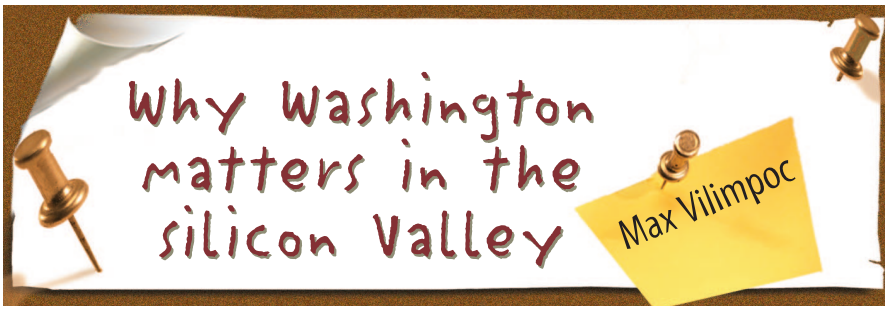

Recently at a party, I met an engineer from a Tier 1 Internet backbone provider. Briefly, we chatted about the technical aspects of her job (optimizing client connections to the internet backbone). A topic we both understood through years of similar coursework. However, when it came time to discuss my work (analysis of spectrum allocation policy), she admitted that the cause and effect interplay between politics and technology generally evaded her attention.

Even though many US technological achievements are born elsewhere, decisions that affect the future viability of all types of engineering are made regularly on Capitol Hill (Washington, DC). In fact, public policy has an enormous impact on the direction of our careers. From the impact of research and development allocations (see "Where are those research dollars," pg. 13), to global competitiveness stemming from our national industrial policy, to the management of information-age resources such as the radio spectrum— engineers often operate in an environment that is the cumulative product of years of political manipulation.

What *is* public policy and why does it matter? "Policy is about meeting social needs and solving problems using the public resources that are available," says Chris Brantley, Director of Government Affairs for the IEEE. "The challenge for the policy maker is—what gets done first and what is the best way to do it?" he adds.

The creation of public policy has both active and passive components. The active mechanisms of public policy may be as direct as on-the-streets advocacy or as discreet as in-the-halls of Congress lobbying. As a physical entity, public policy takes the form of advisory statements, e-mails, and faxes to the House of Representatives and Senate, formal comments to Federal Notices of Inquiry, and open letters published in newspapers and magazines by professional societies. Ultimately, the goal of all these processes is to convince a sufficient number of Congressional legislators or Executive Branch administrators that one particular proposal is more favorable than another.

A myriad of federal regulatory agencies and special interest groups also engage in the ritual dance to position a selected breed of technology and policy at the top of the legislative inbox. The Federal Communications Commission, variously seen as the vanguard and villain of the airwaves, toils away in the Southwest quadrant, handing out exclusive radio spectrum licenses. The U.S. Patent and Trademark Office, overlooking the Potomac River and Ronald Reagan National Airport, governs and confers limited monopoly rights over intellectual creations. The Departments of Energy, Commerce, Transportation and others take their positions straddling the Mall, doling out and managing federally sponsored research grants. Each day, through the development and ratification of public policy, these agencies square up the agenda of the Executive Branch with the needs and demands of the citizenry.

The political and financial interests of major industries are well served by the throngs of Golden Triangle lawyers and economists. (The Golden Triangle is an area of northwest Washington, DC with a high concentration of lobbying agencies and law firms involved in public policy.) However, the ongoing administration of law and the development of legislation are under-served with engineers not participating in the process. "If we don't speak for our interests, then who will?" asks Brantley. For often, a proposed policy may not provide the optimal outcome in the engineering sense, but rather it simply keeps up the status quo.

For instance, in the 106th Congress, a bill authorizing the construction of numerous new, low power radio stations would have allowed a large number of small, local stations to take root. Instead, after months of debate, a small amendment (see Box A) to the bill effectively banned the licensing of new low-power FM stations until a study could be completed determining their effects.

