IPV6, INNOVATION, AND THE STANDARDS PROCESS

Remarks By

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Thank you for this opportunity to speak to you this morning about IPv6 and its implications for innovation, U.S. competitiveness and standards.

First a word of introduction. I have worked over forty years in R&D in a variety of fields in engineering and physical sciences at the RCA Laboratories, now the Sarnoff Corporation. After retiring in 2003, I became a co-founder of Medeikon Corporation in New Jersey, where I currently serve as senior vice president of advanced technologies, working to apply optical technology to cardiac diagnostics to assist in the treatment of coronary artery disease.

That introduction is my way of saying that I am not an IPv6 expert, but an engineer and observer who is tuned to innovation, technology development and entrepreneurship. I see IPv6 not only as a key innovation, but also as one in which we in the United States must maintain the lead in view of this climate of world competition.

I have also been privileged this year to serve as President of the IEEE-USA. For those of you who are not familiar, the Institute of Electrical and Electronics Engineers (IEEE) is the world's largest technical professional society, with over 360,000 members in more than 150 countries around the world.

IEEE-USA is a part of IEEE, created in 1973 with the mission of advancing the public good and promoting the careers and public policy interests of the more than 220,000 U.S. IEEE members.

I particularly appreciate the opportunity to share this moment with you because my career and professional path have been dedicated to innovation and U.S. technological leadership.

From the very beginning, one of the recurring issues on our IEEE-USA agenda has been that of competitiveness, innovation, new technologies, and the creation of high value jobs for engineers and other technical professionals in the U.S. We are tied as closely to these issues as we can be, and work the Hill actively to promote them on behalf of our member constituency.

Innovation and competitiveness are also popular topics these days in Washington circles, but competitiveness has taken on a significance of its own in the context of the globalization trend, the rapid growth of in-sourcing and outsourcing of high-tech labor, the increasing dislocation of an aging U.S. high-tech workforce, and strong international competition in both maturing technology sectors like IT and in emerging fields such as nanotechnology.

Indeed, as summarized by Norm Augustine in a recent testimony to the House Science Committee that "America today faces a serious and intensifying challenge with regard to its future competitiveness and standard of living."

Similar themes have been echoed by a number of events and significant reports which have been released in rapid succession over the past eighteen months or so.

Just to name a few:

- There is the National Innovation Initiative spearheaded by the Council on Competitiveness.

- We have the National Academies' report entitled "Rising Above the Gathering Storm."

- The American Electronics Association, the Electronics Industry Association, the Business Roundtable, the National Association of Manufacturers, the Technology CEO Council, TechNet and other trade and industry groups have all put out their own policy agendas beating the innovation drum.

- The Center for Strategic and International Studies has a report warning about the collapse of basic research funded by the Department of Defense and the implications for the United States' future defense capabilities.

- And the now disbanded Presidential Information Technology Advisory Committee put out a report earlier this year warning of vulnerabilities to our national IT infrastructure and urging a national cybersecurity R&D initiative.

Congress is also starting to take note.

- In addition to hearings held to highlight several of the competitiveness reports, Virginia Senators Warner and Allen, along with Rep. Frank Wolf, helped spearhead an Accelerating Innovation Conference here in Washington this October. An even broader National Summit on Competitiveness was held just a few days ago at the Department of Commerce. And at least two major technology-oriented bills are expected this year or next.

- Senator Lamar Alexander will be introducing an innovation bill next week based on the National Academies' recommendations.

- Senators John Ensign and Joe Lieberman will introduce their National Innovation Act of 2005, on Dec. 15th, the one year anniversary of the National Innovation Initiative.

- The House Science Committee is also tuned in and developing its own views on the nature of the problem and likely solutions.

Whether these bills will offer new solutions and/or whether Congress and the White House have the political will to invest significant new resources in S&T remains to be seen.

So, where does all this debate stand with regards to US innovation and competitiveness? I venture to offer a few observations:

First of all, there seems to be broad agreement with the National Academies' finding that "the scientific and technological building blocks of our economic leadership are eroding at a time when many other nations are gathering strength."

You can see this trend unfolding in the daily business headlines…most recently yesterday's announcement that Microsoft would be investing $1.7 billion in India over the next four years and by the announcement on December 6 that Intel plans to invest a billion dollars in India over the next five years, with over $800M of that investment focused on Intel's R&D center in Bangalore.

