Testimony of Edward W. Felten
Professor of Computer Science, Princeton University

United States Senate, Committee on Commerce, Science, and Transportation,
Hearing on
Consumer Privacy and Government Technology Mandates in the Digital Media Marketplace
September 17, 2003

Digital technology presents an unprecedented opportunity for the entertainment industry – and an unprecedented challenge. As the price of storing and distributing digital content drops, new services and business models become possible. New types of copyright infringement become possible too; and unfortunately infringement has become all too common. The debate is not about whether this infringement is harmful – we all know it is – but rather about how we should respond to it.

Entertainment companies are understandably concerned about the rise in infringement, and they have proposed technology mandates as one response. While well intentioned, these mandate proposals are of dubious technical merit. Worse yet, they may cause serious harm, by curbing innovation in information technology and consumer electronics. The worst case – which is very possible – is that mandates will retard the development of legitimate technologies, while failing to make any dent in infringement. If it is not possible to avoid mandates altogether, the next best alternative is to limit their scope carefully so as to reduce the harm they cause.

Technology, like the rest of our culture, relies on a community of creative people striving to combine old ideas with new to advance a common body of knowledge. Although textbooks portray technical progress as an inexorable advance along nearly preordained lines, in practice the process of discovery is anything but predictable. It is

only through trial and error – with many zigzags and false starts – that we know which way to go. Technology moves fastest in an open and chaotic marketplace of ideas, unconstrained by mandates.

The Digital TV Transition

The transition to digital television (DTV) will greatly increase the clarity and visual resolution of TV programming. This change will reduce piracy, by increasing the quality difference between legitimate and pirated programming.

Consider the mechanics of DTV piracy. Full-resolution DTV images require an enormous amount of hard drive space to store and an enormous amount of bandwidth to transmit. A three-hour TV movie in ATSC format occupies about 26 Gigabytes (i.e., about 26 billion bytes) of storage. To store just one such movie requires a hard drive that costs about $50 – enough money to buy two or three DVD copies of the same movie. To transfer this file across the Internet to one other person, assuming both parties have fast home broadband connections, takes about two days. Few would-be pirates would go to this much trouble, when the same movie is available, sooner and at a lower price, on DVD or pay-per-view instead.

A pirate would choose instead to compress the video file, to make it smaller at the cost of reducing visual quality. A file small enough to transfer quickly over a broadband connection will have fairly poor visual quality. Whether would-be infringers are willing to download these infringing files depends on how the files' quality compares to that of legitimately obtained content.

Today's analog television offers mediocre visual quality, so highly compressed

files may be an acceptable visual substitute (for customers who ignore copyright law). However, DTV offers a much better visual experience, making the degraded quality of compressed files much more evident. The highly compressed files offered by pirates will therefore be less attractive after the DTV transition than they are today.

The DTV transition will make legitimate content better, without affecting the quality of pirated on-line content. The result will be to raise the demand for legitimate content. Because of this, technology mandates make even less sense in the future DTV world than they do today.

Innovation and Regulation

The main effect of mandates would be to impede legitimate technical progress.

Innovation is inherently unpredictable. If we know how to do something, we are already doing it; so a technology advance is by definition a surprise. The path forward is not a straight one. We move forward by trial and error, as new insights teach us how to build on past failures.

To foster innovation, then, we must keep the field clear for surprising developments, so that experimenters and entrepreneurs can pursue whatever avenue of progress they discover. Closing off these avenues through overregulation carries a high price, in missed opportunities and inventions that are never made.

It is tempting to imagine that we can concoct a regulatory regime that is truly technology-neutral, not favoring one technical approach over others but discriminating among products based only on their effectiveness. In practice, though, any regulation will encode certain assumptions into its definitions, its terminology, and its criteria.

Those assumptions might seem innocuous when the regulation is written, but over time they will channel and limit progress. Existing approaches will move ahead, but new, innovative technical approaches will be stifled if they conflict with the regulatory assumptions. Since we cannot predict the technical future, we will not be able to write regulations that keep the road clear for future inventions. The winning products, and the winning technical approaches, will be chosen not by the market but by the regulators. Inevitably, this will retard technical progress.

Regulation and General Purpose Technologies

Regulation has an especially harsh effect on general-purpose technologies such as personal computers and the Internet, which are capable of performing powerful operations on data without needing to understand that data in detail.

The classic example of a general-purpose technology is the telephone network, which can carry a conversation about any topic, between any two people, and can do this without the network itself having to understand what those people are talking about. The telephone network is designed for the simple, general-purpose task of transmitting sounds from one place to another. It is indispensable precisely because it is general-purpose – because it can be used to talk about any topic whatsoever, and because it transmits faithfully every pause, inflection, and nuance in the speakers' voices; and it is feasible to build a flexible, inexpensive, and easy-to-use telephone system only because that system does not try to understand what it is transmitting.

Personal computers and the Internet are also general-purpose technologies, as they are designed to operate on data of absolutely any type, without the need to

understand that data. As with the telephone, the general-purpose nature of these technologies makes them both more useful and much easier to build than the special-purpose alternatives.

