Public Knowledge

May 22, 2003

Secretary Marlene H. Dortch
Office of the Secretary
Federal Communications Commission
TW-A325
445 Twelfth St., SW
Washington, DC 20554

Re: MB Docket No. 02-230

Dear Ms. Dortch:

The attached documents are submitted in response to the MPAA document entitled "Trend—Download an HD Movie in 5 Minutes," electronically filed on May 7, 2003, in the above referenced proceeding. We respectfully request that a copy be delivered to each of the Commissioners, the Media Bureau and Office of Strategic Planning and Policy Analysis.

Thank you,

Mike Godwin
Senior Technology Counsel

cc:
Chairman Michael K. Powell
Commissioner Kathleen Q. Abernathy
Commissioner Michael J. Copps
Commissioner Kevin J. Martin
Commissioner Jonathan S. Adelstein
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HOW TO MISUSE TECH STATISTICS

By Mike Godwin
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One-Page Executive Summary

This paper responds to a recent "white paper" filed by the Motion Picture Association of America (MPAA) with the Federal Communications Commission in proceeding MB 02-230 (broadcast flag). The MPAA "white paper" purports to refute recent arguments, offered in the proceeding, that Internet "piracy" of high-definition digital TV content is effectively impossible and that significant copyright infringement in this arena is likely to remain so for some time to come.

How to Misuse Tech Statistics reveals fundamental flaws in the MPAA "white paper" where statistical data is misused and thus discredits the "white paper's" claims.

Specifically, *How to Misuse Tech Statistics* notes that the MPAA has continually shifted to new arguments in favor of the broadcast flag as old arguments have been refuted. We observe that the MPAA originally argued that piracy of HDTV content is possible today, and that digital TV content is more piratable than analog TV content. Both arguments have since been conclusively refuted in the broadcast-flag proceeding, forcing the MPAA to develop new arguments in favor of a broadcast flag.

The latest MPAA argument is that rapid increases in Internet bandwidth and rapid improvements in compression technology are on their way. These arguments are advanced solely based on statistical trends, however, and ignore hard limitations on near-term improvement of bandwidth and on near- and long-term improvement of compression.

Essentially, the MPAA white paper makes three basic errors:

- It assumes that all computer technologies are improving at rates similar to those of chip speed and storage capacity, and treat this presumed improvement as a kind of "natural law."
- It ignores hard facts, such as the hard limits on the possible advances in video compression, that would cast doubt on its predictions.
- It "cherry-picks" statistics from the beginnings of a period of accelerating advance, and uses them to predict an ever-increasing trend.

This paper suggests that a better strategy for the MPAA is to embrace technological advance rather than attempt to hobble it with a "broadcast flag" scheme.

HOW TO MISUSE TECH STATISTICS

New "Laws" of Tech Advance Don't Make A Case for the Broadcast Flag

By Mike Godwin
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On May 7 the Motion Picture Association of America filed with the Federal Communications Commission a "white paper" that provides enough material for a new chapter or two for Darrell Huff's classic book, *How To Lie With Statistics*. The paper was engineered to prove that Internet redistribution of broadcast television content is an imminent threat; Hollywood hopes the paper well sell the Commission on the need to impose a "broadcast flag" scheme of content protection that (among other things) would affect the design of nearly all computers. Where's Darrell Huff when you need him?

Well, at least we have his book, which has been a must-read for journalists and ordinary citizens for nearly half a century, and with good reason -- it explains in ordinary language how folks manipulate, misrepresent, and disguise statistical data in order to serve their purposes. In doing so, it also imparts some good basic knowledge about statistical methods.

Nowadays, many of us are more sophisticated about statistics, but there are also new tricks we have to watch out for -- especially when those tricks involve projections about technological advance. The main tactic the MPAA has used in its new white paper has been to invoke well-established trends in computer technology -- regarding processor speed and storage capacity -- and argue by analogy (plus these cherry-picked statistics) to persuade the FCC that other computer-related technologies, compression and broadband capacity, are increasing just as fast.

In reality, they're not, but you can see why the MPAA compelled to make this argument -- it's because their two previous arguments in favor of a broadcast flag content-protection scheme have collapsed.

Two Strikes for the MPAA

Originally, the MPAA argued that digital-television content is more easily "piratable" over the Internet because, well, it is digital, and everybody knows that digital copies don't lose resolution in successive copying. The only problem with this argument is that it ain't so. Today's digital devices routinely convert analog information to digital information, and back again. Your cell phone does this all the time, for example. More specifically, there are countless devices already in the field today that convert analog

television content to digital form (and back again). So the notion that digital TV is more "piratable" than analog TV quickly evaporates. In fact, since digitized copies of analog TV content are smaller than DTV or HDTV, they're actually more easily piratable.

