement into a complex contract called a license. The manufacturer may use this license to levy burdensome requirements on the consumer such as requiring approval for disposing of the software even by gift or requiring periodic renewals of the license. This situation is particularly troublesome because the consumer is not able to negotiate special terms and conditions or even examine the license before the purchase. Consumers frequently can't even vote with their purses due to the dominant market positions of certain manufacturers.

UCITA's "self-help" provisions present unacceptable security and privacy risks to

consumers

The UCITA requirement that the consumer provide access (for example to permit the manufacturer to disable the software if the consumer has not renewed the license) into their computers presents tremendous risks to the technologically unsophisticated consumer. The timing is particularly inopportune because it comes just as consumers are moving to broadband Internet services. Broadband connections to the Internet already present significant opportunities and incentives for hackers and crackers to attack consumers' computers in their homes without the addition of a well-defined access mechanism.

UCITA prevents full disclosure of the software product to consumers

Not only does UCITA allow the software manufacturer to not disclose defects known to the manufacturer in advance, it can be used to specify licensing terms that prohibit the publication of reviews of the software which are critical in nature. This puts the consumer, who generally does not have the capability to test the software before accepting it, at a considerable disadvantage in making a purchasing decision.

UCITA shifts the jurisdiction of disputes to a location of the manufacturer's choice

Consumers are used to getting protection against manufacturers' actions and product deficiencies from their state's attorney general. UCITA would permit the software manufacturer to require consumers to bring all claims in a state or country of the manufacturers own choosing, regardless of the cost of the software. This would require consumers to undertake expensive and burdensome efforts to protect their rights. In fact, in California, a software company litigated the issue of venue with a woman who purchased and attempted to use her software in California, attempting to make the venue a state on the East Coast. Because all of this was over a $65 software purchase, it is not hard to believe that no other consumer would ever try to initiate such an action.

About the Author

Bob Ellis

Bob Ellis is a concerned citizen, neither a lobbyist nor the representative of any industry or group. Bob and his wife Margery have lived in XXX since 1995. He retired in 1993 as Sun Microsystems' representative on the Technology Committee of the Computer Systems Policy Project (CSPP - an industry policy study organization) and co-manager of Sun's university research program. Previously, he held computer graphics software development and management positions with Sun, GE-Calma, Atari, Boeing and Washington University (St. Louis, MO). He received BS and MS degrees in Electrical Engineering and Computer Science from Washington University (St. Louis). Bob currently does work as a volunteer for technical societies; he is a member of the Association for Computing Machinery's (ACM) U.S. Public Policy Committee (USACM) and serves as the Chair of the Public Policy Program of ACM's Special Interest Group on Computer Graphics and Interactive Techniques (SIGGRAPH). As a service to the community, he is currently giving a series of presentations to the computer-using general public on the implications of digital technology policy issues.

A Letter from a Constituent

February 15, 2001

Representative XXX
XXX State Capitol

Dear Representative XXX: I am writing as a constituent to urge you to oppose HB XXX, the Uniform Computer and Information Transaction Act should it come before you during the legislative session. As a retired software development manager with 35 years of professional experience and as a consumer who uses computers and the Internet extensively, I am excited about the opportunities these capabilities will bring to the XXX economy. However UCITA is not the answer. If passed, I believe it will have the opposite effect by hurting XXX consumers and making it more difficult for business users of software to do business.

By changing what should be considered a sale into a licensing transaction, UCITA encourages the broad use of "shrink-wrap" software and "click-on" licenses whose terms become fully enforceable when the customer opens the package or clicks the button on line. The customer cannot negotiate the terms even if he or she is aware of them. Similarly, the vendor can reserve the right to change them at any time without what reasonable people would consider effective notice.

Software publishers will be able to enforce contract provisions that are onerous, burdensome or unreasonable, such as disclaiming any liability for failure to disclose known defects or requiring permission to dispose of the software even as a gift or\ donation. The purchaser bears the burden of proving that these provisions are unconscionable and may not even be able to seek remedy in their own state. UCITA can be used to restrict the practice of "reverse engineering" to develop compatible or complimentary products; it can also be used to prohibit any reviews of the product that may contain negative comments on the software. UCITA requires that purchasers have a "back door" into their computer to provide the publisher access, a process that compromises the security of their computer and the privacy of their information.

