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Will ASICs be replaced in comms gear?

By Rick Merritt

NICK MCKEOWN, an engineering professor at Stanford University, expects a new breed of merchant networking processors to replace ASICs in routers and switches over the next decade. McKeown says he has looked into the future of communication processors “and if you squint hard it looks like RISC for networking.” McKeown helped kick start the movement toward software-defined networking based on the OpenFlow protocol. Its goal is to enable a new class of software apps that manage gangs of simplified switches and routers.

If the effort succeeds it could ease and lower the cost of running large data centers and business networks. It will also disrupt the current business model based on expensive network gear that uses complex ASICs and proprietary code. McKeown sees a new breed of merchant chips taking the place of the big ASICs companies such as Alcatel-Lucent, Cisco, Ericsson, Juniper and others design today.

The first attempts at creating them likely will emerge over the next two or three years, he said.

In a research effort with Texas Instruments and others, McKeown created a prototype on paper of the new device. It essentially consists of a parsing engine that interprets the increasingly wide set of headers on each packet then pushes the packet into a pipeline of execution units that match patterns in the headers and take actions on them.

“It's a brute force feed-forward pipe of match and action, match and action,” he said, relating work in a paper now under review for publication. The paper reports that for 15 percent more silicon area and power such a chip could handle any current or future protocol at the same performance levels as today's protocol-specific ASICs. McKeown predicts that in a decade the big router and switch players will have replaced their ASICs with such merchant chips and morphed into software companies.

“We'll look back in 10 years and they will be providing control plane software and apps on top of it,” he said. Two or three companies are said to be exploring such chips already including startup xPliant and existing players such as TI and possibly Cavium and Mellanox.

“Merchant silicon is one of the prime drivers of this movement,” said McKeown. “The incumbent chip vendors such as Broadcom and Marvell are adding OpenFlow support to their switches already -that’s what they should do, and they have been involved from the start,” he said.

McKeown sees a new breed of merchant chips taking the place of the big ASICs companies such as Alcatel-Lucent, Cisco, Ericsson, Juniper and others design today.

A chicken-and-egg dance

It will be revolution by evolution as the new software and new hardware emerge in a chicken-and-egg dance. The current 1.x versions of OpenFlow represent a compromise. “Ideally we would have started it as a generic match-and-action flow, but it had to be mapped on to existing chips—the next generation will be more protocol independent,” McKeown said.

Last year, the Open Networking Foundation (ONF) that oversees OpenFlow engaged ASIC makers in a so-called Forwarding Abstractions working group. It aimed to narrow the gulf between what OpenFlow wants to enable and what existing and planned ASIC do.

Now ONF is starting a new effort it calls a chip advisory board. “We will learn from them what’s possible [in silicon], and out of that will emerge what’s possible for the next generation of OpenFlow,” he said. OpenFlow began using content-addressable memories as an intermediary to interface to router and switch ASICs, but the approach limited its functionality. More recently it has used a technique of matching multiple tables.

“The protocol independent version [of OpenFlow] will take a while,” McKeown said.

An evolving software stack

On the software side, the pieces of the code to enable software-defined networks are still emerging as are the people who will write it. Startups including Big Switch Networks and Nicira, now part of VMware, already have their own versions of OpenFlow controllers. Earlier this month, eighteen large comms and software vendors launched Open Daylight, an effort to create open source code for SDN controllers, the APIs for apps that ride on it and maybe more.

Observers expect the giants to jostle over whose code becomes part of Open Daylight. If a solid product emerges they say companies such as IBM will make money selling integration and services using it—but that could be two or three years away.

McKeown uses the metaphor of Posix, a standard set of APIs for what became Linux. It took a decade for the various flavors of the operating system to settle down to a stage that the Posix APIs could be written. The same may be true for the APIs the enable software-defined networking, he said.
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Impulse-radio ultra-wide band IC takes the lead on accurate geo-positioning

By Julien Happich

FABLESS SEMICONDUCTOR COMPANY BeSpoon and CEA-Leti have just demonstrated an Impulse radio ultra-wide band (IR-UWB) integrated circuit able to measure distances within a few centimetres of accuracy. During their experiments with early prototypes, the companies have established what they claim to be a world-record operating range at 880m when following IR-UWB’s standard regulation and 3,641m in compliance with the regulation for emergency situations.

The chip jointly designed by BeSpoon and Leti features a full IR-UWB CMOS-integrated transceiver that is able to perform accurate distance measurements. The stand-alone chip (RF front-end and digital base band) was designed to be “smartphones-friendly” in the sense that it could leverage the components already available on most smartphones to become operational, allowing OEMs to design-in the new capability for only the cost of the new chip.