Playing on the fear of potential interference, the amendment only allowed low-power stations to operate on frequencies three-channels away from established high-power stations. Since most radio markets have few three-channel wide gaps between existing stations, the provision severely reduced the number of newly available station licenses. In a report released in July 2003, engineers studying the problem on behalf of the MITRE Corporation discovered that, contrary to overblown industry claims, additional low-power broadcasters would not negatively impact existing high-powered commercial broadcasts.

In a world driven by constant technological innovation, there is an acute need for engineers to participate in the legislative process: Our present and *future* economic wellbeing depends on it. Since innovation is a key driver of economic growth, a nation's collective ability to advance its marketplace and technological base is intrinsically linked to its science and technology policy.

H.R. 3439, "Radio Broadcasting Preservation Act of 2000," Amendment, Section 2(a)
as reported in House Report 106-567:

SEC. 2. MODIFICATIONS TO LOW-POWER FM REGULATIONS REQUIRED.
(a) THIRD-ADJACENT CHANNEL PROTECTIONS REQUIRED-
(1) MODIFICATIONS REQUIRED- The Federal Communications Commission shall modify the rules authorizing the operation of low-power FM radio stations, as proposed in MM Docket No. 99-25, to—(A) prescribe minimum distance separations for third-adjacent channels (as well as for co-channels and first- and second-adjacent channels); (…)

Source: http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=106_cong_reports&docid=f:hr567.106.pdf **(A)**

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What can happen

Unforeseen consequences can result from poor policy decisions that may restrict the ability of engineers to pursue cutting-edge research and innovation. Consider the impact of energy policy on the technological direction of fuel cells, alternative energies, and low-emission vehicles development at university and corporate research facilities.

A WISE way to get involved

A great first-step, especially for new engineers and soon-to-be grads, is to apply for a position with the Washington Internship for Students of Engineering (WISE). Created through the collaboration of several different engineering societies, WISE is a boot camp introduction to the world of public policy. For 10 weeks during the summer, a group of 10 to 12 students pick an issue of policy related to their sponsoring society and learn initial aspects of the workings of Capitol Hill. For more info, visit the WISE web site at <http://www.wise-intern.org>. —*MV*

When the government transitioned its Partnership for a New Generation of Vehicles (PNGV) to the new FreedomCAR concept, it dropped the PNGV push for more efficient internal-combustion engines. The focus is now solely on the development of a hydrogen-fueled economy. Although utilizing hydrogen fuel cells as an energy source is a good move, there is still an immediate need for more efficient petroleum-based engines.

Or consider the effects of poor spectrum management (again) on the development of novel wireless technologies. Although over 50% of the radio spectrum remains measurably unused at any moment, tightly regulated access to the spectrum inhibits the deployment of advanced wireless voice and data services. Stress on existing infrastructures is becoming increasingly apparent through dropped calls and service outages as additional consumers expand the total volume of use. As the proliferation of cellular data services increases, the bandwidth crunch will factor even more heavily into infrastructure expenses and upgrades. Ultimately, the cost will be borne by the end user.

Wireless networking also suffers from a lack of spectrum access. This is evidenced by the severe performance degradation that occurs when multiple Wi-Fi users attempt to share bandwidth from access points in, say, a coffee shop or library. Much success has been made of the deployment en masse of license-exempt Wi-Fi equipment. However, its full potential has yet to be unleashed as a third broadband path to the home (distinct from DSL or cable modems). The appeal of deploying last-mile high-speed wireless Internet to the home can be seen in the number of small wireless Internet Service Providers that have blossomed in rural areas to bridge the digital divide. In the "heartlands" of the US, where long-range wireless links must be made, it makes little sense to require users to emit the same low-power signals as urban users whose proximity requires limited transmission distances. Yet, even though they may be miles away from other potential users, the current "Part 15" unlicensed device regulations force rural and urban users to share the same set of rules regarding spectrum use.