UCITA is also so broadly drafted that it may ultimately affect transactions of all types of goods where software is involved (e.g., a car, house, kitchen appliances, etc.). UCITA has been actively opposed or criticized by over twenty-five state attorneys general, businesses which use software, software developers, consumer advocacy organizations, library associations, writers and photographers, the Federal Trade Commission, the American Law Institute and the Institute of Electrical and Electronics Engineers - United States of America (IEEE-USA). Please oppose this legislation until these problems are

fully addressed and take action to ensure that UCITA provisions adopted in other states do not adversely affect us here in XXX.

Thank you for you attention to this matter. If I may be of further assistance in this matter, please do not hesitate to contact me.

Yours Truly,
XXX

UCITA Diary #2
Bob Ellis

(Reprinted from Computer Graphics, August 2001)
(http://www.siggraph.org/pub-policy/CGColumn-08-2001.html#3. UCITA Diary #2)

In the May 2001 issue of this column, I started commenting on my activities in my home state regarding the introduction of a bill that would make the Uniform Computer Information Transactions Act into a state law. This is the second and final (for this legislative session) entry.

As opponents of UCITA made known the problems with UCITA, the legislator who introduced the bill wisely decided not to even hold formal hearings but to pass back the concerns to the group that developed the model legislation. It also became obvious that there was nothing uniform about UCITA because Virginia and Maryland have both passed different versions. If there was any chance of the bill being passed here, changes would have had to be made which would have been responsible for yet another non- uniform UCITA.

I'm sure UCITA will be back so keep tuned for more information.

Appendix II

This is the document used to determine if there's interest in a presentation.

Computers, Public Policy and You

Bob Ellis
January 2001

As the general public's use of digital technology (computing, recording (CD, DVD, etc.) and data transmission (Internet, HDTV, etc.) has dramatically increased, governments at all levels have been rapidly passing new laws and the courts have been busily interpreting these and existing laws. Many of these new and existing laws directly impact what you can and cannot do with this new technology, even for your personal use. This

presentation explores the impacts and what you can do to influence the developing public policy in digital technology.

This material can be presented as a single presentation or as a multi-session course. The presentation format is a 15-minute to one-hour overview of these issues. The course format is a one-hour session on each topic with out of class study of web references.

Prerequisites

There are no formal prerequisites, but an interest in public policy and an understanding of the use of digital technology are useful. Only minor knowledge of digital technology is required. Internet access is required for accessing the course reference material.

Outline

Who can read my email, access my computer files and how can I protect my data and privacy? If I can protect my data will criminals and international terrorists also do this and how will law enforcement agencies deal with the new options?

You mean I don't actually own that software program I just bought and installed and I can't do whatever I want with it? Can I legally own copies of MP3 music files and can I trade them with others? What's all this fuss about Napster and Gnutella? What can I legally do with copyrighted material I download from the Internet? Why can't I get an Internet domain name that's the same as my business?

Why can't I make a copy of the DVD movie I own or even have access to the digital format?

Is it safe to use my credit card to make purchases on the Web? Will I ever have to pay sales taxes on my Web purchases? What can organizations on the Web do with the personal information I supply?

How can I protect my children and grandchildren from objectionable material on the Web when the courts keep throwing out the laws passed to protect children? What are the limits on material I can download and store on my computer? How can gambling websites operate when it is illegal in the US to transmit gambling information over telephone lines?

Can my neighbors really access my computer files and print on my printer if I use one of the new high-speed Internet connections? How do these new services differ from my plain old dial up access?

When will I be able to buy an affordable High Definition TV (HDTV)? When will I *have* to buy a HDTV set? Will I still be able to record HDTV programs for my own personal use?

Why is the government picking on Microsoft? Why does the government need to fund computing research with all the rich computer companies out there? What's this Digital Divide I keep hearing about and why is it important to me?

If I don’t like how things are going, what can I do about it?

About the Presenter

Bob Ellis and his wife have lived in XXX since 1995. Bob retired in 1993 as Sun Microsystems' representative on the Technology Committee of the Computer Systems Policy Project (CSPP - an industry policy study organization) and co-manager of Sun's university research program. Previously, he held computer graphics software development and management positions with Sun, GE-Calma, Atari, Boeing and Washington University (St. Louis, MO). He received BS and MS degrees in Electrical Engineering and Computer Science from Washington University (St. Louis). Bob currently does work as a volunteer for technical societies; he is a member of the Association for Computing Machinery’s (ACM) US Activities Committee (USACM) serves as the Chair of the Public Policy Committee of ACM's Special Interest Group on Computer Graphics and Interactive Techniques (SIGGRAPH).

Appendix III

This is the handout that goes with the presentation.

