Kaivan Karimi
Director of Global Strategy,
Microcontroller Group
Freescale Semiconductor

Interconnected
HOW FREESCALE SEMICONDUCTOR IS POISED AND READY FOR THE NEXT MEGA-TREND: THE INTERNET OF THINGS

importance of reactive power

EXCLUSIVE
HD laser projector for mobile devices
Kaivan Karimi
DIRECTOR OF GLOBAL STRATEGY, MICROCONTROLLER GROUP, AT FREESCALE
How the Internet of Things is taking over the semiconductor industry and how Freescale is poised and ready to lead the way.

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RTZ - Return to Zero Comic

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reescale Semiconductor is a global leader in embedded processing solutions for automotive, consumer, industrial, and networking markets. Their wide array of technologies all contribute to the goal of making the world greener, safer, and more connected. We spoke with Kaivan Karimi, the Director of Global Strategy of the Microcontroller Group at Freescale, about how the Internet of Things is becoming larger than most pre-existing markets and what Freescale is doing to prepare for future IoT technologies.
What was your work experience prior to joining Freescale?

In my early days going through graduate school, I had a research assistantship working with NASA on the ACTS satellite, which led to my involvement with digital communications and ultimately digital cellular communication. Later on I worked as a contractor on some government projects as GSM was coming up and analog standards for cellular were slowly going away. I eventually ended up in the Cadence Wireless Design Services group, which focused on cellular business as well as in connectivity in the early days of Wi-Fi, home RF, and Bluetooth. After leaving Cadence I was part of multiple startups focused on technical product marketing of UMTS platforms, and in 2003, I came to Freescale, where I ran the baseband processing product management on the networking side followed by cellular product management on the handset side. In 2007 I left the business unit to lead our corporate development and M&A functions.

After around three years of leading corporate development, I wanted to come back to the business unit, so I came to the MCU division to lead the strategy function, new business development, and some of the product related activities. That actually coincided with the early days of us looking into how the connectivity landscape was changing—from the perspective of industrial applications and process automation to the up-and-coming landscape of the Internet of Things. We started pulling strategies and products together that would help us in our future product offerings targeted at this emerging market. As an example, we began moving our some of our MCUs to an ARM based platform and put major emphasis on wireless connectivity. Some of those products are coming in terms of new arrows—some are on our roadmaps. Bottom line, it helped us position ourselves for offering the right products for the up-and-coming IoT market.

How long have you been working in the wireless market?

I have been working in the wireless market for 16 years collectively and three years now on the MCU side with a different angle towards wireless, hence a different perspective than a traditional MCU person. Right now the megaphone is in the hand of operators and they define it in a completely different way than the reality of what IoT will be once its fully rolled out. If you look at the Internet of Things from communication and connectivity, it’s completely different from some of the things you read in the press, and that’s part of the reason why most of the material out there is very vague and doesn’t truly describe it from the bottoms up.

Even folks who understand the architecture talk about in terms of machine to machine (M2M). Note that the IoT is not just about M2M but also machine to people, machine to infrastructure and machine to nature. When you only talk M2M, you define the issues as only communication issues, as there is a perceived notion of an existing “machine” which is already intelligent and does something. In reality, the “things” are not necessarily intelligent and need to get embedded processing to become smart before they can communicate.

How do you envision the Internet of Things and the ecosystem surrounding it?

I think the Internet of Things is going to be significantly bigger than a lot of pre-existing markets. It’s going to be about a lot of services, some of which nobody has thought of yet. It’s going to go through one of these curves that the people who “networked” the Internet went through. Who would of thought of Facebook 10 years before Facebook? We’re in a similar situation in regards to the IoT.