CEA-Leti had worked on UWB for the past 12 years, initiating its first research program on the topic in 2000. It is only after a decade of explorations and dead-end pruning that some results became commercially exploitable, explained Pierre-Damien Berger, a researcher at CEA Leti.

This is when Jean-Marie André, now BeSpoon’s CEO, got convinced that the technology could yield new functionalities and new services around very accurate geolocation. It took another three years of investigations under a joint research program established with CEA-Leti for BeSpoon to cover the gap between its initial proof of concept and product industrialisation.

“From the very beginning, there were several companies interested in this technology, but few had the expertise to cover the last mile, from academic results to a real product!” explained Jean-Marie André. “Now we have several big names among our strategic partners, large system integrators who are currently exploring different use cases and who would be our first customers if we can supply them the chips in volume.”

Several wafers were produced at CEA-Leti and André expects the IC to ramp up in volume production in “several quarters”, probably early next year, to be produced using STMicro’s foundry services.

“Today, about 95% of indoor positioning solutions rely on WiFi signal strength which varies a lot, hence the fairly low accuracy within a meter at best if you don’t move too much” jokingly commented André. “So far, all commercial IR-UWB solutions were based on discrete components assembled on a PCB. These were not cost-constrained applications and tuning the timing for synchronisation and signal modulation could be done by changing a few capacitor values until the solution worked for the intended application”, explained André, “whereas integrating everything into a single chip was the real challenge, and very few labs in the world are able to do that. We are aiming at consumer volumes and our chip is extremely optimised and price constrained”.

Combining a UWB radio receiver and transmitter with signal drivers and a precise timer for synchronisation and modulation, each chip is able to track various signal paths and find out which one is the earliest to arrive (with the shortest distance travelled being the line-of-sight) based on precise time-of-flight measurements.

Because radio waves travel at the speed of light, a 1ns time delay represents 30cm of travelled distance. “Designing a circuit able to provide accurate timing to within a few hundred picoseconds was extremely challenging” emphasized André, “the actual chip has a proven timing accuracy below 120 picoseconds, which translates into a positioning accuracy of under 5cm.”

This precision is not affected by walls or people passing by, offering a very robust solution to indoor location. In one use-case, BeSpoon thinks the chip could be used for mobile geofencing, whereby user-defined tracking distances could be set between a mobile phone or a portable belt-tag and other electronic devices (for example a laptop, a cashier’s desk to be unlogged, car keys). The belt-tag or the smartphone could then alert the user in case these belongings were left too far behind.

For precise indoor geolocation, existing WiFi hotspots which are currently used for positioning via signal strength triangulation could be upgraded with a USB dongle bearing BeSpoon’s IR-UWB chip. Jean-Marie André feels BeSpoon could have a future as exciting as that of companies who pioneered Bluetooth and WiFi. At first, the IR-UWB chip could be used in combination with other RF technologies. In a later stage of adoption, it may end-up being integrated with other compatible RF blocks into radio modules or even licensed as an IP block for chip integration.
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Software defined networks snare open source spotlight

By Rick Merritt

EIGHTEEN MAINLY LARGE communications and software companies have created the Open Daylight Project in the Linux Foundation to develop open source code for software-defined networks (SDNs).

The group will develop a wide range of software including an SDN controller and an applications interface for it with the first elements slated for release this fall.

SDN aspires to ease the job of programming large networks by abstracting details of network functions today expressed in many complex protocols and ASICs. Operators will then control network functions using applications and high-level programming languages running mainly on Linux servers.

The group aims to deliver a full stack of SDN software including north- and southbound OpenFlow APIs.

The 11 founders consist mainly of established companies for which the move to SDN is a potentially disruptive influence. The founders are Big Switch Networks, Brocade, Cisco Systems, Citrix, Ericsson, IBM, Juniper Networks, Microsoft, NEC, Red Hat and VMWare. Silver-tier members consist of Arista Networks, Dell, Fujitsu, HP, Intel, Nuage Networks (the new SDN unit of Alcatel-Lucent) and PlumGrid.

The group promises to build both north- and southbound application programming interfaces (APIs) for its SDN controller. It also plans to develop open source code for “a virtual overlay network, protocol plug-ins and switch device enhancements,” according to its press statement.

Big Switch and Cisco separately will propose contributing at least some code from their SDN controllers to the project. IBM will submit an open-source version of its Distributed Overlay Virtual Ethernet (DOVE) technology as its initial contribution.