Computers, Public Policy and You

Robert Ellis
February 2001

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As the general public’s use of digital technology (computing, recording (CD, DVD, etc.) and data transmission (Internet, HDTV, etc.) has dramatically increased, governments at all levels have been rapidly passing new laws and the courts have been busily interpreting these and existing laws. Many of these new and existing laws directly impact what you can and cannot do with this new technology, even for your personal use.

For example, in the pre-digital days you could access copyrighted printed material by simply buying a book or checking it out of a library. You might copy a few pages for your personal use but it was considerable work, expensive and the copies were generally not high quality. In the digital age, just to read material downloaded from the Internet or

contained on a CD-ROM, a copy must be made inside your computer. Once there, perfect copies can be made with little or no trouble and expense. This simple change has had profound effects.

Who can read my email, access my computer files and how can I protect my data and privacy? If I can protect my data will criminals and international terrorists also do this and how will law enforcement agencies deal with the new options?

Email travels through and is stored on many computers even after it has been deleted. Computer files can generally be read by anyone who has access to the computer either physically or via a network. Encryption technology "scrambles" file contents so that they can only be unscrambled by someone who has the mathematical "key". This works for files on your computer as well as files, such as email, sent over the Internet. Encryption is the first line of defense of your privacy. Protect your email address. Access web sites with "cookies" turned off. But remember, almost anything can and has been subpoenaed; computers have very long and accurate memories.

Smart criminals and terrorists all use encryption. Encrypted file can be opened without the key by powerful computers with the effort required depending on the length of the key. Escrowing systems for the keys by independent third parties and available to governments by court order (much like wiretaps) has been proposed, but there are many problems (e.g., how do you protect human rights organizations from totalitarian governments?). Snooping systems like the FBI's Carnivore can collect information subject to court ordered constraints.

You mean I don't actually own that software program I just bought and installed and I can't do whatever I want with it? Can I legally own copies of MP3 music files and can I trade them with others? What's all this fuss about Napster and Gnutella? What can I legally do with copyrighted material I download from the Internet? Why can't I get an Internet domain name that's the same as my business?

Unlike books, video and audiotapes and tangible goods, most software is licensed, not sold, and the rights of the licensee are controlled by the "shrink-wrap" or "click-through" license that can impose any constraints the licensor wants. Common constraints include not making copies, requiring licensor approval before disposing of the software, not analyzing the software, not writing articles about the software without the licensor's approval, etc. The legality of these licenses has been questionable, but a new prospective law, UCITA, attempts to change that.

MP3 is just a form of compression of audio data and is not illegal to use or have MP3 files. An MP3 form of copyrighted material is subject to the same rules as any other copy. Except for "fair use" you cannot copy, sell or perform in public any form of copyrighted material although you can give it away or even resell it (first sale doctrine). Fair use derives from the U.S. Constitution. Fair use is generally defined as including making copies for personal, private or non-profit use, quoting in reviews or scholarly works, etc. Fair use is not precisely defined by statute.

Napster and Gnutella are systems for exchanging MP3 formatted files of data. As long as the work is not copyrighted or otherwise controlled and you have a legal right to share it, using Napster and Gnutella is not illegal. But it is easy to abuse these systems.

Copyrighted material you have legally downloaded from the Internet is subject to all the conditions listed above.

In the pre-Internet days, trademarks had a strong geographical and line of business separation (e.g., Apple Computer and Apple Records). Although country and even further geographical domain names exist, everybody wants to be in the .com top-level domain. Who has trademark rights - United Airlines, United Van Lines, and United)? Similar names (e.g., etoy vs. etoys) also cause problems. New top-level domains (.biz, etc.) will probably just make it more confusing.

Why can't I make a copy of the DVD movie I own or even have access to the digital format?

DVD movies are weakly encrypted by a scheme called CSS and unless you have a way to unscramble the data (such as a computer program like DeCSS), there is no way you can get a viewable picture. A technology also prevents making VHS tape copies of the analog signal. In addition, there is no digital output data stream from any device that has been manufactured under appropriate license arrangements. The only way currently to see a DVD movie in digital format is on a properly configured laptop computer.

Is it safe to use my credit card to make purchases on the Web? Will I ever have to pay sales taxes on my Web purchases? What can organizations on the Web do with the personal information I supply?

Making a credit card purchase on the web is somewhat safe if the number is sent via a secure connection. But the number is usually stored on an Internet accessible computer and there have been many cases of crackers breaking into these computers and stealing the information. Normal consumer credit card protections apply to Internet transactions.