Economic interests often thrive on the obscurities of technology-related policy. An excellent example of the domination of policy by economic, rather than technical, forces is the ongoing delay in the transition from analog to digital television. Since the early 1940s, analog station operators have been assigned the use of 6 MHz for each television channel. With digital compression and modulation technologies, it is possible to transmit the equivalent of one standard definition television channel in 600 kHz. Yet, rather than shrink their spectrum allocations, the FCC allowed current broadcasters to retain the full 6 MHz license, effectively giving them nine additional channels at no extra charge. At market value, these 5.4 MHz slices of spectrum might auction for $5 billion (USD) apiece. (See: "The Value of the Airwaves," from The Citizen's Guide to the Airwaves Explanation Report, July 2003, New America Foundation in "Read more about it.") Yet broadcasters paid nothing for their spectrum windfall. Not only were present broadcast licensees allowed to retain this spectrum, but they were also given an additional, semi-permanent license to use during their transition to digital transmission. In contrast, the cellular communications industry, starving for additional spectrum, spent billions of dollars at auction to acquire licenses as recently as 2001. (See Box B).

Maintaining the status quo

The lack of participation by engineers in the public policy realm means that Congress makes its decisions in the absence of important advisory information. As a result, the development and the deployment of better, cheaper and more efficient technologies may be stifled in the early stages by powerful incumbent industries. Imagine if the internal combustion engine had been rendered illegal in the early stages by lobbyists representing horse breeders and carriage manufacturers. In fact, in the early 20th century, as automobiles were beginning to gain popularity, several municipalities moved to ban them. They included Mackinac Island, Michigan, which to this day maintains the ban (more for reasons of tourism than aversion at this point). In his January 2002 *State of the State* speech, Michigan governor John Engler made a note of this technological reticence saying, "If we fail to seize our opportunity, if we fail to adapt, we risk becoming as irrelevant as the horse and buggy."

Such statements may begin to explain why you can read about new technologies far in advance of their commercial availability. Just recently, for instance, the FCC announced an initiative to examine the policy ramifications of Broadband over Power Line technology. Yet as far back as 1998 the technology's availability was announced in the *Financial Times* and other news outlets. Why then the delay? Why did it take so long for a technology to filter down to the masses?

The answer to these questions revolves around the power of entrenched interests. Within these broad agencies tasked with governing our energy, spectrum, transportation, et al. policy, there is a keen awareness of the power of established industries. Oftentimes, policy decisions are based less on improving the efficiency of a managed resource or standard, and more on serving up regulations seemingly most beneficial to special-interest lobbyists. While enhancing the business environment for already-established industries, such policies also have smothering effects on the competition.

Special interest groups line the coffers of various political candidates' campaigns in the hopes of gaining an edge in later windfalls and giveaways. During the 1996 and 1998 mid-term elections, the National Association of Broadcasters (NAB) donated nearly $700,000 (USD) to the campaigns of congressional representatives. According

to the Center for Responsive Politics, the NAB spent close to $5 million in lobbying fees during that same time period. As luck would have it, the Telecommunications Act of 1996 rewarded broadcasters with additional spectrum licenses worth an estimated $70 billion for free. (This is a figure commonly cited and originally estimated in 1995 by Robert Pepper, of the FCC Office of Strategic Plans and Policy.)

Even more recently, the long-sought removal of media ownership limits was rammed through the Federal Communications Commission (FCC) on 3 June against the stated wishes of over 750,000 petitioners. According to figures from the Center for Public Integrity, from 1995 to 2003, officials from the FCC accepted over 2,500 expenses-paid trips, provided by broadcasting and telecommunications industries, worth some $2.8 million.

Rather than taking a longer view of our technological future, the US Congressional leadership seems to primarily worry about winning re-election every 2 to 5 years. For long-term competitiveness in an increasingly tech-aware global economy, the protection of incumbent industries makes poor national policy. Engineering is a heavily recursive industry where advances made in the present are fed back into the cycle of innovation. Curtailing innovation in one research area at home leaves the door exponentially ajar for other countries to fill in the gaps. Instead of *being* the established competition, playing catch-up to the competition could become the norm rather than the exception.

The many forks in the road

Future products are often tied to the funds allocated to the government's research budget, which is defined by various policy priorities. Although research and development funding has increased in absolute terms as a portion of the federal budget in recent years, the fastest growing funding in 2003 is for anything related to homeland security.