In subsequent filings, the MPAA abandoned its argument that digital content is more subject to Internet infringement than analog TV content is, but still asserted that captured TV content, whatever its source, can be "instantly" or "instantaneously" transmitted by e-mail or other means across the Internet. It turns out that this claim is also false -- and easily disprovable by anyone who tries e-mailing a 400-megabyte, low-resolution digital copy of a TV episode to a friend. Not only are there typically limits on the "upstream" capacity of residential broadband, but few if any e-mail services will tolerate a subscriber's making copies of huge files to the e-mail server (a necessity for Internet mail prior to its forwarding the message and attached file to the intended recipient). Their argument against peer-to-peer trading of video content is somewhat stronger -- there's no need for an intermediate copy of the whole TV file -- but the basic fact here is that TV files are huge -- orders of magnitude larger than the digital song files traded in today's peer-to-peer networks. This means that "last mile" bottlenecks and other architectural constraints in our Internet infrastructure make copying TV content online an excruciatingly difficult chore for any of us who isn't a student at a well-wired university or an employee of a well-wired technology company. (But don't take my word for any of this -- try sending a captured copy of "Buffy the Vampire Slayer" over your own home's DSL or cable modem and see how many hours or days it takes you.)

That was two strikes for the MPAA, which taught the movie companies a lesson -- when the currently available data don't support the case you're making for the ubiquitous copy protection of the broadcast flag scheme, find some statistics that show how Internet piracy of digital television is going to be a problem any minute now.

Massaging the Numbers

For Jim C. Williams, the MPAA vice president for "Television & Video Systems Standards" who wrote the "white paper" for the MPAA, the difficulty in making this case is that Moore's Law -- the generally accepted prediction that processor capacity doubles every 18 months so -- doesn't tell us anything at all about the likely threat of Internet infringement of TV content. Moore's Law tells us plenty about the speed of what will happen *inside* tomorrow's computers, but it tells us practically nothing about how fast data, including TV content, will be able to move *among* computers on the Internet. Similarly, Williams's largely true predictions about the increase in hard-drive and optical-disk storage capacity don't tell us anything about Internet piracy either.

Williams's approach to his white paper can be summarized by stating it as three rules:

(1) Assume that all computer technologies are improving at rates similar to the those of chip speed and storage capacity, and treat this presumed improvement as a kind of "natural law."

(2) Ignore hard facts that would cast doubt on your predictions.

(3) Cherry-pick statistics, ideally from the beginning of a period of accelerating advance, and use them to predict an ever-increasing trend.

Here's how the MPAA made use of these rules in its "white paper."

Moore's Law and "McCann's Law." Gordon Moore, the engineer who later co-founded Intel, famously predicted decades ago that transistor density on integrated circuits will double every two years or so, resulting in increases in chip performance and decreases in cost. So far, the Moore's predictions have tended to come true, not least because the semiconductor industry has been laboring to make sure they do. It's nice to have the computer industry embrace a law with your name on it, which is probably why Bill McCann, a principal of the one-year-old company Zetacast, proffered "McCann's Law" in April at a conference in Dublin. "McCann's Law" predicts that, since compression of television content is to some extent a function of how powerful the processors are that are doing the compression, the amount of bandwidth it takes to send standard-definition television live should decrease by a flat 15-percent every year. In his defense, McCann was careful to put cautionary question marks after the "McCann's Law" slide in his PowerPoint presentation, and to note that his prediction is dependent both on the complexity of the content that's being compressed and on "quality expectations." In short, if you're not sending anything complex, and if your quality expectations are appropriately low, why, then, you can continue to compress TV content further every year. (Digital TV, and especially HDTV, is more complex than regular analog TV, and is already compressed.)

"McCann's Law" must have been music to Williams's ears, since it seemed to provide one way out of the hard fact that captured TV files are too big for consumer-broadband file-traders to transfer over the Internet in any practical way. But the MPAA paper chose to ignore that there are other factors that shape how well compression works. Basically, there are two ways to compress television content (or any other kind of data). One is to store the data more efficiently. For example, instead of having separate color data for every pixel in every frame of "Lawrence of Arabia," you could arrange for each pixel to refer to a color table where the color information is stored -- if two pixels are the same color (often the case in "Lawrence of Arabia," which shows lots of sand and sky), you can store that color information only once, but have both pixels refer to it.

The other way is to "lose" data from the content, by eliminating information that most viewers won't notice is missing. For example, two "sky" pixels in "Lawrence of Arabia" may be slightly different shades of blue, but if you "lose" one shade and make both pixels the same color, most viewers won't notice that the movie as it appears on their TV is slightly different from the version they saw in the theaters. Of course, if you're more ruthless about eliminating color information (or other kinds of information, such as resolution), you can compress TV content even further, but more people will notice the degradation in quality. If "McCann's Law" were true, then over time (a century or two) you could reduce "Lawrence of Arabia" to a single pixel's worth of information, and

people would still watch it. This seems unlikely. Even McCann doesn't go so far -- the chart he offers on page ten of his PowerPoint presentation suggests that a leveling off of compression efficiency has already begun. But Williams papers over these troublesome facts about compression by citing only recent statistics and then extrapolating from those statistics as if they represented an inexorable physical law. Williams and the MPAA clearly hope that the FCC and other policymakers don't know enough about computer-based compression to raise questions about the "white paper" extrapolations.