Today's competitiveness debate, unfortunately, reminds me of the national discussion we had 20 or 30 years ago about maintaining a U.S. leadership position in manufacturing, but eventually did relatively little to save it. We are pretty much in the same situation today. Protectionism, trade barriers and government subsidies that distort market economics are just not politically acceptable solutions, and we're struggling to identify viable policy alternatives that can have a real impact.

Another fundamental problem is that we currently appear to lack a broad political consensus on why it is imperative to preserve our S&T leadership in the first place. We certainly have champions, but many opinion leaders take a broad macroeconomic view of our global challenges that fails to distinguish between potato chips and computer chips.

Developing that national consensus is made even more difficult by the fact that U.S. multinationals have fully embraced the global market, and now lobby Washington with their global interests at the fore.

Everyone is looking for the new "Sputnik" scare to wake everyone up and generate a national will to act. Each report has helped ratchet up the level of awareness and debate, but I'm afraid we are still waiting for the real "Sputnik" catalyst to emerge. One question this audience should ask itself is whether widespread adoption of IPv6 by Japan, China, Korea and other Asian countries will have this same Sputnik effect for U.S. policymakers, and what you can do individually and collectively to raise that question as part of the current competitiveness discussion.

I'm afraid Bill Wulf probably had it right in his recent testimony before the House Science Committee, when he compared our situation to that of the proverbial frog being slowly boiled. As a nation, we've noticed the water is getting warmer, but aren't sure yet that it's necessarily a bad thing or what we should do about it.

An important point, which I believe is missing from the current debate, is a recognition that innovation ultimately derives from individuals, who apply their know-how and the company's tools and resources to solve problems in new and often unexpected ways. They and their companies need federal R&D dollars, tax breaks and other policies, which are important in creating environments ripe for innovation, but ultimately, it is our human resource that makes the magic happen. And if we want to remain competitive in science and technology, then our policy response also needs to focus on how those individuals are incentivized to be creative problem-solvers.

We also need to overcome the worrisome perception that somehow U.S. innovators are losing their competitive edge. This trend is demoralizing indeed. Older engineers (i.e., those over 35-45) are increasingly being discarded with the implication that they are technologically obsolete. The younger generation isn't treated much better. The perception is being quietly created that U.S. students are no longer up to snuff, perform poorly in math and sciences compared to foreign-born students, and therefore are ill-prepared for technical careers, and/or lack sufficient incentives to pursue them. There are even whispers that our best and brightest are lacking in the essential qualities of curiosity and entrepreneurial drive.

The truth is hard to gauge. There are statistics and anecdotal evidence aplenty to support just about every opinion that you or I might care to venture. As for myself, I think that our next generation of youth still includes bright, entrepreneurial people who are making career choices based on their vision, on math and science proficiency, and on fundamental cost-benefit analysis. Unfortunately, engineering compensation increasingly lags that of other professions, and this has been aggravated by the fact that the basic supply-demand mechanism for regulating pay has been affected by expanded insourcing and outsourcing of technical services. As a result, the opportunity cost of pursuing technical careers just doesn't look that appealing right now. This has to change if the U.S. wants to retain a world-class technical workforce instead of borrowing one from our competitors.

So what does all this activity mean for us as a nation, for IPv6 and for realizing the potential of the Next Generation Internet? Well, I feel that, despite its importance, breadth, and all the potential services it will enable worldwide, the current high-level debate has not identified IPv6 as an innovation opportunity of national significance. That's unfortunate, because we know that Asian, European and other nations are working very diligently on IPv6, or even seeking dominance in setting its standards.

Indeed, the European Union is supporting a number of IPv6-related research initiatives with huge investments that include matching funding from European industry, with

objective toward global deployment of IPv6. IP networking is booming in China, where it has long been recognized that IPv4 cannot support the long-term deployment of network. Realizing the strategic importance of IPv6 back in the late 1990s, leading Chinese Universities and the Chinese telecommunications industry have devoted large amount of effort devoted to the establishment of its own IPv6. In 1995, the Chinese government established CERNET, the China Education and Research Network to link all Chinese learning and research institutions. More recently, CERNET has been collaborating with Nokia to build experimental networks for the whole country. This is to say that the international competition is strong, and more importantly that, if we allow ourselves to fall behind, we may lose the opportunity of setting the standards for IPv6-enabled applications, as we have done for many fields over the years.

Everyone here understands that IPv6 is fundamentally an enabling technology. It is an enabling technology in at least two senses. First of all, by significantly increasing the number of assignable IP addresses, IPv6 opens the door to direct peer-to-peer communications and device networking on a large scale. And by allowing every device to have its own unique identity, IPV6 enables new approaches to security.