A battle for the control of SDN’s future may emerge between the ONF and Open Daylight, especially around APIs for OpenFlow. In addition to having several technical working groups of its own, ONF runs the largest annual SDN event, the Open Network Summit.

The Open DayLight code will be licensed under the Eclipse Public License, the same approach used for Java-based projects. The Linux Foundation said the project will be run like other open-source collaborations. The group’s software will not necessarily be confined to run on Linux but could support other operating systems, too.

Open Daylight appears to be an attempt by large established comms and software companies to counterattack a rising group of mainly startup companies who were among the first to roll out SDN products. However two of the most high-profile startups are also involved in the effort, Big Switch and Nicira, acquired last year by VMware for more than a billion dollars.

Indeed, SDN is often described as virtualization for the network, just as VMware, Citrix, Microsoft and others now provide virtualization for servers. However today’s networks are much more complex than servers with dramatic variations among competing vendors expressed in silicon and low-level software protocols.

The latest move harkens back to the early days of Unix in computing as well as more recent open-source efforts in server virtualization such as OpenStack. As with Linux, free open-source SDN code could gain market dominance, disrupting early players with proprietary software.

However it’s still early days for SDN with lively debates about exactly what the term means and how its benefits should be delivered in products. In addition, the complexity and proprietary nature of today’s networks prevents any quick or easy roads to SDN.
Germanane beats graphene

By R. Colin Johnson

Researchers at Ohio State University (Columbus) have devised a new method of depositing germanium in atomically thin layers, boosting its performance 10-times over silicon -- making it an easier-to-fabricate alternative over other next-generation materials like graphene.

“We have been able to fabricate a germanium analogue of graphene - monolayers which are terminated with hydrogen just like graphane materials, but which are much easier to fabricate,” said professor Joshua Goldberger at Ohio State. “In the process, we also converted it from an indirect bandgap to a direct bandgap material, making it suitable for optical applications as well.”

Crystalline monolayers of hydrogen-terminated germanane (right) were synthesized by dissolving sacrificial calcium layers (left) with hydrochloric acid. Source: Ohio State.

Goldberger claims to have for the first time synthesized millimeter-scale pure crystalline lattices of hydrogen-terminated germanium (GeH) from the topochemical de-intercalation of CaGe2, which he describes as a layered van der Waals solid analogous to terminated graphene (CH). Goldberger has dubbed his material “germanane” to liken it to the monolayer version of graphene called “graphane.”

Besides being based on germanium instead of carbon like graphene, the biggest difference between the materials is that germanane has the potential to be more easily grown using conventional semiconductor fabrication equipment than graphene. He predicts that the new material will be useful in fabricating next-generation optoelectronic devices and advanced sensors, since calculations predict that its electron mobility will be five-times better than bulk germanium (10-times higher than silicon) with a bandgap of 1.53 eV (slightly higher than gallium-arsenide).

Graphene researchers have already demonstrated that the electronic properties of semiconductor monolayers can be striking better than those of the bulk material, spawning numerous efforts to create functionalized monolayers of other bonded crystal structures. Higher carrier mobility is achieved by virtue of the ultra-thin topologies, but by terminating these monolayers with ligands for specific applications, the ultra-thin materials can also be made far more sensitive than bulk material for sensor applications.
Organic image sensors sensitive to X-rays, visible and near IR spectrum ranges

By Julien Happich

NIKKOA SAS CARRIES on its organic image sensors technology developments by extending its sensitivity to X-rays, and validates its compatibility with substrates based on CMOS technology. The company has produced several innovative organic image sensors, thereby confirming the potential of its thin film organic technology.

NIKKOA’s technology consists in depositing thin films of photosensitive organic materials onto active or passive reading substrates. Current products are mainly based on TFT backplanes on glass, with a sensitivity optimized in the visible and/or 700/900nm spectrum range. The first evaluation cameras based on these sensors have already been shipped to the company customers and two new product families are now feasible: X-ray sensitive image sensors based on 256x256, 98µm-pixels organic image sensors, coupled with a CsI scintillator optimized for 70-90keV energy, and VGA CMOS sensors with 15µm-pixels based on organic photodiodes and CMOS pixel arrays.

“The extension of the sensitivity to the X-rays range and the application of Nikkola’s technology to various types of substrates (TFT or CMOS) enables, in the very short term, the production of large area visible, IR or X-rays image sensors at an extremely competitive cost structure compared to existing technologies, as well as the production of CMOS image sensors sensitive in the infrared beyond the cut-off wavelength of the silicon” said Alain Jutant, President of Nikkola SAS.

