

ENGINEERING THE WORLD

HAGOP KOZANIAN, VICE PRESIDENT FOR WORLDWIDE ANALOG MARKETING AT TEXAS INSTRUMENTS (TI), DISCUSSES THE ANALOG, EMBEDDED PROCESSING TECHNOLOGIES THAT DELIVER INNOVATIVE SOLUTIONS WHICH CHANGE THE WORLD

We live connected lives in an analog world, and the opportunities for technology to make a significant impact on the way we live, learn and work are more promising today than ever. Innovative engineers create new applications and open new markets every day that improve existing products and, even more exciting, unlock new ways of interacting with the world around us. Semiconductor technology is the backbone of many of these inventions.

Every few years, an undercurrent of technology drives the creation of products that change our lives. In the last couple of decades these have been very visible: mobile phones enabled us to talk to anyone on the move, the Internet opened up the world's knowledge to anyone with a connection and the smartphone movement combined the two. Now we can access

any information, regardless of where we are. There are also countless inventions which spawned from these underlying technologies, such as crowd sourcing, social media, cloud computing and many others.

To spend time predicting the next such wave, in our experience, is a futile exercise. What we have learned over the 83 years of our existence is the importance of focusing on what we're good at doing. At TI, we provide instruments in the form of analog and embedded processing semiconductors for our customers to innovate with. Let's look at some of the innovations we are seeing emerge and let you be the judge of which ones will change our world in the coming decade.

The Pace Of Innovation

Imagine a world where:

- Cars automatically correct mistakes made by the driver, eliminating avoidable accidents.
- Factory production lines don't shut down, because equipment diagnoses itself through smart sensors to avert failure.
- Implanted medical devices don't have to be replaced because they continually charge themselves.
- Medical patients monitor their vital signs with mobile devices and send the data to their doctors.
- Individuals with vision impairment read Braille on an ebook.
- Lives are saved because early-warning sensors provide alerts about natural disasters.
- Smartphones are powered by energy harvested from their environment.
- We can personalize our energy consumption based on a smarter home area network, while utilities track power losses to ensure efficient energy delivery.

Most of these applications are in use today and our customers are actively developing others. Throughout the world innovative analog and embedded processing technologies are increasingly enabling visionary companies to develop smaller, better-performing products that improve automation, safety, convenience and energy efficiency.

Wireless power will help consumers charge their electronic devices more easily. Just as Wi-Fi replaced Ethernet cable for Internet connectivity, wireless power will give users a way to charge their smartphones, tablets, wireless keyboards and other portable electronics in more places – such as automotive consoles, charging pads and even office furniture – without the cables used today.

At TI we have begun installing wireless charging technology in our conference tables so employees, customers and others



Figure 1: The role of the semiconductor supplier is critical to technology advancements

can experience the benefits right here. Looking into the future, a technology that was used in electric toothbrushes in its early days could someday provide wireless charging for electric vehicles.

Connected World

One of today's game-changing innovations is the smart grid. Technology advances are creating once-in-a-generation leaps in efficiency for electric utility companies and giving consumers the information they need to become smarter about how they use energy. The advanced meters at the heart of the smart grid ecosystem deliver near real-time data about consumers' use of power to utility companies and to the consumers themselves. These revolutionary changes are based on huge amounts of data collected by integrated circuits in smart meters and delivered wirelessly to central databases.

The smart or connected home – part of what many call the Internet of Things – is a network of machine-to-machine communication that we believe is still in its infancy. This network includes connected alarm systems that can be monitored through smartphones to notify users when something at home needs attention. It includes connected thermostats that adapt to their surroundings and can be controlled from anywhere in the world using a mobile device. At the core of these innovations are analog and embedded processing technologies, in the form of low-power RF chips, sensor integrated circuits (ICs), analog front-ends, microcontrollers, power devices, interfaces and various semiconductors.

These types of connected technologies are evolving quickly and the pace of innovation increases every year. For example, technologies that currently connect users to their alarm systems and thermostats soon may connect them to sensor nodes throughout their homes, enabling users to turn appliances on or off, receive alerts when power consumption increases, or use cameras to monitor activity on handheld devices. Some of these applications are on the market today and more are on the horizon.