When I look at it, I am looking at it from the technology building blocks. I have a graph in my paper that represents it. I started thinking, “Well, the Internet of Things—what are the ‘things’?” What is the taxonomy of the Internet of Things? Then I started looking at the different nodes that will collectively build up the Internet of Things, from the edge/sensing nodes all the way through the cloud. A “thing” could be something like your toaster oven or any appliance, or a bridge on a road or the road itself. When you read about the Internet of Things, the word “smart” shown up all over. “Smart” appliances, homes, cars, etc. The word “smart” is all over the IoT. So what makes something “smart” when previously it was “dumb,” for lack of a better word? What makes your toaster “smart” now and how was it “dumb” before? Well, your toaster used to use a mechanical button to be pushed down and it would be mechanically adjusted for how brown you wanted your toast to be. Now you can add an MCU or an embedded processor to the toaster with a user interface to determine how brown your toast is going to be and it’s more accurate and reliable.

That’s how something becomes “smart.” It’s not by adding cellular connectivity to it—a cellular operator talks about it—but actually by adding a MCU to it.

The next step is to determine how you can connect this “smart” thing. Chances are you do this with a short-range radio of some sort, such as Bluetooth low energy, Zigbee, 802.15.4, and LoRa. There are going to be a handful of short range radios that are going to exist which are going to be communicating via one of the different widgets (Wi-Fi could also be one of them). That toaster is going to connect to a box inside of the home which will be a hub (gateway).

How many applications could be connected to a hub?

If I lived in an apartment building, then every door or window that opens, every appliance, every electrical wall outlet, smoke detector, thermostats, etc., would all be connected to an apartment level hub or gateway. Each of the hubs would have an embedded processor in them and they will be communicating via a short-range radio to a box inside of your apartment which becomes a signal aggregator. That hub would have an embedded processor in it. This signal processor would be able to make a lot of the decisions, from a command and control perspective, locally and pass basic information to the cloud for big data analysis, or pass the majority of the data to the cloud for processing. There is going to be that flexibility all based on the services that will be offered. That example is just for an apartment, but as the IoT grows, there will also be floor-level unit for processing, which will have a hub or gateway. Then there will be building level, and then a neighborhood level gateway. Finally, the last gateway in the hierarchy will start communicating to a gateway server somewhere in the cloud, whether it’s for command and control purposes, or for big data analysis.
When you talk about a smart home, you are also talking about service providers for home health, elderly monitoring and care, home automation, landscape and maintenance, and all kinds of other services that will be offered.

How do you envision the Internet of Things affecting homes?

Today, in my home for instance, I have Internet service, land line phone and mobile phone service. My electricity, water and gas are separate. A while back, my home phone company had a triple play for our neighborhood, so I got my Internet, cable and land line phone altogether from one company. My mobile phone still goes through someone else, but those four services are covered. Still, my security system, electric, water and gas are separate. When you talk about a smart home, you are also talking about service providers for home health, elderly monitoring and care, home automation, landscape and maintenance, and all kinds of other services that will be offered. There will be lots of different companies that will be providing different services to the

IoT is going to be the largest data network in the world. It’s estimated that there will be about 1 trillion devices by 2025. Because of the IoT’s massive scale, each node can be a point of intrusion, so security is a huge issue. If you do an online search on IoT, there are so many creative things that people are talking about, from self-driving smart cars, self-maintaining smart homes, and self-harvesting smart farms, to all kinds of other creative “smart” stuff and applications. Because of those applications, there are endless potential types of edge nodes and the technology that needs to be associated with them. Embedded processing certainly needs to be paired up with some sort of sensor, a power source, and some sort of communication technology. The permutation of all of this gives you a lot of variations.

There is a lot of fragmentation today when you look at the community solution. I believe the dust will settle down to four or five short range wireless communication technologies—there won’t be one standard that’s going to dominate for sure, but there will be a handful of them. There are a lot of legacy systems that would need to be added to the system in order to put them on the network. In these legacy networks, there was no concept of coexistence or a interoperability plan with other systems for services offerings. I will give you an example of that in a little bit for a smart home application.

The product lifecycle for consumer items can be 18 months to 24 months typically. When you’re talking about things that need to be out there for 15 years, it’s a completely different ball game.