These developments especially enable the production of image sensors immediately interesting for dental radiography and some security applications. They also enable other combinations such as the production of small size, high resolution, SWIR-sensitive CMOS image sensors at a very low cost structure, opening up new imaging solutions in the medical or automotive markets.

Novel process could reduce OLED manufacturing costs

By Christoph Hammerschmidt

WITH OLEDs CURRENTLY in the early phase of commercial production, manufacturing processes are subject to optimization. A dissertation thesis published at the University of Aachen could enable manufacturers to significantly reduce production costs.

According to the thesis submitted by researcher Manuel Boesing, a significant reduction of OLED production cost could be achieved by employing organic vapor phase deposition (OVPD). OVPD is a process for depositing organic thin films from the gas phase. Compared to the well-established process of vacuum thermal evaporation (VTE), OVPD allows to achieve much higher deposition rates (and consequently a higher throughput), Boesing states. Furthermore, OVPD allows to process complex device structures with high reproducibility. This holds especially true for devices containing multiple mixed layers consisting of several different materials.

Boesing's research focuses on the development of OVPD-processed highly efficient white emitting OLED for general lighting. Different organic light emitting materials (phosphorescent as well as fluorescent) were investigated with respect to their compatibility with the OVPD process. In this context, Boesing processed and characterized a number of monochrome OLED with respect to their electro-optical properties.

Using the investigated phosphorescent materials in an optimized device structure, an external quantum efficiency (EQE) higher than 17% was achieved. Using the investigated fluorescent materials in an optimized device structure, an EQE of up to 7.9% was achieved. This surprisingly high efficiency (fluorescent materials typically exhibit an EQE of only 5%) can be explained by a partial conversion of excited triplet states into excited singlet states. Based on the obtained results, different approaches for white emitting OLED were tested. By (vertically) combining a blue fluorescent emitting layer with a red and green phosphorescent emitting layer in one single OLED unit (single unit OLED) a white OLED with a maximum power efficiency of 16 lm/W was obtained. However, an efficiency of about 30 lm/W could be reached by (laterally) combining three monochrome OLED units in one device (multi-unit OLED). To increase the efficiency of a multi-unit OLED, the researcher tried to improve its light out-coupling efficiency (which is typically only about 20% for devices of this type) by placing an inorganic semi-transparent reflector layer at the anode side of the organic layer stack (in order to create a weak micro cavity together with the reflective cathode). While for blue emitting OLED no efficiency improvement was obtained, this approach almost doubled the luminous efficiency of red emitting OLED, reaching a luminous efficiency of 60 lm/W and an EQE of 21% at 200 cd/m².

For a white emitting OLED consisting of monochrome pixels, this corresponds to an efficiency improvement of more than 30%, so that an overall efficiency of about 40 lm/W can be obtained.
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TSMC starts FinFETs in 2013, tries EUV at 10 nm

By Rick Merritt

FACING HEATED COMPETITION from Globalfoundries and Samsung, TSMC pulled in plans for initial production of its 16-nm FinFET process to the end of 2013. In addition, it hopes to adopt extreme ultraviolet lithography to make 10-nm chips starting in late 2015 but is still researching e-beam as an alternative.

Company executives detailed the new processes and how they aim to get there at an annual symposium here. They also provided an update on their work on 3-D chip stacks and their ongoing ramp of today’s 28-nm process node.

“It looks like we have another 7 to 8 years ahead in advances -- maybe more -- we can see in technology down to 10 and even 7 nm,” said Morris Chang, founder and chief executive of TSMC, speaking to a small group of press after a keynote here.

“Moore’s Law is going to go on and we will be there -- if anyone pursues it, we will pursue it,” he told an audience of several hundred chip designers.

Chang, a veteran of more than 50 years in semiconductors, forecasts four percent growth for the industry this year. “Fab-less companies probably can enjoy nine percent growth this year, and we are also optimistic about ourselves -- we expect growth in the teens,” he said.

He said TSMC will spend more than $9 billion in capex in 2013. That’s up from $2 billion in 2009.

A heady ramp for 28 nm

Much of this year’s growth comes in the 28nm node. Just a year ago, Qualcomm’s chief executive Paul Jacobs was telling his investors the company could sell more of the advanced chips than it could make at TSMC and was searching for capacity elsewhere.

In June 2010, TSMC broke ground on a so-called Gigafab 15 site in Taichung, Taiwan, it planned as its manufacturing center for 28-nm chips. By April 2012, just 22 months later, it started production in half the planned facility -- a record for the Taiwan foundry.