The transition to IPv6 will no doubt create employment opportunities for network and security professionals here in the United States, as users make the transition. But the real potential of IPV6 lies in what new services and applications it enables. Estimates of the market potential range upwards to the trillion-dollar level. That represents an awful lot of potential jobs that will be created, and hopefully the U.S. will be able to claim its fair share.

Already there is considerable effort underway to introduce new consumer electronic devices based on IPv6. There is work well underway on networking RFIDs using IPv6 for various purposes. Other applications and services including TV and Voice on the Internet are already nearing the market. IPv6 has the potential is help transform the Internet as a delivery platform for broadband content of all types.

I know that a big part of this Summit is designed to highlight current IPv6 deployment plans and application development, but if you'll indulge my imagination for a minute, I can venture to mention a few idle speculations on the potential of IPv6. (You may have already thought about them already.)

The Internet has arguably produced at least two major innovations – email and the World Wide Web with all the services it provides and the businesses it creates. Just think how different almost every aspect of our life is today as a result of these underlying technologies and new standards. But today's Internet still falls short of its true potential as a peer-to-peer communications device. IPv6 is revolutionary, in that it will enable users to push, as well as pull information in unimaginable ways.

IPv6 could provide the stepping stone to the next killer application. One possible – candidate is likely to be ubiquitous, wireless-enabled, embedded computing.

Imagine being able to walk down the street with a small portable device that allowed you to access embedded computing applications and the Internet on demand. No need for an office any more, and no need for a personal computer, at least as we know it today, for that matter.

E-commerce and on-line banking should explode once everyone has the ability to be notified immediately and securely every time a transaction is made against their personal accounts.

Portable preferences is another interesting concept. Imagine using a small IPV6-enabled device to automatically communicate your personal preferences on just about anything to embedded computers controlling the environment around you, and not just in Bill Gates' house. Perhaps it could adjust the lighting and temperature controls in your hotel room as you walk down the hall. Or imagine walking into a coffee shop to pick up that vente mocha latte that you ordered and paid for while crossing the street.

Anything that uses sensors could be networked with the aid of IPv6-enabled devices:

- A refrigerator that monitors it contents and transmits a shopping list directly to your grocery story for home delivery or quick pick-up

- Bridges and smart structures with embedded sensors that can signal to a central station about need for repair and maintenance

- Cars to which IP addresses are assigned so that they can more easily offer interactive diagnostic and maintenance services (Imagine having your car diagnosed and even serviced -- at least a tune-up -- while it's sitting in your garage.)

- IPv6 could help revolutionize air traffic control and all forms of intelligent transportation, etc., etc.

One area of particular interest to IEEE-USA and its Medical Technology Policy Committee is the real-time monitoring of health-related information and its collection in medical databases accessible through a National Health Information Network. Many doctors are already carrying PDAs to help them with diagnosis, to warn of drug interactions, and to record their observations electronically into a digital medical record. In an IPV6-enabled world, every medical device could be linked directly to the database.

Great as all these innovative applications can be, we must not ignore paying attention to privacy, and their ethical and social implications. There is a certain Orwellian aspect to this, which we must be cognizant of as technologists. The idea of controlling the temperature of our house remotely via an IPV6-enabled thermostat would be attractive to many homeowners worried about energy costs. But we wouldn't necessarily want the local utility to have that access and control. And we definitely wouldn't want a Big

Brother snooping on our thermostats as part of a government crackdown on "energy criminals."

The same is true for digital medical records that present another sort of privacy issue. The last thing we want is a world where insurance companies could deny health coverage based on a genetic predisposition to disease extrapolated from an individual's digital health record.

And, while we are feverishly developing this wonderful technology, let us not forget about world competition in the race for technological dominance. Let us not forget that IPV6 has been years in the development here and in other countries, and that some of those countries are already moving to adopt IPv6 and may have a head-start on the U.S. in the development of standards.

Just about every nation is looking at government policies to facilitate implementation, as well as funding R&D to deal with the interoperability and advanced networking issues related to IPv6 transition.

Understandably, there are concerns that the U.S. is lagging its competitors in implementing IPv6, and that IPv4 loyalists are resistant to change. The concern by some commentators is whether IPv6 can be driver for U.S. competitive advantage or whether it is already a lost cause, and that resistance to its deployment could be just another nail in the U.S. competitiveness coffin. The concern is that if we miss out on the innovation opportunities, then we would be better served by attempting to leap-frog ahead.