“Rolling out the IoT is like rolling out the largest control data network in the world, and each node can be a point of intrusion, so security is a huge issue.”
home and communicating via one gateway box (note that if everything is supposed to be on IPv6 then you only need one box inside your home). The new types of services (like home health or remote education) will probably go along with whatever the standard is that is set for that box. They will accept whatever revenue sharing and business arrangement that is dictated to them.

But if you look at the utility, security and telephone/ISP companies now, most of them aren’t working with each other yet. They are having a hard time defining a standard — in fact, they are defining completely different standards at the moment. Certainly today there is no revenue sharing model that they will all accept. I don’t think there are as many technological issues to overcome to make something like a smart home network work as there are business issues.

All these heterogeneous types of service providers from different industries will have to come together and accept some sort of revenue sharing model so they can all work together and share a single gateway box. Once that happens, the flood gates of additional services will open and your home will become as ‘cool’ and application-driven as your smart phone.

In what way has Freescale been preparing to help customers produce IoT products?

From Freescale’s perspective, I think we’re in a very good position. When I look at embedded processing, and communications processors, we have significant market share on the networking side, with our network edge processors and microprocessors. From an embedded processing perspective at all layers of abstraction, we’re one of the only companies present in every layer of hierarchy — from the edge of the network to the core — and are in a good position to follow trends and respond at the overall system level. We have all categories of customers with whom we’re working as the industry is transitioning from simple automation to the Internet of Things.

We talked about how security is an important thing for the IoT. Some of it is certainly semiconductor-related (hardware and software), some of it is standards-related and some of it is service-related. We are listening to the various parts of the industry and implementing what we believe is required from a semiconductor, hardware and software perspective. We are also bringing ecosystem partners to help us as well as adding a secure service level infrastructure on top of what we already provide.

We also have excellent sensor offerings. Again, when you look at sensors and actuators and all of that collectively which exists on the edge of the network. We also have some initiatives and work we are doing with our partners that takes our collective offerings one layer higher. We have a home health hub reference platform on which we are working with our partners where we provide the semiconductor content and our partners provide system solutions and software.

With sensor fusion on the health side, we have original research with Dr. Jose Fernandez on how to use sensors and embedded processors to remotely sense and read people’s emotions along with other types of health-related applications. So we have original research, a platform with real example applications and we are looking at the IoT from a variety of perspectives — from the device to the edge of the network and then all the way to the core of the network as well as the service layer.

Now that Freescale has its sights set on the IoT, what is the next step for the company?

We’re tuning our overall portfolio for IoT applications, including our short-range communication products, MCUs and MPUs and all of the supporting development environment, along with our partners. We just announced a microcontroller, the Kinetis® KL02 MCU, which is small enough to be swallowed for potential medical applications. It is tiny -1.9 mm by 2mm - and uses extremely low power consumption but has full 32-bit functionality needed for the robust communication and sensing needs of IoT edge nodes.

These are definitely a different class of products compared to traditional product families, and while I can’t say there are revolutionary changes to the products here, they are significantly optimized for the applications from the power consumption, size and range of devices perspectives. It’s worth noting that almost everything for the IoT is evolutionary stuff — things that exist today but can be optimized for IoT use. And so for the IoT, one size will not fit all. You need to think about different types of applications and then tune your product offerings to be focused for optimum performance. This means a very broad portfolio to support diverse users.

PartSim includes a full SPICE simulation engine, web-based schematic capture tool, and a graphical waveform viewer.

Some Features include:

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- AC/DC and Transient Simulations
- Schematic Editor
- WaveForm Viewer
- Easily Share Simulations

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TRIAC-dimmable LED Driver IC

Designed for compact LED replacement lamps, LinkSwitch-PL enables very small and low cost TRIAC dimmable, single-stage, power factor corrected, constant current drivers for solid state lighting. LinkSwitch-PL is optimized for direct LED current sensing, operates over a wide input voltage range and delivers output power up to 16 W. Its innovative control algorithm provides flicker-free TRIAC dimming with minimal external components. The IC is optimized for non-isolated flyback designs and has a fast start-up time. For more information, click here.