Within eight months it was kicking out 50,000 28-nm wafers a month -- another record -- but it still wasn’t enough. So, next month the second half of the facility is set to produce its first wafers and within five months is expected to beat the old record and add another 50,000 28-nm wafers/month. “The scale is difficult to appreciate,” said Chang.

The “unprecedented ramp of 28-nm chips came with an acceleration in time to good yields and volume production,” said J.K Wang who oversees TSMC’s 300-mm fabs. The foundry expects to see even faster ramps at 20 and 16 nm, so it has several thousand engineers preparing for those nodes at its fab 12 and 14 facilities today.

“In the past, we built one phase of a new fab each a year, now we typically initiate three phases a year,” said Wang. The foundry estimates it makes 1.3 million logic wafers per month total now, far ahead of Samsung in second place at about 900,000 logic wafers/month. It estimates it will produce a whopping 13.5 million wafers/month in 2017 if it continues its growth.

Next up—the 20-nm node

Some industry watchers say 20 nm will be an interim node to work out the wrinkles in double patterning lithography, but not offering many advantages to chip designers. Don’t tell that to Jack Sun, chief technology officer of TSMC. By 2017 he predicts the Taiwan foundry will be making as many 20-nm chips as it 28-nm ones. He claims the node will offer a 1.9x increase in gate-level density over the high-performance 28-nm node, although some speculate rival Globalfoundries will only deliver a 16 percent density increase at 20 nm.

Sun also said 20-nm chips could sport 20 percent higher speeds or 30 percent less power consumption than 28-nm ones. That’s significant though not as much as traditional full nodes. The 16-nm node that follows it will have similar characteristics, but a future 10-nm node will have slightly greater benefits, he said.

TSMC now starts three new fabs each year.

TSMC now starts three new fabs each year.

“Moore’s Law has another 7-8 years ahead, said TSMC founder Morris Chang”

The ecosystem is ready, said Cliff Hou, vice president of R&D at TSMC. Some 38 features of 28 EDA tools have been tested for 20 nm, 185 design kits are available for the node and both foundation and critical interface IP blocks have been verified, he said.

TSMC expects silicon back in May on a 20-nm test device based on an ARM Cortex A15 core, Hou said.
Faster path than expected to FinFETs

TSMC surprised Silicon Valley announcing it will produce its first 16-nm wafers with FinFETs by the end of the year. That matches the timetable Globalfoundries and Samsung announced here just weeks ago.

In general, the industry plans to take what it learned about making 20-nm chips with double immersion lithography and graph 3-D transistor structures on to it. Thus the move makes advances that are less than a full node in density, power and performance.

“We are confident the 16 FinFET process will be there for prime time [production] next year,” said Sun.

TSMC showed a chart estimating a 64-bit ARM core in the 16-nm node will have 90 percent greater performance than a 32-bit ARM A9 core in 28 nm. By contrast an ARM A15 in the 20-nm node will give about a 40 percent boost, TSMC estimated.

Current tests of the 16nm process using a 128 Mbit SRAM are yielding “ahead of plan,” said Sun. the core runs at 0.8V and the I/O at 1.8V, he added. Foundational IP such as standard cells and memory cells are ready for the node. However, the first critical interface blocks won’t start testing until June, said Hou.

A look into the foggy 10nm future

By the end of 2015, TSMC hopes to start shipping its first 10nm wafers using EUV lithography. The key word is “hopes.” Throughput of EUV machines need to get well beyond “100 wafers and hour or it will not be cost effective,” Sun told EE Times. TSMC has been working with an NXE3100 EUV scanner and has demonstrated using it to make fins in a single pass. It hopes to get an NXE3300 soon.

Hedging its bets, TSMC is pioneering multiple e-beam techniques that are “showing good progress,” Sun said. It is using parallel beams to increase throughput which is still too slow, but “prototype tools shows promise that in the future the cost of ownership could be less than EUV,” he added.

Even if EUV hits its targets, the 10nm node also requires use of self-aligning techniques with immersion lithography to minimize the need for EUV to just some critical layers. TSMC also is developing a so-called G-rule that automates the tricky process of handling color conflicts in double patterning.

If all goes well, the 10nm node could offer another 90 percent increase in gate level density. It could also deliver 35 percent speed ups at the same power or 40 percent in power savings at the same speed as a 16nm device, Sun estimated.