While technologies such as the Internet and GPS were initially spawned in military research labs, their civilian use came as an afterthought and should not be considered the model for future "trickle-down" technology development. The government should strive to maintain a balanced research portfolio that includes sponsorship of "pure science" initiatives such as the National Institute of Standards and Technology (NIST) Advanced Technology Program.

Indeed, it is a mistake of immense portent to believe that the successful industries of today will be the market leaders of tomorrow. Thirty years ago, few would have predicted a multi-billion dollar industry dedicated to converting sand into machine intelligence. Therefore, the policies of today must try to accommodate and allow for the next boom industries 30 years from now... whatever they may be.

During his 1 May testimony before a Senate Commerce Committee hearing to discuss S.189, the "21st Century Nanotechnology Research and Development Act," the founder and CEO of the Zyvex Corporation, Jim Von Ehr stated, "I used to oppose any government funding for any industry. […] However, our private sector has gone global and can invest anywhere. The short-term economic decisions that make sense for a particular company might not be the best long-term decisions for our country. (emphasis added) […] While I worry about the 'industrial policy' implications, I worry even more about losing nanotechnology to nations able to invest for periods longer than two to three years."

As we continue the transition towards a technically driven service economy, the need for engineers to involve themselves in public policy is more important than ever before. Instead of grabbing land or physical properties, the property grabs of the future will involve intellectual, intangible rights and will be more likely to slip under the collective radar of society. Land grabs of the future might occur through the creation of software patents, ever more restrictive intellectual property legislation, or through further restrictions on reverse engineering and basic research.

Currently controversial legislative proposals have the potential to disrupt, misdirect, and channel the hard work of engineers towards more limited innovation. Rather than dream large, some engineers are more than willing to work within the confines of a given system. However, paying attention to the dynamics of public policy is important. Otherwise, engineers may find their lush rainforest of innovation shrinking at the edges until it just dots the horizon.

Read more about it

- "Slowing R&D Growth Expected in 2002," National Science Foundation InfoBrief, December 2002, http://www.nsf.gov/sbe/srs/infbrief/nsf03307/start.htm
- "Mackinac's Horsemen: Proud, Stubborn, and Mostly Irish," http://www.mict.com/story/
- "Nortel: Joint Venture Formed To Market Digital Powerline Technology Worldwide," PRNewswire, 25 March '98, mirrored at: http://www.exp-math.uni-essen.de/~vinck /plc/nortel+uuplc.htm

Summary of FCC Auction #35
C and F Block Broadband PCS Auction
12/12/2000 - 1/26/2001

Winning Bidders:	35
Net High Bids:	$16,857,046,150 (USD)
Withdrawal:	$4,907,000 (USD)

Highest Bidders:
http://wireless.fcc.gov/auctions/35/charts/35press1.pdf
http://wireless.fcc.gov/auctions/35/charts/35press3.pdf

Source: http://wireless.fcc.gov/auctions/35/

(B)

- "Senator McConnell's Coalition of Campaign Reform Opponents Gave $243 Million in Political Contributions During Decade," Common Cause News Release, April 9, 1997
- "Money in Politics Alert, Volume 4, No. 24," The Center for Responsive Politics Open Secrets Website, June 22, 1998, http://www.opensecrets.org/alerts/v4/alrtv4n24.asp
- "On the Road Again – and Again," Center for Public Integrity Report and Searchable Database, May 22, 2003, http://www.openairwaves.org/telecom/report.aspx?aid=15
- "The Great Airwaves Robbery," Spectrum Policy Program Issue Brief #2, Nov. 2001, New America Foundation, http://www.newamerica.net/Download_Docs/pdfs/Pub_File_639_1.pdf
- The Citizen's Guide to the Airwaves Poster and Explanation Report, July 2003, New America Foundation, http://www.newamerica.net/index.cfm?pg=article&pubID=1273
- The Advanced Technology Program Website, National Institute for Standards and Technology, http://www.atp.nist.gov/

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