Second Generation SolarBIT Products

IXOLAR SolarBITs are IXYS’ product line of SolarBITs made of monocrystalline, high efficiency solar cells. The IXOLAR SolarBITs is ideal for charging various battery powered and handheld consumer products such as mobile phones, cameras, PDAs, MP3-Players and toys. They are also suitable for industrial applications such as wireless sensors, portable instrumentation and for charging emergency backup batteries. For more information, please click here.

DOLAR SolarBITs are IXYS’ product line of SolarBITs made of monocrystalline, high efficiency solar cells. The DOLAR SolarBITs is an ideal for charging various battery powered and handheld consumer products such as mobile phones, cameras, PDAs, MP3-Players and toys. They are also suitable for industrial applications such as wireless sensors, portable instrumentation and for charging emergency backup batteries. For more information, please click here.

Buck Controllers for Precision Dimming LED Drive

Mouser Electronics, Inc. now stocks EPCOS B3267xP Film Capacitors, a reduced volume series that offers the same capacitance value as the current film capacitor product. EPCOS B3267xP Metallized Polypropylene Film Capacitors are 40% smaller than the current product and offer other significant features including very high ripple and peak current, high frequency AC operation capability, and high voltage capability. In addition, these compact film capacitors have excellent self-healing property, capacitance range from 0.068µF to 2.2 µF, and operating temperature up to 125°C. For more information, click here.

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FEATURED PRODUCTS

**Intrinsically Safe Fuse for Hazardous Locations**
Littelfuse, Inc., has introduced an intrinsically safe fuse for hazardous locations. The fuse is hermetically sealed, with an encapsulated design that is well suited for 125V applications. The current rating options range from 62mA to 5A in order to function in a range of hazardous environments. The fuse encapsulation prevents heat and sparks from being exposed to the hazardous gases or dust in the environment. This eliminates the need for an additional potting, epoxy, or encapsulation process for the fuse, thereby reducing total product cost. For more information, click [here](#).

**Starter Kit for MCU Family**
The MPLAB Starter Kit for PIC24H MCUs is a complete hardware and software kit for exploring the power of PIC24H family of MCUs for multi-tasking needs. With a built-in debugger on the board, simply install the software and connect the USB cable to the PC. The starter kit features PIC24HJ128GP504 MCU with 128 KB Flash and 9 KB RAM as the computational unit. A tri-axial accelerometer is provided for acceleration detection. For more information, please click [here](#).

**Single Modem AISG Transceiver**
The ASC3011HN transceiver is a highly integrated DSP based AISG modem with software programmable parameters that can be used on tower mounted devices or base-stations. The device has a small form-factor HVQFN64 package to enable an optimized design with very low component count. The device can be used with the AISG compliant factory settings. Through the I²C bus, the settings can be changed and stored in on-chip non-volatile memory. The device has a very low component count. For more information, please click [here](#).

**Micro Power Touch Screen Controller**
AKM Semiconductor, the world’s premier supplier of audio ICs for professional and consumer markets, launched the AK4186, a low operating voltage resistive touch screen controller (TSC). This new device, an enhanced version of the widely-used AK4183, includes both 4-wire and 5-wire touch screen control interfaces. It is ideal for limited-space smartphone applications, reducing PCB space by 80% using a micro CSP package. This high speed operation enables faster coordinate transformation. For more information, please click [here](#).

**Precision Digital Power Monitor**
The ISL28022 is a bi-directional high-side and low-side digital current sense and voltage monitor with serial interface. The device monitors current and voltage and provides the results digitally along with calculated power. The ISL28022 provides tight accuracy of less than 0.3% for both voltage and current monitoring over the entire input range. The digital power monitor has configurable fault thresholds and measurable ADC gain ranges. For more information, please click [here](#).

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Logiscope transforms an iPhone, iPad or iPod into a 100MHz, 16 channel logic analyzer.

Not only is it the most intuitive logic analyzer available, the triggering is so powerful you’ll be able to count the hair on your bug.
Although Compound Photonics has been around for 8 years, you may not have heard of them until recently. That’s because the company has been operating “stealth mode,” developing a potentially game-changing technology for smartphone and tablet devices. After acquiring the laser component part of Alfalight, Inc.—an integrated laser systems company based out of Madison, Wisconsin—Compound Photonics is pleased to announce its full HD light engine that are fully embeddable into smartphones, tablets, and other mobile devices.