Whether or not such concerns are justified, it is clear, at least to me, that IPv6 is where the world is going, although IPv6 will have to coexist with IPv4 for awhile during the transition process.

We are in a competitive race and we're slow out of the blocks, but the transition time for the adoption of IPv6, makes the race more like a marathon than a sprint. There is still some time for us to catch-up.

One impetus for catching up is the Office of Management and Budget's August directive on federal implementation of IPv6, signaling that the U.S. government is committed to that race. As the nation's largest consumer of goods and services, the government can play a tremendous role in keeping us in the competition as well as helping move the private sector toward IPV6. But we shouldn't kid ourselves that the OMB directive is the same as a national vision, mission, and action plan for the U.S., equivalent to the plans already in place in Japan, China and Korea.

I believe the innovation opportunities will be there if we move forward confidently and seize them. We can do it. After all, we are the folks who invented the Internet in the first place. And I hope you will pardon my pride as an IEEE Leader in noting that both recent Presidential Medal of Freedom winners Vint Cert and Bob Kahn are IEEE Fellows. As a nation, we've got a tremendous store of know-how and can-do spirit to build on.

We can also take advantage of our catch-up position by observing what others around the world are doing to solve the interoperability issues and other implementation problems that come with adopting any new technology. If we watch closely and learn from their mistakes, we should be able to integrate IPv6 more efficiently, shortening the learning curve to put ourselves in a position to challenge them in the application area.

The opportunity is there. The question is whether we will take advantage of it and rise to the challenge. The biggest obstacle, in my opinion, is ourselves and the Wall Street business models that favor short-term profits over more risky investment strategies focused on driving innovation and technological progress. We're living off our past successes, and it is time to invest in our future, to create new successes.

I promised to say a few words about standards. I have touched earlier on the risk of not being able to establish the standards for IPv6 due to world competition, particularly the competition from China, driven by its single mindedness and its huge market size. Standards have always been an important component of the global competitive landscape. No application explosion is possible without the development of standards. No universal acceptance is possible without the development of standards. The country which establishes the standards is likely to be one that dominates the field.

Successful businesses benefit from standards both by actively participating in the standardization process and by using standards as strategic market instruments.

Standards are also fundamental building blocks for international trade. They assure the interconnectivity and interoperability required for success by products and applications that must compete in an increasingly global marketplace.

As you know, the IETF is responsible for developing the basic IPV6 protocol and standards. In addition, industry consortia are forming to develop application-related standards for specific interfaces and hardware applications. Although the IPV6 protocol has been around since the 1995, in many ways, IPV6-related standards are still very much in a fledging state of affairs.

The IEEE is a major player in the international technical standards area, with over a century of experience in developing globally-implemented voluntary, consensus standards. In addition to producing the well-known 802 local area network standard series, the IEEE Standards Association is currently working on a wide variety of new application-oriented standards such as:

- Intelligent highway systems and vehicular technology
- Distributed generation of renewable energy
- Voting Equipment
- Rechargeable Batteries for PCs and Cell Phones
- Motor Vehicle Event Data Recorder
- Public Key Infrastructure Certificate Issuing and Management Components

Some IEEE standards projects, such as the P1609.4 Standard for Wireless Access in Vehicular Environments, take advantage of the enlarged address space offered by IPV6. IPV6 is an important foundational technology to many of our projects, and one we are open to exploring further.

Companies anxious to develop broad-based, consensus standards can look to the IEEE for the tools, methods and experience needed to help develop and gain wide acceptance of these types of standards.

In closing, let me leave you with a few fundamental thoughts:

America's ability to compete in a global market, its ability to create high-value jobs and maintain a high quality of life for our citizens, and our ability to maintain our national security in the face of new and emerging threats, all hinge on maintaining a highly competitive technology sector.

In technology and other key sectors of our economy, the only way that the United States can compete effectively in the global marketplace without lowering our standard of living is by increasing our productivity and out-innovating our competitors. We have to be faster, smarter, and more nimble. We won't be able to maintain a technological edge in every sector, but will need to somehow identify and focus our efforts on those sectors that are most critical.

And lastly, by opening a door to potential new "killer apps" for the Next Generation Internet, IPv6 represents one of those key technology opportunities where the United States can't afford to let the world pass us by.

I commend your work in helping to build the Next Generation Internet, and hope that you are successful in raising awareness about the importance of America's role in making worldwide deployment of IPv6 a reality. We at the IEEE stand ready to help you in any way that we can.