Current U.S. law says that a seller only needs to collect sales taxes on interstate commerce if it does business in the state where the purchaser lives. Most states have use tax laws that require you to pay an equivalent tax on goods purchased out of state. Use tax laws are very difficult to enforce, but some states have started putting use tax questions on their income tax forms. There is currently a great debate about the fairness of the current laws.

In the U.S. an organization can do anything it wants with the personal information it collects from individuals, unless it has a stated policy limiting its actions. There are efforts to get on-line organizations to state and adhere to a privacy policy and to enact laws limiting what organizations can do with this data.

How can I protect my children and grandchildren from objectionable material on the Web when the courts keep throwing out the laws passed to protect children? What are the limits on material I can download and store on my computer? How can gambling websites operate when it is illegal in the US to transmit gambling information over telephone lines?

The problem with the child protection laws is that there is no practical way to allow adults their First Amendment rights to free speech. You can install and use filtering software,

but there are severe limits on the capabilities. You can monitor the child's on-line activities.

Except for explicit exceptions to the First Amendment (child pornography, libelous statements, proprietary information, etc.) you can download and store anything you find on the Internet. Other countries do not have such legal systems and may restrict the accessing and ownership of certain forms of materials. This is an important issue for the Internet because it basically doesn't recognize national borders.

I don't know how gambling sites can operate legally using telephone lines.

Can my neighbors really access my computer files and print on my printer if I use one of the new high-speed Internet connections? How do these new services differ from my plain old dial up access?

Unless you have disabled all file and resource sharing, the people who share your cable data channel can easily access your computer. If you also want to operate a home computer network, you have a problem.

Both cable Internet access and DSL do not use the switched telephone network. In addition, cable companies are not common carriers so they may exercise more control over what you access with your computer than the telephone companies. There are numerous unsolved technical, security, privacy and policy issues using these services.

When will I be able to buy an affordable High Definition TV (HDTV)? When will I *have* to buy a HDTV set? Will I still be able to record HDTV programs for my own personal use?

Affordable HDTV systems will be available when there is a mass market for them (like UHF enabled TV sets many years ago). There are many unresolved technical and policy issues.

At some point a few years from now (when the broadcasters return their analog channels) you will have to buy a HDTV set or a converter for your present set. This will not happen until these become affordable.

Because of the concerns of the producers of digital TV programming, we are currently headed towards a situation of copy-protected technology that will not let you make recordings. Many issues are unresolved such as how to provide fair use. And remember the Betamax decision.

Why is the government picking on Microsoft? Why does the government need to fund computing research with all the rich computer companies out there? What's this Digital Divide I keep hearing about and why is it important to me?

Many people feel that Microsoft illegally used its likely monopoly status in operating systems to restrict competition in other software.

Most companies, even pharmaceutical companies, rely heavily on the results of government funded basic research. Most companies are not equipped to make good

decisions on basic research. Many argue that the success of government funded basic research in the last fifty years has been responsible for much of the economic growth in the United States.

The digital divide refers to the fact that computer and Internet access is not uniformly distributed across all ethnic, social and economic classes and this is a potentially limiting situation in equitable access to our legal, government and economic systems. Also, disabled people may not have good access to computers and the Internet. A recent court ruling has said that accessibility laws apply to both computers and the Internet. Computer-based voting systems may become the next big access issue.

If I don't like how things are going, what can I do about it?

As with other policy issues, effective computing policy activity requires informed citizens who then approach their government representatives either individually or in organized groups to effect changes. Fortunately for those who have access, the Internet is an excellent resource for information. Use search engines and be sure to find out who really sponsors a site (e.g., HRRC). Be sure to look at web sites ending in ".org".

Disclaimer

The author is not an attorney and the material in this work should not be considered legal advice. The material is the personal opinion of the author. The references to certain URLs contained in this work are provided as a service to the reader. Their presence should not be interpreted to mean that the author either supports or endorses the referenced material

The author has made a best effort to determine the validity of the material at the time of writing, but makes no claims as to its continued validity.

About the Presenter

Bob Ellis and his wife have lived in XXX since 1995. Bob retired in 1993 as Sun Microsystems' representative on the Technology Committee of the Computer Systems Policy Project (CSPP - an industry policy study organization) and co-manager of Sun's university research program. Previously, he held computer graphics software development and management positions with Sun, GE-Calma, Atari, Boeing and Washington University (St. Louis, MO). He received BS and MS degrees in Electrical Engineering and Computer Science from Washington University (St. Louis). Bob currently does work as a volunteer for technical societies; he is a member of the Association for Computing Machinery's (ACM) US Public Policy Committee (USACM) serves as the Chair of the Public Policy Program of ACM's Special Interest Group on Computer Graphics and Interactive Techniques (SIGGRAPH).