We spoke with Scott Niesen, Director of Marketing for Compound Photonics, about the importance of this acquisition, the remarkably small size of their projector, and the potential 3D projection capabilities in the not-so-distant future.
AllAlight’s Appeal

In order to make this HD laser projector possible, Compound Photonics needed to find a laser diode that was efficient enough to run off of a mobile device’s battery. That’s where AllAlight came in. The commercial laser component part of AllAlight brought two essential technologies into Compound Photonics’ technology portfolio. “AllAlight had set the benchmark for laser diode efficiency at 60,” Niesen told us, “this means that they take 60% of the power coming into the laser diode and translate it into light output.” This capability allows for the projector to have extremely high performance coupled with an efficient light engine, which is crucial for mobile device components.

The other technology AllAlight brought to the table was its wavelength stabilization technology. When a device pumps out laser light as a projection, it’s important to maintain consistent color quality that doesn’t vary. “With AllAlight’s wavelength stabilization technology,” Niesen stated, “the light coming out of the laser has a very small tolerance for variation within wavelengths.” With the acquisition finalized, Compound Photonics is in the advanced stages of development for their HD light engine. The light engine integrates the full HD imager, projection lenses, and laser illumination. The light engine includes an application-specific integrated circuit (ASIC) to tell the lasers when to fire and control the pixels. “The ASIC essentially does all the interpretation of the video source coming in.”

The HD Projector

The technology for the embeddable HD projector was palpable after the acquisition, which meant that Compound Photonics could finally emerge from “stealth” mode. The company appeared in October of 2012 to let everyone know that they had been working on a full HD laser projection light engine that could be embedded in smart phones, tablets, and other mobile devices. Their product is unique in that it is a completely vertically integrated light engine design. Niesen clarified: “By vertically integrated, I mean that we will make the full HD imager, which is a liquid crystal on silicon.” The device is full 1080p, meaning there are 1,920 pixels across the top, 1,080 pixels running top to bottom, which gives it a 2.2 megapixel display that is 1/3 inch in diagonal. The resolution is amazing given that this is such a tiny module. In demonstrations of the device, the team was showing a 40- and 60-inch diagonal image in a dimly lit room. Obviously the smaller the image, the brighter it will be, because the light is closer to the surface. The goal, according to Niesen, is to get the projector to be able to show a 30- to 40-inch diagonal image in ambient lighting. The team is currently working with handset manufacturers to figure out where the projector can be placed in smartphone device. “It makes sense if you think about holding a smartphone,” Niesen explained, “You’d be holding it horizontally and you would have your content on the smartphone display.” The device with the HD projector would also come with an intuitive UI. “The UI would show all of the different things you could do with the projector, in terms of brightness and video settings.”

Potential Applications

With the unique capabilities of an HD projector in a smartphone device, a seemingly endless array of applications will come about. Since this projector will be implemented in smartphone and tablet devices, user control of power and battery life is a critical component. “The way we approach this is from a perspective of lumens per watt,” Niesen stated, “Lumens are a measure of brightness and obviously watts are a measure of power.” Therefore, if you want to project a two-hour movie on your smartphone, the user might want to think about connecting the phone to their charger. Conversely, if you are merely showing a friend a short, 6 minute YouTube video, the user could go full brightness on battery power for the duration of the video. The way that Compound Photonics is designing the UI for the module will allow the user to have a lot of controls over these different variables. If the user wants high output (in terms of brightness) for a short period of time, or if they want to extend battery life, that can all be adjusted. “We can give the user an intuitive control,” Niesen said, “That way, the user can set the desired brightness settings through the UI on the phone.”

