

**IEEE International Conference on Consumer Electronics**

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IEEE colleagues, it is truly an honor to present reflections on the past 50 years in the consumer electronics industry, where we've seen cycles of innovation and consumer behavior repeated, time and time again. I think there's something to learn from the march of technology. And I also believe very strongly that advances in consumer electronics are only made after significant investments in solid research and development.

And even then, R&D isn't enough. The tech roadside is littered with inventions that may have seemed like great ideas, but there wasn't a compelling product or the right mix of price and promotion.

Success in consumer electronics is more than just a great technology. It takes innovation matched with a better experience for the consumer – and the right mix of product, price, and promotion to score a winning goal.

I'm pleased to spend a few minutes of this short reflection looking back at where we've come from. However, after a half-century in this business, I know that it's the road ahead that really matters.

**Long and Winding Road**

How did I get here? I started in the business right out of university training and went to work for one of the biggest names in electronics during the 1950s and '60s – the mighty Radio Corporation of America. I started in the defense electronics side of RCA, and soon moved over to Consumer Electronics, beginning with work on Intermediate Frequency Amplifiers and Tuners for the research group that was plugged into RCA's home instrument division. This was the early 1960s – when UHF tuners were not yet built into every TV sold.

**The Legend of TV's Long & Winding Road: A Memoir**  
**Wayne Luplow**  
**Zenith R&D Labs, LG Electronics USA**

Armed with a 1962 Electrical Engineering degree from the University of Wisconsin and a 1964 Masters in Engineering from the University of Pennsylvania, I moved on to Chicago and to Zenith -- 50 years ago, when color TV was still in its infancy.

And while I've worked on literally hundreds of different projects and products, I'm most proud of the work that went into creating and deploying North America's Advanced Television system. Today, an initiative called the Future of Broadcast Television is building on that effort, working with standards-setting groups here in Europe, in Asia, and in the Americas, to pursue next-generation digital TV standards.

I've been a member of the board of directors of the Advanced Television Systems Committee for 26 years and have also been deeply involved, for decades, with the U.S. Consumer Electronics Association. I'm proud to have served as chair of the CEA Video Systems Committee since 1998, as past-chair of the CEA Technology Standards Council, and as a charter member of CEA's Academy of DTV Pioneers.

Of course, work on advanced television started for me at Zenith, and our efforts to develop the technology behind the ATSC DTV transmission standard called Vestigial Side Band (or VSB for short). Zenith also played major role in the Grand Alliance in the United States that merged competing advanced TV systems to create a "best-of-the-best" all-digital broadcasting standard.

And that was the focus of the U.S. standards setting process -- to identify the "best-of-the-best" HDTV standard for American consumers and the more than 1,600 TV stations spread across all 50 U.S. states. ATSC technology has been adopted elsewhere, of course, in Canada, Mexico and in some Central American countries and, most notably outside the Americas -- in South Korea.

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Speaking of Korea, as many of you may recall, global technology leader LG Electronics acquired a controlling interest in Zenith in 1995. The LG-Zenith merger was completed in 1999. And our Zenith R&D Lab carries on today -- continuing to develop advanced new transmission and reception techniques for over-the-air digital TV to mobile and fixed receivers.

Among the most rewarding experiences of my career are those associated with IEEE, including leadership roles in the ICCE -- first known as the IEEE Spring Conference -- which was born near my home base of Chicago back when there was a spring Consumer Electronics Show. Now, those meetings take place under the banner of the multi-location ICCE, the terrific conference we're all attending here in Berlin.

I was privileged to have served for 35 years as the editor of the "IEEE Transactions on Consumer Electronics." That meant sifting through mountains of technical papers, giving me an insiders' view of the evolution of consumer electronics technologies for decades.

Today, I'm honored to represent the IEEE CE Society on the board of the ATSC -- which has continued its intensive work after the U.S. adopted its digital television standard in 1996. Today, in fact, ATSC is working on next-generation transmission technologies that will bring TV into the Internet age, with non-real-time and Internet functionality, as well as more flexible new ways for broadcasters to reach consumers wherever they go.

### **Dynamic Industry**

We are so fortunate to work in such a dynamic and exciting industry! It's about the only industry in the world that continuously improves year-after-year with amazing innovations matched with falling prices.