Regulation poses a special danger to general-purpose technologies, because those technologies are capable of such a wide range of uses. Any regulatory ban on devices that are merely *capable* of certain disapproved uses will necessarily ensnare general-purpose technologies, even if those technologies are not designed for or primarily used for nefarious purposes.

Consider, for example, a hypothetical regulation that bans technologies that can be used to negotiate drug deals. This regulation, though presumably well intentioned, would amount to a ban on telephones and the telephone network. Someone who did not understand how telephones work might reply that the solution is to redesign the telephone network so that it cannot be used to talk about illegal drugs. But such a mandate would be contrary to the nature of the telephone network, which is fundamentally incapable of understanding how it is being used. Even if it were somehow possible to build such a restricted telephone network, the regulation would still fail to achieve its goal, as drug dealers would just switch to talking in code, perhaps discussing purchases of "sugar" and "flour." General-purpose technologies will always be capable of both good and bad uses. To eliminate the bad uses is to eliminate the technologies themselves.

This is not to say that nothing can be done about telephonic drug dealing, or about any other misuses of general-purpose technologies. My point is that mandates are not the right solution to these problems, which are best addressed through other means, such as traditional police work.

A Technical Perspective on Mandates

An analysis of technology mandates must start with a clear understanding of what the mandates are trying to achieve. There are two possible goals: they might be intended to control consumers' use of content, or they might be designed to prevent "Napsterization," or widespread copyright infringement. To put it more bluntly, a mandate may try to change the rules of our copyright system, by transferring certain rights (in practical terms) from the public to copyright owners; or it may simply try to better enforce the traditional copyright system.

It is easy to see how controlling legitimate use serves certain private interests; but mandating such technological control amounts to a significant change in public policy. Other witnesses are addressing the implications of this transfer in more depth, so I will not dwell on it here, except to say that such a policy change, if it is to be made at all, should not be introduced through a regulatory back door.

If the goal is to prevent Napsterization, then the protective technology must be especially effective. Network redistribution is such a serious threat because it allows a single illicit copy of a work to become available to hundreds of millions of people all over the world. To prevent Napsterization, then, it is not enough to prevent most consumers from copying most of the time. As long as *even one* consumer has the technical knowledge to "rip" and redistribute the content, along with the inclination to do so in spite of the law, the content will become available to everybody – it will be Napsterized. To prevent Napsterization, a protective technology must be so strong that not even one would-be pirate can defeat it.

Today's anti-copying technologies don't even come close to meeting this challenge. At best, they control and limit the activities of ordinary users; but a would-be pirate with a moderate level of technical skill can defeat them with moderate effort. Today's technologies do not, and cannot, prevent Napsterization.

Most independent technical experts believe that no technology will ever prevent the capture and redistribution of digital content by determined pirates. Certainly, this view is consistent with the checkered history of anti-copying technology. If this view is correct, then – like it or not – technology is not the answer to the digital copyright dilemma, and the result of mandates will be all pain and no gain.

Even if a technical antidote to Napsterization is in our future, that antidote will come about only through continued research and experimentation. Restricting technical progress by over-regulating will only lock in today's level of ignorance, delaying the day (if it ever comes) when we know enough to solve this technical puzzle. If we are not careful, we will mandate the use of ineffective technologies, while preventing the creation of better ones.

Reducing the Harm Done by Mandates

I have argued above that technical mandates retard innovation and provide few if any benefits in return. My hope is that we will have no technical mandates at all.

If we must have mandates, they should be structured carefully so as to minimize the harm they cause. To that end, I would suggest four guidelines.

First, any mandate should be aimed at preventing infringement, and not at controlling consumers' legitimate, fair uses of content. The mandate should be limited

to technologies that leave fair use and the right of first sale intact.

Second, technologies should be evaluated according to simple, neutral technical criteria. Keeping the criteria simple and neutral will reduce their influence on the direction of technical progress, and will keep the barriers to entry low so that new technical approaches can be tried. The criteria should be based on results achieved rather than on the use of specific technical methods.

Third, the mandate should allow for the possibility that no satisfactory technologies exist, rather than simply assuming that a suitable technology can be found. If nothing works, the mandate process should be willing to admit that fact and wait for better technologies to develop, rather than locking in a bad solution.

Fourth, the set of devices subject to the mandate should be as narrowly defined as possible, so as to minimize the regulatory impact on unrelated markets. A device should not be regulated merely because it might conceivably be modified or reprogrammed for an infringing use. It is especially important to protect general-purpose technologies, which by their nature are especially susceptible to regulatory harm.

Conclusion

Copyright infringement is a serious problem that has no easy solution. We should resist the "quick fix" of technology mandates, which will do little if anything to reduce infringement, but will impose a regulatory drag on the very industry whose progress might yield a better solution to the piracy problem. If we must have technology mandates, they should be narrow and carefully focused. The path to a better future lies not in limiting technical progress but in embracing it.