Compound Photonics recently did a survey with mobile application developers to get an idea of what can be developed for the HD projector. “One of the interesting findings in that study,” Niesen told us, “was that the app developers think that projection would be used in conjunction with all of the other functionality that’s integrated into your phone.” These functions range from still or video cameras, GPS, voice recognition, and even touch or gesture recognition. Compound Photonics is also working to design a projector with 4k capabilities, which is essentially ultra high definition. As of now, it can’t be used in mobile devices, but could be used to create compact, high-resolution 3D-capable front projectors. The futuristic 3D projectors seen in sci-fi movies are suddenly not too far-fetched.

“I’ve been in the hardware business for a long time,” Niesen told us, “I’ve taken the perspective that the hardware always comes first and then the people figure out what to do with it.” This was certainly the case with smartphones when they first hit the market. “I don’t think anybody thought GPS would be integrated in your smartphone when they came out,” Niesen said, “Now, Google tells us where to go and how to get there.” Niesen has high hopes for the HD projector; “I think the same thing will happen with having the ability to project what’s on your phone.” The possibilities in these early stages are already unlimited in what the potential applications could be.
The ISL6730A, ISL6730B, ISL6730C, ISL6730D are active power factor correction (PFC) controller ICs that use a boost topology. The ISL6730B, ISL6730C, ISL6730D are Coming Soon. The controllers are suitable for AC/DC power systems, up to 2kW and over the universal line input.

The ISL6730A, ISL6730B, ISL6730C, ISL6730D are operated in continuous current mode. Accurate input current shaping is achieved with a current error amplifier. A patent pending breakthrough negative capacitance technology minimizes zero crossing distortion and reduces the magnetic components size. The small external components result in a low cost design without sacrificing performance.

The internally clamped 12.5V gate driver delivers 1.5A peak current to the electrical power MOSFET. The ISL6730A, ISL6730B, ISL6730C, ISL6730D provide a highly reliable system that is fully protected. Protection features include cycle-by-cycle overcurrent, over power limit, over-temperature, input brownout, output overvoltage and undervoltage protection.

The ISL6730A, ISL6730B provide excellent power efficiency and transitions into a power saving skip mode during light load conditions, thus improving efficiency automatically. The ISL6730A, ISL6730B, ISL6730C, ISL6730D can be shut down by pulling the FB pin below 0.5V or grounding the BO pin. The ISL6730C, ISL6730D have no skip mode.

Two switching frequency options are provided. The ISL6730B, ISL6730D switch at 62kHz, and the ISL6730A, ISL6730C switch at 124kHz.

**Features**
- Reduce component size requirements
- Enables smaller, thinner AC/DC adapters
- Choke and cap size can be reduced by 66%
- Lower cost of materials
- Excellent power factor over line and load regulation
- Internal current compensation
- CCM Mode with Patent pending IP for smaller EMI filter
- Better light load efficiency
- Automatic pulse skipping
- Programmable or automatic shutdown
- High reliable design
- Cycle-by-cycle current limit
- Input average power limit
- OVP and OTP protection
- Input brownout protection
- Small 10 Ld MSOP package

**Applications**
- Desktop computer AC/DC adapter
- Laptop computer AC/DC adapter
- TV AC/DC power supply
- AC/DC brick converters

**Table 1. **Features in Family of ISL6730

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Reactive Power Part 1: What it is; why it is important

There is a global trend toward adding dynamic reactive devices to serve urban load areas.

P. Jeffrey Palermo
Executive Consultant
DNV KEMA Energy & Sustainability
A number of interrelated factors contribute to this increasing use of dynamic reactive devices, such as the following:

- Many urban areas are experiencing a growth in load levels. These urban areas also see less generation close to the load center. Either legacy generating units have been retiring or they are operating less, because they are less efficient than newer generators. Losing these generators reduces the amount of local power generation and dynamic var support available in the urban areas. As a result, urban areas often rely on increased power imports to serve their load.

- Increased power imports tend to reduce local transmission voltages, which, in turn, reduce the effectiveness of various devices that support the local voltages. In the extreme, this could become a kind of voltage spiral of death.

- In many cases, there is enough transmission thermal capability to deliver the needed imports, but there are increasingly frequent periods where voltage/var factors limit system operation.