3-D stacks and 450-mm wafers

The good news in 3-D stacking is TSMC is now hitting better than 95 percent yields for the kinds of 2.5-D silicon interposer designs Xilinx pioneered with four FPGAs laid next to each other on a silicon interposer. The foundry expects multiple tapeouts of such devices this year. “This is the low hanging fruit and a natural start in 3-D,” said Sun, noting the interposers will scale from 100 to 50 microns.

It’s still early days for true 3-D vertical stacks using through silicon vias. The TSVs are scaling from six to two microns and various prototypes are in the works.

Last year, TSMC tried a 2.5-D stack that set 40-nm logic and a Wide I/O memory die from SK Hynix next to each other. The Wide I/O die passed tests to comply with the Jedec spec, but more tests are still in the works.

In May, TSMC hopes to tapeout a “true 3-D IC stack” at 28 nm using all memory chips, Hou said. Later it will try merging logic and memory in a vertical stack with TSVs.

Sun predicts such chips might be ready for production in 2015 or 2016, matching recent estimates from Globalfoundries. Meanwhile more logic 2.5-D stacks will ship this year and mixed logic with memory 2.5-D stacks should emerge in 2014, he said.

“The not too distant future there could be a silicon superchip smartphone with a 3-D package,” Sun said. The next generation of silicon wafers is further out -- not coming online until at least 2016, said Wang. TSMC is acting as general contractor for the G450 Consortium fab that is now testing prototype tools for 450-mm wafers. TSMC estimates all the tools will be ready for high-volume production by the end of 2015 - except the litho systems. Immersion systems won’t be ready for 450-mm wafers until late 2017, and EUV...well, Wang hopes they could be ready at the start of 2018. Again the key word is “hopes.” So, TSMC plans to start a pilot 450-mm wafer line in 2016 or 2017, ramping production of 10 or 7-nm chips.

A 450mm and a 300mm wafer compared.
Texas Instruments aims to develop a better way to the cloud with HP Project Moonshot

By Paul Buckley

TEXAS INSTRUMENTS INCORPORATED is participating in HP Project Moonshot and the HP Pathfinder Innovation Ecosystem and has affirmed the company’s commitment to helping HP develop innovative, energy-efficient server technology optimized to address new styles of IT workloads.

TI’s KeyStone II-based multicore System-on-Chips (SoCs), now shipping, further advance efforts to design, deliver, standardize and deploy innovative solutions that are tuned for today’s extreme-scale demands.

HP Project Moonshot, a multi-year, multi-phased program, is dedicated to the development of a new family of software-defined servers, including extreme low-energy processing technology purposefully built to address surging infrastructure pressures from emerging application trends. Pioneering the future of extreme-scale technology, the HP Moonshot System is the first solution with a modern architecture engineered for the new style of IT, utilizing a revolutionary server designed to help customers significantly reduce physical space requirements, energy use and costs.

The close collaboration between TI and HP over the last year ensures that TI’s SoCs are the right fit for the HP Moonshot System. TI’s KeyStone II-based SoCs, which integrate fixed-and floating-point TMS320C66x digital signal processor (DSP) cores with multiple ARM Cortex-A15 MPCore processors, packet processing, security processing and Ethernet switching, give customers the performance, scalability and programmability needed for a variety of applications in the high performance compute, cloud computing and communications infrastructure markets. These new SoCs offer customers more than four times the capacity and performance at the same power relative to existing solutions*. This is due, in part, to the C-programmable floating point C66x DSP cores that bring about a tremendous amount of compute performance at low power. These SoCs are best-in-class in terms of performance and power efficiency due to their all-in-one nature and functionality.

The KeyStone architecture claims to be the industry’s first implementation of quad ARM Cortex-A15 MPCore processors in infrastructure-class embedded SoC, offering developers high capacity and performance at reduced power for networking, high performance computing.

The architecture provides an unmatched combination of Cortex-A15 processors, C66x DSPs, packet processing, security processing and Ethernet switching, transforming the real-time cloud into an optimized high performance, power efficient processing platform.

The KeyStone architecture 20 plus software compatible devices across KeyStone I and KeyStone II generations, enabling customers to more easily design integrated, power and cost-efficient products for high-performance markets from a range of devices. To help advance HP Moonshot, the expanded HP Pathfinder Innovation Ecosystem establishes a close collaboration of industry-leading technology partners dedicated to accelerating the development and deployment of energy-efficient, workload optimized servers.

New standard tracks soft IP usage through the semiconductor design

By Julien Happich

ACCELLERA SYSTEMS INITIATIVE has completed its IP Tagging 1.0 standard, designed to provide a mechanism to track critical soft IP data throughout the entire chip design and development process such that it can be readily identified, tagged, and used again for future designs.