As the connected home and world continue to evolve, engineers developing products for the consumer, industrial, automotive and other markets will invent uses for chips that will continue to help people live smarter and more efficiently.

Consumers Drive Technology Advancements

The driving forces behind these innovations are continuous changes in what consumers care about and the ongoing effort



Figure 2: Robotic arm in a manufacturing environment

by end-equipment manufacturers to achieve greater efficiencies. And the key to success for semiconductor suppliers like TI is to understand and help customers address these trends.

In the industrial segment, for example, companies are creating efficiencies by increasingly automating their manufacturing processes. Improving efficiency enables them to reduce waste and increase output, all while improving the safety of their employees on the factory floor. A programmable robotic arm made even 2% more precise with advanced analog and embedded processing ICs can have a significant impact on a company's success. That robotic arm requires front-end sensor devices, operational amplifiers, communication chips, microcontrollers and power management.

Closer to home, the greatest sources of power consumption within TI wafer fabs are the engines that cool the water used in



Figure 3:
Automotive
infotainment will
be re-defined with
new technologies

manufacturing processes. Compressor motors are the most inefficient part in those engines. So, to improve manufacturing efficiencies by consuming less power and creating less waste, TI now uses variable-drive motors built around analog and embedded processing ICs.

Advancements in the Automotive Market

In the automotive market, manufacturers respond to consumer demands by introducing products to improve safety, save energy and deliver always-on connectivity. Start-stop capability for example, shuts off a gasoline-powered engine when it comes to a stop and then restarts it when the driver presses the accelerator – reducing fuel consumption by at least 10%. That capability sounds simple, but the technology behind it is complex. During hot

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summers for example, sensors must tell the air-conditioning compressors to keep blowing cold air. Given that the engine belt is stopped, the compressor motors need to be electrically driven. That capability requires FET technology, motor-control chips, microcontrollers and communication chips.

Shifts in consumer expectations are among the most dynamic changes in today's automotive market. In previous generations young car buyers cared most about the speed and look of their vehicles. Today, however, they want to stay every bit as connected behind the wheel as they are elsewhere. This shift is driving automobile manufacturers to create complex infotainment systems that look and behave like tablet computers.

Adaptive safety is one of the most exciting opportunities in the automotive segment. When we drive at highway speeds today, we trust that other drivers just a few meters away are competent behind the wheel. That's not always the case. Imagine technology-based safety mechanisms that, for example, apply the brakes before an imminent collision. Those types of technologies are available today in some cars, and manufacturers will increasingly include more advanced safety features in the future. ●

MAKING INNOVATIONS REAL

At TI, we have been helping customers engineer the world for nearly 85 years. To us, this means listening to and understanding our customers' needs and then delivering true innovation that in turn enables them to create innovative products for their customers. We are passionate about delivering value-added solutions that make a difference in the world.

Making strategic acquisitions is just one of the important steps we've taken to accomplish that goal. Over the last decade, TI has acquired several large and small companies that have expanded our portfolio to offer complete analog and embedded processing solutions. Each of these decisions has focused on acquiring products and design expertise that deliver differentiation and value for our customers.

TI also has invested in more than 75 advanced analog process technologies that we – and our customers – believe are fundamental to differentiation in the market. These process technologies range from ultra-low-power that enables our customers to compete in the lowest power environments, to high-precision processes that deliver, for example, advanced operational amplifiers that increase the accuracy of robotic arms. There also is increasing interest in higher power process technology for industrial applications, where we are investing considerable efforts.

The purpose of these capabilities is to deliver analog and embedded solutions that help our 90,000 customers create innovative products and accelerate their time to market. One way we do that is to make it as easy as possible for engineers to evaluate our products, simulate their use and complete their design.

This is an exciting time for TI and for the use of technology to improve the world. Our commitment to building a better future is ingrained in everything we do – from the responsible manufacturing of semiconductors to caring for our employees and giving back inside our communities. For more than 80 years, we have been at the forefront of technical innovation, enabling customers to differentiate products with higher integration, faster speeds and lower power. Today, we are engineering the future with advances in industrial, automotive, energy harvesting, power management, cloud computing, safety and security, health technology and more.



Figure 4: Applications enabled by analog technology

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