- Public opposition to new transmission lines is also common.

- In many deregulated markets, there are limited means to require or encourage generator construction or to schedule power outside the normal generation dispatch market. In other markets, requiring generators to operate outside normal economic dispatch can be very costly. These urban areas, however, often face an underappreciated risk associated with the addition of these complex dynamic reactive devices.

### Reactive Power and Why it is Important

Fundamentally, electrical power is developed, delivered, and consumed as voltage and current. In a simple direct current (DC) device (like a flashlight), the power (the brightness of the bulb) is the voltage times the current, which is measured in watts. Watts are a measure of the ability of a device to perform useful work. This is what is called real (and sometimes active) power because it can produce useful (real) work.

In alternating current (AC) systems—like all modern power systems—things become a bit more complicated. Common customer load devices—especially motors—have inherent characteristics that shift the relationship between current and voltage. This shift is measured in volts—from the French term Volt-Ampere reactive. Since much of the power system load is motors in factories, businesses, and homes, this becomes a significant issue for utilities. Transformers and transmission and distribution lines and cables also have characteristics that contribute to this shift.

Increasing var load reduces the ability of the system to deliver real power and perform useful work. In extreme cases, a high var load can shift the voltage and current so much that it reduces the power system’s delivery capability so that almost no active power can be delivered. There can also be other undesirable effects like low voltages and increased equipment heating and system losses.

While reactive power does not provide useful work, it is essential for AC transmission and distribution systems, motors, and many other types of customer loads.

### Compensating for reactive loads

The shift of motors and other reactive loads can be offset using compensation devices. Reactive compensation commonly comes from three types of devices:

1. **Capacitors** are the largest source of compensating reactive power and are commonly used throughout the power system.

2. **Synchronous condensers** are a type of rotating machine—like a generator—but they do not produce real power, only reactive power. There are also other devices that use high-power electronics to rapidly control reactive power from large banks of capacitors.

3. **Conventional generators**, in addition to supplying real power, are an important source of reactive power.

Reactive power loads must be supplied either locally from customer-owned devices or from the system itself. It is almost universal for some of the reactive load to be compensated locally as power-factor correction. Power factor is a measure of the relation between real and reactive power. The power factor ranges from 0.0 to 1.0, where 1.0 means there is only real power (no reactive power); 0.0 means there is no real power, only reactive.

### The Difference Between Passive and Dynamic Reactive Resources

While there are various differences in the hardware involved, the main distinction between passive and dynamic reactive resources is how quickly they can respond to the changing needs of the power system.

- **Passive reactive** sources are devices with fixed var ratings, which can be connected or disconnected (switched) as system conditions change. The most common passive device is a capacitor. Capacitors can be permanently connected or switched throughout the day. The switching action can be made in a few seconds using automatic controls. (The response is much slower if it depends on manual actions by a system operator.)

- **Dynamic reactive** sources are active devices that can provide variable amounts of reactive power in a few milliseconds. Common examples are static var compensators (SVCs), static synchronous compensators (STATCOMs), synchronous condensers, and conventional generators. All are capable of rapid dynamic response. Some types of renewable generating sources are also capable of providing dynamic reactive support using power electronics and other means.

DNV KEMA recently completed a study where several dynamic reactive sources (SVCs) were needed to reach full output in 10 milliseconds (0.01 seconds). These static var devices then needed to continuously swing from maximum to minimum output to maintain stability within the first 10 seconds. Such a response is not possible with switched passive devices.

### About the Author

Mr. Palermo has more than 35 years of experience in the power sector, with specific expertise in system planning and sector restructuring. At DNV KEMA, Mr. Palermo is responsible for system planning and operating studies of generation and transmission systems within a range of multi-utility coordination schemes. He advises and assists utilities in developing and evaluating transmission plans—including a wide range of system analyses using a variety of steady-state and dynamic system analysis tools and techniques.