Using the Soft IP Tagging 1.0 standard, engineers now have the ability to easily determine if a block of IP is contained within a chip, if it is the correct version, and if it is a candidate for reuse. In addition, semiconductor foundries, providers of IP, and manufacturers of design tools now have a standard way to track IP usage and royalty information with their customers.

The chip design process can include editing, synthesis, timing, placement, wiring, and other steps. Normally, control of a third-party IP source is lost once the block of IP is licensed, unlocked, or otherwise made available in clear code. IP Tagging 1.0 facilitates a data-driven method to tag a block of IP and track “where used” for applications such as ownership, royalty calculations, and recognition. It also facilitates the implementation of version identification for applicable bug fixes and errata and allows tracking of other data.

“I would like to thank the members of the IP Tagging Working Group for their dedicated efforts in achieving this IP standard, “ said Kathy Werner, Accellera’s IP Tagging working group chair. “Soft IP Tagging 1.0 not only provides a mechanism for version control and bug tracking, but can be used to determine the compatibility of an IP block for reuse in a future design. Engineers can now feel confident there is a standard methodology built around IP reuse, tracking, and data control.” The Soft IP Tagging 1.0 standard is available immediately for download under open source license at www.accellera.org
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Watch the video
Smart watches will leverage smartphones adoption to flourish in 2013, says ABI Research

By Julien Happich

SMART WATCHES HAVE been around for the last decade. The wearable computing device has failed to take off for one reason or another: they looked ugly, were too bulky, had weak functionality, or the battery life was not good enough. However, over the last nine months a number of new smart watches have emerged that could change consumers’ perceptions.

Market intelligence firm ABI Research projects more than 1.2 million smart watches will be shipped in 2013. “The strong potential emergence of smart watches can be attributed to several reasons,” says senior analyst Joshua Flood. “Contributing factors include the high penetration of smartphones in many world markets, the wide availability and low cost of MEMS sensors, energy efficient connectivity technologies such as Bluetooth 4.0, and a flourishing app ecosystem.”

The wearable computing device can be split into four categories: notification types, voice operational smart watches, hybrid smart watches, and completely independent smart watches.

Notification type devices are the MetaWatch and Cookoo smart watches, for example, offering alerts for incoming calls, messages and other notifications. Voice operational smart watches enable users to conduct calls and speak some commands via the device such as Martian’s smart watch.

Standalone smart watches with their own OS are moving beyond a smartphone accessory. With the potential to be purchased as a standalone product without the need for a smartphone, they offer high functionality and can connect to other consumer devices like audio speakers. A good example is the Italian smart watch maker, I’m Watch. Other good possible archetypes for this category could be Apple’s hotly anticipated iWatch, Samsung’s Galaxy Altius and Microsoft is also reportedly planning to release a new touch-enabled watch for its Windows-based smartphones and tablets. “Smart watches that replicate the functionality of a mobile handset or smartphone are not yet commercially feasible, though the technologies are certainly being prepared,” adds Flood.

Microsoft, Foxconn ink patent licensing deal

By Dylan McGrath

MICROSOFT CORP. SAID it entered into a worldwide patent licensing agreement with Taiwan's Hon Hai Precision Co., the parent company of electronics contract manufacturer Foxconn.

Microsoft (Redmond, Wash.) said the deal provides broad coverage under Microsoft’s patent portfolio for devices running the Android and Chrome OS, including smartphones, tablets and televisions. Microsoft said it would receive unspecified royalties from Hon Hai under the agreement.

Microsoft has been aggressive in threatening legal action against handset OEMs perceived as violating its massive software IP portfolio. Firms such as HTC Corp., Acer, LG Electronics and Samsung Electronics Co. Ltd. have already agreed to pay Microsoft royalties on Android-based phones. Motorola Mobility, now a subsidiary of Google, remains a holdout and is fighting Microsoft in court over patents.

Jim McGregor, founder and principal analyst at Tirias Research, said Microsoft is beginning to have success forcing firms that build smartphones and other products on behalf of others to sign licensing agreements for fear of being sued.

“Unfortunately, the contract manufacturers and ODMs are getting caught in the crossfire,” McGregor said. “They almost have to have that legal indemnity to avoid getting sued.”

Foxconn, the world’s largest contract electronics manufacturer, is well known for building products for Apple Inc.—including iPhones and iPads—and firms. The firm is estimated to manufacture more than 40 percent of the world’s consumer electronics.