To be sure, price erosion has put tremendous profit pressure on manufacturers and retailers over the years. But, for better or worse, it's what consumers have come to expect, and is a major driver for innovation. Back in the 1960s, it was common to invest several hundred dollars for a small-screen, 19-inch black-and-white TV set. Just think about what you paid for a TV over the years versus virtually every other consumer durable.

The end result is that consumers benefit from more features, and the cost of a new set continues to be driven down by innovation, competition, and sheer supply-and-demand. But falling prices aren't the real story. Frankly, neither are bigger screen sizes. The real amazing part of the past five decades is how innovation has shaped our industry.

### **Innovation Drives CE**

Innovation drives Consumer Electronics. Period. We've seen it over and over – from the development of UHF receivers on black-and-white TVs early in my career, to solid state chassis, to bigger picture tubes, to more and more advanced ICs, to high-definition digital TV, to today's world of smarter, flatter and more mobile screens.

Working in consumer electronics, you soon learn to design a product that can be mass produced. And it's not like building a one-of-a-kind, or even a few-of-a-kind. You have to design for the mass market, with components that have huge tolerances.

That's no small feat. It takes the concentrated work of a lot of players from many different disciplines. In the product development process, if you are both competitive AND collaborative, you'll meet a lot of dedicated, hardworking people.

One piece of advice that I've learned over the years: It's important to 'fill in the blanks' and to you take time to value the contributions of your colleagues. Those could be colleagues from your own company, or even a competitor. Take the time to listen. You never know when your perceived adversary may end up on the same side!

### **Cooperation is key**

There's a wonderful example in Zenith's past about the value of cooperation to solve a persistent problem. Zenith's founder, Commander Eugene McDonald, couldn't stand television commercials, so he directed his engineers to work on early concepts for pay TV beginning (believe it or not) in the 1940s.

And by the mid-1950s, he was delighted to greenlight a lab project that showed how a beam of light could be used for the first time to control a TV set, and particularly to mute the sound "during those annoying commercials" – as Zenith ads said at the time.

Eugene Polley was that young engineer who started tinkering with a flashlight and in short-order developed the Flash-Matic remote control. You could sit in your easy chair and control channel changing, mute the sound, and turn the set on and off. Not bad for 1955. And parenthetically, it should be noted that channel-change at that time was done via stepping motors – long before electronic tuners replaced mechanical tuners.

But a flashlight-based remote system wasn't perfect. That's where Zenith's Dr. Robert Adler came in. Among his many innovations was the ultrasonic remote control that worked by striking precisely tuned rods (and had no batteries). The Zenith Space Command remote put the power in your hand to change channels and control the sound on your TV just by pushing a button. And while IEEE Life Fellow Adler was credited with 180 U.S. patents, his most memorable contribution is probably the ultrasonic remote.

When I joined Zenith in 1964, the ultrasonic remote was the norm. It was the industry standard for a quarter century. And TV makers shipped some nine million units in the U.S. by the early '80s, before ultrasonic was replaced by Infrared and electronic RF remotes. As an epilog to the saga of the remote control: I know of no TV sold for many recent years without a remote control!

Bob Adler used to say, “Research and Development need to continue, as they are the key to the future – because that is what got us here today.” I think we can all agree with that!

### **Technological Evolution**

In Zenith’s labs in the 1960s, we were also working on surface-acoustic-wave filters to replace coils and other components for integrated TV tuners. And, of course, development of color TV was in its heyday.

While RCA had been first to market with a practical all-electronic color set in 1954, Commander McDonald made it clear that Zenith would not experiment on American consumers. RCA carried the ball with color, virtually on its own, until Zenith and others joined with color sets in the early 60s.

One by one, the major TV networks followed suit. First was RCA’s NBC network. And then ABC went all-color, and then, by the mid-‘60s, CBS.

Color TV didn’t really take off until the 1969 introduction of technologies like Zenith’s Chromacolor – the first black matrix surround on a shadow mask tube that doubled the brightness of a color TV. Finally, price and promotion, and good network content, made color TV a wise investment for most consumers – and industry growth exploded.

Zenith had a hand in a number of other early innovations– such as the afore-mentioned first pay TV system for over-the-air broadcasts. It was called Phonevision – because the pay part was handled by phone.