References

[Note: This list has not been updated. Use as example only. See updated reference list elsewhere in these notes.]

General

The Association for Computing Machinery (ACM) U.S. Public Policy Committee (USACM) -
http://www.acm.org/usacm/
ACM SIGGRAPH Public Policy Program - http://www.siggraph.org/pub-policy/

Privacy

Electronic Frontier Foundation (EFF) - http://www.eff.org/
Electronic Privacy Information Center (EPIC) - http://www.epic.org/
USACM on Encryption - http://www.acm.org/usacm/crypto/
USACM on Privacy - http://www.acm.org/usacm/privacy/

Intellectual Property (Including Digital Copy Control)

American Library Association (ALA) Policy Activities - http://www.ala.org/work/
Home Recording Rights Coalition (HRRC) - http://www.hrrc.org/
Motion Picture Association of America (MPAA)/Motion Picture Association (MPA) - http://www.mpaa.org/
Recording Industry Association of America (RIAA) - http://www.riaa.org/
USACM on Copyright - http://www.acm.org/usacm/IP/#copyright
USACM Intellectual Property Library - http://www.acm.org/usacm/IP/

Electronic Commerce

UCITA

Americans for Fair Electronic Commerce Transactions - http://www.4cite.org/
Association of Research Libraries - http://www.arl.org/info/frn/copy/ucitasum.html
Bad Software - http://www.badsoftware.com/
Computer Professionals for Social Responsibility - http://www.cpsr.org/program/UCITA/ucita-fact.html
Digital Commerce Coalition - http://www.ucitayes.org/
Institute of Electrical and Electronics Engineers (IEEE) on UCITA - http://www.ieeeusa.org/forum/grassroots/ucita/index.html
Federal Trade Commission - http://www.ftc.gov/be/v990010.htm
National Conference of Commissioners on Uniform State Laws - http://www.nccusl.org/
UCITA News - http://www.ucitanews.com/
UCITA On-Line - http://www.ucitaonline.com/
USACM on UCITA - http://www.acm.org/usacm/IP/#ucita

Free Speech

American Civil Liberties Union - http://www.aclu.org/issues/cyber/burning.html
Center for Democracy and Technology - http://www.cdt.org/
Electronic Frontier Foundation (EFF) - http://www.eff.org/
Internet Free Expression Alliance - http://www.ifea.net/
Responsibility in Free Speech - http://www.zondervan.com/green.htm
USACM on Free Speech - http://www.acm.org/usacm/speech/

Broadband Internet Access

BroadBand Internet - http://www.broadband-internet.org/
Broadband Wireless Internet Forum - http://www.bwif.org/
CableLabs - http://www.cablelabs.com/
DSL Forum - http://www.adsl.com/
Federal Communications Commission - http://www.fcc.gov/broadband/
NetAction - http://www.netaction.org/

Digital Television

Association of Local Television Stations - http://www.altv.com/
DigitalTelevision.com - http://www.digitaltelevision.com/
Federal Communications Commission - http://www.fcc.gov/dtv/
National Association of Broadcasters - http://www.nab.org/
PBS - http://www.pbs.org/digitaltv/

Computing Research Support

Computing Research Association (CRA) - http://www.cra.org/
USACM on Science Research Support - http://www.acm.org/usacm/funding/

Equitable Access and the Digital Divide

Closing the Digital Divide - http://www.digitaldivide.gov/
PBS - http://www.pbs.org/digitaldivide/

Appendix IV
The ACM Public Policy Office and ACM Washington Update
Bob Ellis and Myles Losch
(Reprinted from Computer Graphics, February 2002)

The ACM Public Policy Office in Washington D.C. publishes an email newsletter. The issue dated January 31, 2002 contains the following items:

Start of the Second Session of the 107th Congress
NAS Panel Releases Report on Broadband Deployment
Election Reform Legislation Update
AAAS Colloquium to Address Issues Raised by September 11 Attacks
Two New Cybersecurity Bills Introduced in the Senate
OMB Reports to Congress on Federal IT Security
NAS Report Makes Recommendation to Enhance Infrastructure Security
ACM Fellow Dr. Peter Freeman to Head the NSF's Computer Division

While not as timely as the newspaper or other news media, the newsletter does highlight issues of interest to computing professionals.