Internet Bandwidth and "Nielsen's Law." Jakob Nielsen, a former Sun Microsystems Engineer, predicted in 1998, prior to the economic downturn in the Web- and telecommunications sectors, that Internet bandwidth would increase at a rate of 50-percent-per-year. Nielsen deduced this trend by noting that in 1983 he was connecting to the Internet with a 300-bps modem, whereas by 1998 he was connecting via an ISDN line. (We may safely assume he's using a cable modem or DSL modem today if he's connecting from home.)

"Nielsen's Law" is not nearly so widely accepted or as uncontroversial as Moore's Law, however, for a number of reasons. The biggest reason for doubting Nielsen's Law is the fact that actual throughput (as distinct from theoretical throughput) in residential broadband isn't like processor speed -- instead, it's dependent on many other factors that have nothing to do with technological advance. Even Nielsen acknowledges that "average bandwidth increases slowly." And even in 1998, he noted, telecom companies "are conservative: they need to dig up streets and install equipment in hundreds of thousands of central offices so they think twice (or thrice) before investing the necessary billions of dollars [and] after they invest, it takes *time* to update their sprawling physical plant." Yet digging up the streets and installing new equipment, as well as spending billions of dollars, is a prerequisite for continued rapid broadband growth.

Nielsen's prediction back during the tech boom seems less than realistic today, given the tech bust and the economic troubles afflicting the telecom sector. More importantly, the statistical basis of his generalization about increases in bandwidth is drawn from his experiences during a time when home connection to the Internet was just starting out. Of course connectivity seemed to be increasing rapidly in that period -- neither improvements in modem speed nor later ISDN connections required significant new investment in the telecom infrastructure itself. The same is not true for future increases in broadband capacity -- ask any subscriber to cable Internet services who's experienced a slowdown as other users in his neighborhood get online.

None of these considerations is reflected in the MPAA paper, which cites "Nielsen's Law" as if it were an established fact, then passes lightly over the problem of the "last mile" infrastructure bottleneck, except to say that new technologies and competition among Internet service providers should solve that problem Real Soon Now. (Never mind that it's unclear where the investment dollars for either new technology implementations or new wireless and fiber infrastructure are going to come from.) Williams's primary argument, apart from the handwaving about new technologies, is essentially statistical -- "Nielsen's Law"-predicted increases in connectivity, together

with “McCann’s Law”-predicted increases in compression will lead to the downloading of high-definition movies in five minute over the Internet by 2012. “Decision makers should take this analysis into account,” he writes soberly.

What’s Really At Stake

Decision makers who are knowledgeable about the ways you can go wrong with mere statistical extrapolations, and who are knowledgeable about the actual technologies involved in Internet connectivity, are likely to smell something fishy. After all, if one applied the MPAA’s sort of reasoning to automobile trends between 1900 and 1920 (when automobiles' average top speed increased from about 25 mph to about 50 mph), the "trend" predicts that the average top speed of automobiles in 2000 A.D. will be 800 mph, based on doubling every 20 years. Plus, even if cars' average top speed had reached 800 mph, that doesn't mean the roads have been built that allow cars to go that fast. (In fact, it’s entirely possible to build a car that reaches 800 mph today, but prototypes driving on anything other than salt flats will have a regrettable tendency to take flight.)

It’s also clear that the Motion Picture Association of America misstated the facts in initial filings with the FCC. The MPAA asserted, baldly, that *even today* captured TV content can be distributed “instantly” by e-mail, web page, or peer-to-peer file-sharing -- assertions that remain demonstrably untrue. Now that they’re using misleading statistical claims to bolster their case, the estimable Darrell Huff offers a half-century-old suggestion how we should interpret their efforts: “Those who present statistical arguments on behalf of industry are seldom found, in my experience, giving labor or the customer a better break than the facts call for, and often they give him a worse one. … As long as the errors remain one-sided, it is not easy to attribute them to bungling or accident.”

It probably isn’t an accident that the MPAA is putting all its muscle behind a proposal that would require FCC-based control over aspects of the design of new computers, hard drives, and other digital devices (these devices would be required to monitor for TV content marked with a “broadcast flag” and would have to be made secure against consumer modification). What really bugs the motion-picture industry is something we may reasonably infer from Williams’s paper, which is that computers themselves are becoming capable of storing captured TV content in higher volumes. Hollywood is worried that new computers will erode the aftermarkets they’ve established for TV shows and movies (including syndication and repackaging as DVDs). What would make more sense, however, is if they embraced technological change rather than seeking new regulations over it -- even if my criticisms of the MPAA “white paper” are wholly misconceived, and even if their pie-in-the-sky predictions about bandwidth and compression turned out to be true.

As MIT computer scientist Hal Abelson puts it, “if the day does come when everyone could in principle store the entire 100-year output of Hollywood in a cell phone and transmit this at the rate of one TV-season-content per second, well, that would spark amazing opportunities for incredible consumer value based on products we haven't

dreamed of yet, but which will never reach the public if Washington hobbles innovation in the electronics industry with a broadcast flag."