In the late 1970s, Zenith developed the “zoom” feature that allowed the viewer to zoom-in, or expand, a part of the picture by remote control.

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In the early '80s, Zenith innovated by merging the phone with the TV, with a product called SpacePhone – long before Voice over IP became common in today's Smart TV platforms.

Another idea before its time in the mid-'80s was teletext, with decoder-equipped TVs – from Zenith in the U.S. and others (mostly in Europe) – that displayed electronic newspapers, delivered on the vertical blanking interval of analog terrestrial broadcasts... all before the computer became of age and before digital television was even on the drawing boards.

And there were important innovations in product safety, too, with Zenith leading the industry in the use of 100-percent fire retardant plastics in TV cabinets.

Of course, not every avenue was a success. Sometimes in your career you may toil in the vineyards, without bearing any fruit. That was the case for me in the mid-1970s, working in a remote location and trying to develop integrated circuit technology. We were mounting chips on ceramic substrates – a technique that ultimately was not widely commercialized.

But with all of the success in our industry, you couldn't begin to think about it without the concurrent development of semiconductor technology. Semiconductors drive TVs, computers, cell phones, dishwashers, washing machines – they make those products cost-effective and sellable.

Sometimes, of course, the marketing hype gets ahead of what's really possible. Even back in the 1960s, we talked about flat-panel television that you could hang on a wall. And well into the '90s, it always was promised to be “just 10 years away...” Most consumers today probably have no idea that flat panel TV technologies were being developed and perfected in laboratories around the world -- decades ago.

HDTVs for the first several years were projection- and CRT-based. In the late 1990s, the era of the wall-hanging TV finally arrived as digital high-definition was taking hold in the United States and around the globe.

### **HDTV Collaboration Success**

More than 25 years ago, Zenith started down the path of “Spectrum Compatible” advanced television with AT&T Bell Labs. It was the first partially digital system that proved the concept of simulcast broadcasting.

These developments were key building blocks for the all-digital HDTV systems of the early 1990s. One of Zenith’s main contributions to the industry enabled TV simulcasts -- with the previously unused “taboo” channels that could be used to add-in the DTV/VSB transmissions without interference-from or interference-to analog signals.

We tested our concepts at the Advanced Television Test Center in Washington, D.C. and eventually, thanks to the gentle prodding of the FCC’s advisory committee head and former FCC chairman Dick Wiley, the competing proponents worked on creating the “best-of-the-best” Grand Alliance system, beginning in 1993.

It was a great adventure in cooperation and collaboration to be part of the Digital HDTV Grand Alliance...a groundbreaking alliance of fierce competitors, such as RCA, Philips and General Instrument, which worked together to develop what is now known as the A53 ATSC Digital TV Standard – today’s North American DTV Standard.

When you work in an arena where there’s no definitive decision-making process, you conclude that cooperation is the only way you’re going to get there. It’s a continual give-and-take -- like a marriage -- otherwise, you don’t get anywhere!

High-definition TV had started with a system from Japan's NHK. It was analog and consumed 1 ½ channels, 9 megahertz, to broadcast just one HDTV program. That led to a quest by American companies like Zenith, AT&T and RCA to develop a U.S. HDTV system... and by Chairman Wiley's advisory committee to oversee the complex competitive process, and ultimately propose to merge the various proponents.

It was the Grand Alliance system that was ratified by the Federal Communications Commission on Christmas Eve in 1996, a profound decision that still ripples throughout our industry.

On reflection about the Grand Alliance experience, I think there are important lessons to be learned. Listen to what your in-house and out-of-house colleagues are doing. Look for win-win solutions. You can compete forever and end up with nothing that consumers and industry will embrace.

It doesn't have to be a battle to the death, as it was with the Beta and VHS recording wars in which, arguably, the better technology, with the better picture quality, lost. But the consumer-accepted system won out – the system that could record two hours on one tape.

### **Future of Television**

Now we stand before another major decision. Should the digital TV systems in place around the world be adapted, improved and enhanced – to merge with Internet connectivity and to permit new features and functionalities made possible by advanced compression?

Obviously, research and development plays a critical role here. I know we should all want the innovations that deliver better products to consumers and more flexibility for broadcasters and programmers.