To subscribe to the ACM WASHINGTON UPDATE send e-mail to listserv@acm.org with "subscribe WASHINGTON-UPDATE" (no quotes) in the body of the message. Back issues are available at: <http://www.acm.org/usacm>

The office is interested in interactions with ACM members. To contact the ACM Public Policy Office should you have questions, comments, suggestions or recommendations regarding public policy issues or USACM activities, please contact the ACM Public Policy Office located in Washington, DC, by e-mailing usacm_dc@acm.org or calling +1 202 659 9711. The ACM Public Policy Office would also be pleased to assist ACM members in contacting or meeting with U.S. elected officials in Washington, DC.

To show how the office works to educate government officials on topics important to our members, early in 2002 its director Jeff Grove supplied the example below. In it, 'SSSCA' (http://cryptome.org/sssca.htm) denotes a failed legislative proposal by movie studios, which this column cited as follows in February 2002:

"... In the U.S. Senate, pressure from the computer industry [in late 2001] derailed efforts ... to force architectural constraints on computers and software, the better to protect against copyright infringement. This initiative was accurately described (by Harvard professor Jean Camp et al.) as the 'Turing Machine Prohibition Act,' and ... analysts warned that it could yet re-surface…"

The legislation would have banned new general-purpose computers (defined as able to arbitrarily manipulate digital data). Regular contributor Myles Losch notes that in the computing field, reaction to this proposal resembled what might have been expected from bicyclists (not to mention motorcycle enthusiasts, scooter users et al.), had it been suggested that to reduce road accidents involving two-wheel vehicles, only three- or four-wheelers be made or sold to consumers.

Grove writes: "[ACM's Past President, Dr.] Barbara Simons, Andy Grosso (Chair of the ACM Law Committee) and I ... visited with [South Carolina] Sen. Hollings' top counsel on the [U.S.] Senate Commerce Committee [which Hollings chairs] ... We took the opportunity to educate him on our concerns with legislation like SSSCA and its potential damaging effects on computing research and education, not to mention the rights of consumers. He told us that SSSCA, as we knew it was out, but that Chairman Hollings is still committed to working with industry to protect content. The Committee is holding a hearing on February 28 to discuss what role the government has in getting industry to agree to a standard for content protection. [Disney CEO] Eisner, [Rupert Murdoch's] News Corp, Mitsubishi, and an unnamed CEO of an IT company are to testify. We were told that there is not an opportunity for ACM to testify at this time, but he committed to talking with us as things move forward. He did mention the possibility of subsequent hearings with folks like [Stanford computer law professor] Larry Lessig being called to testify.

"On the [U.S.] House [of Representatives] side, both the Commerce and Judiciary Committee staff have told me that SSSCA is not a priority this [year]..."

In future columns, we hope to report new developments on this important subject.

Appendix V
SIGGRAPH Public Policy Email List
Bob Ellis and Mark Banas

(Reprinted from Computer Graphics, February 2002)

At the SIGGRAPH 2001 Public Policy BOF meeting Mark Banas volunteered to set up an email list. This has been done and has been available for a while. To date there hasn't been much activity but Mark and I have several ideas of how to make it more useful and active.

To subscribe to this automated list, send an email to "publicpolicy-request@mab4d.com" with the word "subscribe" in the Subject line. You will receive a reply asking you to confirm the email address you are subscribing. Once you reply to this message you will receive a welcome email, and then you are officially on the list. You will begin receiving all messages sent to the list for distribution, and can contribute messages as well. If you would like to unsubscribe at any time, send an email to "publicpolicy-request@mab4d.com" with the word "unsubscribe" in the Subject line. Again, you will be asked to confirm your request before that email address is removed.

One of the activities I've been interested in pursuing is to establish a mechanism where pointers to policy articles of interest can be made available. Several of us actively scan and have interesting articles and materials on policy sent to us. One possibility would be to have a special section on the web page for this. Or we could use the email list and send out a weekly update. I'm looking for a volunteer (see article on volunteers) who would like to get involved in SIGGRAPH's public policy activity by organizing this activity.

Mark has set up an archive of the emails sent to the list and is interested in setting up a searchable database of the archive. He has also proposed initiating a digest of material in the archive and perhaps sending it out on a regular basis. That way people who would like to monitor the activity on the list could have their communications from it batched.

If the activity ever reaches a significant level we might also want the list to be moderated, but we're a long way from that level of activity.