Mr. Palermo has appeared as an expert witness before FERC, Congressional committees, state legislatures, state and federal courts, arbitration panels, and state and provincial utility commissions. He has provided numerous lectures on restructuring, system planning, and system operation.
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Placeshifting Video
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Anthony Wong
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Video is everywhere, available to users of handheld devices with Internet broadband access virtually any time, any place, and in many formats. One of the major consumer electronics industry challenges in recent years has been to conveniently, seamlessly, and consistently deliver video across a broad range of formats.
The solution is "placeshifting," which allows consumers to watch live or DVR-recorded content on any wireless device. Placeshifting enables viewing and listening to live, recorded, or pre-stored media on a remote device (computer, tablet, mobile phone, or TV) over the Internet or over a data network. Placeshifted content can be enjoyed in any location; users can watch sporting events, news programs or comedy shows at home, at work, on the move, in a hotel room or in their favorite coffee spot.

To stream "mobile-device-friendly" full HD-resolution content requires the use of transcoding technology, because mobile devices cannot handle MPEG-2. Transcoding adjusts the bit rate required to send the stream over a low-bandwidth network. The optimal transcoder can output the stream for any mobile device. The latest placeshifting technologies use the proven H.264 standard, with its successful application in handheld devices including today’s popular smart phones and small cameras. Compact, low-power ICs now allow widespread deployment of products capable of playing H.264/AVC video at standard definition and with HD TV resolutions. In these handheld and mobile devices, H.264 combines high quality with low memory sizes, allowing for seamless video.

As the most widely used video-encoding format, H.264 supports the HTML5 video tag, and is supported on every Blu-ray digital video disc (DVD) player, plus most Flash and Silverlight players. The format’s efficient hardware-acceleration capability delivers excellent, high-definition video even on inexpensive mobile and handheld products. The decoding takes place inside the processor; no additional software support is required.

Another H.264 benefit is the ability to use video taken directly from a camera on the web with no need to encode it. This is significant because the same video with different encoding typically needs additional software support, consuming power and slowing the process.

Mobile Devices and "Placeshifting"

To meet the audio and video specifications of playback equipment, the ideal H.264-compliant device provides robust and reliable bidirectional H.264/MPEG transcoding of audio data for multiple formats. Translating adds the ability to convert H.264 video data into H.264 formats of various video resolutions and bit rates.

The ICs needed to enable the technology must be flexible, so they can fit the various formats, resolutions and bit rates that differ throughout the world. For example, Japan and the United States use MPEG-2 for broadcasting, while Europe, South America and most of continental Asia use the H.264 specification.

Power requirements also have to be minimized, and footprints need to be compact. New generations of devices reduce power consumption below 1.2W when using the H.264 transcoding function in full, high-definition mode. This is achieved by using miniaturization technologies and by incorporating memory into the device. As with many other audio and video ICs, the small footprint makes it possible to use the devices in home electronics equipment, smart phones, and other mobile and portable equipment.
Fujitsu’s proprietary transcoding technology delivers industry-leading levels of low power consumption and integrates 1GB of Fast Cycle RAM (FCRAM). The built-in memory technologies and miniaturization process technologies hold power consumption to 1.2W. Connecting two tuner modules to two tuner input terminals enables simultaneous control of a program as it is being viewed and of another program as it is being recorded.

The MB86M01/M02/M03 series also reduces the delay time required during transcoding, which speeds distribution over a network. This represents a significant improvement over Fujitsu’s first-generation transcoding products. Those products, the MB86H57 and MB86H58, have been widely used in home electronics equipment and mobile products to deal with format-conversion issues while maintaining good video quality. Since demand for wireless distribution of HD content to mobile devices is growing rapidly, Fujitsu designed the new series to meet the specific requirements of multiple regions and bandwidth constraints. The combination of low power requirements, compact footprint, embedded memory and transcoding functionality enable the placeshifting and other capabilities required to bring all the benefits of H.264 to mobile products.

About the Author

Anthony Wong is a senior marketing manager with Fujitsu Semiconductor America based in Sunnyvale, California. He has more than 15 years of technical and business management experience in the semiconductor industry. He is currently engaged in ASSP marketing and corporate strategies.

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