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Looking to the future, it seems to me that several trends bear repeating.

We've seen a "globalization" of the TV business. Once dominated by "American" brands like RCA, Zenith, Magnavox, Motorola, Admiral and Philco; and European brands like Philips, Telefunken, Siemens and Thomson, the world is changing. The Japanese dominance that superseded the Americans and Europeans has been quickly overtaken by the South Koreans. And now, new brands and new approaches are emerging – including China's rapidly expanding TV industry.

New players are on the field, and several familiar names are investing heavily to transform the viewing experience beyond the familiar and comfortable confines of cable, satellite, and broadcast networks.

Now, it appears that the Internet itself may hold the key to a more connected, cohesive, and on-demand world. New standards are being developed that make it possible for viewers to cull the latest news from a variety of broadcast and online sources – and search and play almost any program ever made available. And new technologies will bring life-saving emergency alerting via broadcasting, 4G and the Internet – to any device, anywhere.

That said, I believe you must have the long view on these technologies. What is past is prologue. The first remote controls are the grandfathers of today's search engines. And, who could have predicted, even just a few years ago, the wired and wireless, on-demand world that exists today.

In the 1960s, we had a goal of a TV that hung on the wall like a picture frame. We believed it could happen. And it did. We just didn't realize how long it was going to take!

So we must choose carefully, when making predictions about the future. The move from one technology to another will probably take longer than you think. Just look at the flat panel. It's not about Plasma or LCD; it's about a shift in consumer buying habits and available products.

Advanced television work started in the mid-1980s. It wasn't standardized and approved by the FCC until the middle 1990s. And it took another 13 years, until 2009, before high-power analog TV channels in the United States were finally turned off.

### **The Road Ahead**

The road ahead is even more exciting -- for manufacturers, broadcasters, studios, and content creators alike. The next-generation ATSC 3.0 standard will bring new flexibility and new opportunities for over-the-air TV stations. Mobility will continue to grow in importance. Internet-connected "Smart" TV is already a standard feature in most big-screen TV sets, merging the immediacy of live TV with the deep catalog of streamed content and the information-rich Internet.

But I also believe that we must have patience. This stuff takes time. After all, many of our technology transitions have ended up in the dust-bin of history. Transitional waters are sometimes littered with technologies that get thrown overboard. Remember: 8 Track tape? AM Stereo radio? The cassette and the laserdisc?

As a long-time observer of television, it's obvious to me that the road ahead is for TV products that are bigger and better --including Ultra HD 4K and even giant 8K screens with stunning picture quality. But TV is also getting better and smaller -- with more mobile options to bring live broadcast content to viewers watching on tablets, smartphones, watches, and any number of future devices.

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Television of tomorrow will be, all at once, bigger – and smaller. A home theater, and a theater-on-the-go. Personalized with programming tailored to you, and able to receive live images from anywhere on the planet – whether delivered by an antenna, cable, satellite, cellular or Internet connection. Content itself will be more personalized and targeted, but also offer more choices to let millions experience the same thing at once.

In short, the research and development teams of the future will be looking at how to make our world even smaller – from information sources, rich with the world's knowledge, to live telecasts delivered to ever bigger, and ever smaller, screens.

And in the end, the same familiar axiom applies – because success in consumer electronics is more than just great technology. It takes innovation matched with a better experience for the consumer -- and the right mix of product, price, and promotion -- to keep consumers coming back again and again.

**Sites Set on Next 50 Years**

As I look back – and forward – I would be remiss if I didn't thank my company, Zenith, and now LG, and the hundreds of colleagues I've had the privilege of working with -- for the opportunity to play my small role in this amazing dynamic industry. I've been fortunate to have worked with our industry's true pioneers –men who developed innovations like FM stereo radio and stereo TV... the wireless remote control and pay TV systems... large color displays and advanced ICs.

I have had many great mentors over the years – people who have been dedicated to constant improvement and innovation excellence...including industry luminaries like Carl Eilers, Charlie Heuer, Karl Horn, and Bob Adler -- all of Zenith. Plus Norm Parker of Motorola, and RCA's Dave Carlson and Bernie Lechner, to name just a few.

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It's been a great ride over the past 50 years – but my sites are set on the next 50, and the possibilities that consumer electronics innovations will bring to consumers throughout the world!