Intellectual property battles have long been a part of the high-tech landscape, but seem to have ramped up in recent years. Companies like Microsoft, Apple and Google—which owns tens of thousands of patents—have been engaging in legal action and bidding to acquire other patent portfolios to strengthen their competitive positions. Apple and Samsung famously squared off in court last year in San Jose, Calif., in a fight over smartphone patents.

Will Foxconn become OEM?

McGregor said Foxconn may have agreed to the deal because it eventually hopes to become an OEM, making its own branded products. HTC took such a path—starting as a contract manufacturer before eventually making its own successful handsets.

“Some of it is related to the fact that they [Foxconn] are building products for companies that they know are being sued by Microsoft,” McGregor said. “Their customers are already getting sued. It’s kind of preemptive to keep that waterfall from going down.” Horacio Gutierrez, corporate vice president and deputy general counsel of Microsoft’s intellectual property group, said the deal with Hon Hai expands the success of Microsoft’s Android licensing program.

“By licensing both brand name companies and their contract manufacturers, we have successfully increased the overall effectiveness and global reach of the program,” Gutierrez said.
Intelligent diagnostics maximize factory-floor up-times

By Hubert Baierl

MORE THAN OFTEN it is common that when technical equipment fails, finding the root cause of the failure consumes significantly more time than actually fixing the problem. In highly sophisticated factory automation environments where capital intensive equipment is in operation or where time-coupled chemical processes are at work, line-downs can have substantial implications on the commercial viability of the enterprise. Therefore, the days of machinery providing no diagnostic feedback are becoming obsolete. Solutions that can provide intelligent diagnostic feedback as the system is beginning to fail (“preventive maintenance”) or when a hard failure has occurred (“repair”) are key to reducing expensive unscheduled downtimes.

Power management with built-in diagnostics

The ISO2H823V is a power management integrated circuit with built-in intelligent diagnostic functions designed for use in a wide range of industrial control applications, including Programmable Logic Controllers (PLCs), Distributed Control Systems, Robotics and many more. This 8-channel high-side driver IC features integrated 2.5kVRms galvanic isolation, which exceeds the IEC 61131-2 requirements for reinforced isolation. Concurrently, the device sets a new standard for system-level diagnostics.

Each of the 8 channels is equipped with five-fold diagnostic monitoring capabilities: Open Load Active (OLA), Open Load Inactive (OLI), Short-to-Vbb, Over Current and Over Temperature. Additionally five types of diagnostic feedback on the IC-level are provided. This is all integrated into a small 12x12 mm VQFN package. In the industrial control system, thanks to the integrated galvanic isolation, the ISO2H823V is positioned between the 3.3V micro-controller domain (“control side”) and the 24V factory floor domain (“process side”).

The most frequent failure mechanisms on the application level include overload of the driver outputs or actually having no load (“open load”) connected to the driver outputs. Another severe deficiency is lack of or insufficient supply of the 24V Vbb on the on the factory side of the system. The ISO2H823V can detect either of these problems and many more. This capability is highly valuable for OEMs to prompt preventive maintenance and in case of malfunctions to drastically reduce the time required for repair.

The benefit for the system designer rests in the fact that many powerful diagnostic capabilities are available in the single IC. This eliminates the need to develop complex and potentially cumbersome circuit layouts based on multiple discrete components, to be able to perform diagnostic monitoring. In consequence, system design efforts, risks and time are reduced substantially, PCB area can be kept small, and the reliability of the solution is not compromised.

Hubert Baierl is Senior Business Manager at Infineon Technologies – www.infineon.com

Fig. 1: Line-downs can have substantial implications and early diagnostic feedback can limit potential losses.

Five types of diagnostics for each individual channel:

Overload [OCL]

Wear-out of machinery may lead to an output overload. In its extreme form there is actually a short circuit to GND caused either by erroneous wiring, short-circuit during operation or a natural disaster which leaves the equipment flooded, i.e. it literally is under water. The ISO2H823V can detect such cases. When the switch of a channel is “on”, that channel’s output current is monitored. If the output current exceeds the threshold to activate the current limitation, typically set at 1A, then Over Current Limitation (“OCL”) is flagged to the micro-controller – see figure 2. Unlike other products, the ISO2H823V provides not only overload feedback, but it also informs the system controller which channel is subjected to the overload. This information can be instrumental to identify the root cause, which is critical to getting the system back on line within the shortest time possible.

Open load [OLA]

Mechanical strain, e.g. vibration or excessive bend stress of a cable, as well as corrosion can lead to the wiring between the IC switching output and the load to become high-ohmic or even disconnected (“wire-break”). The ISO2H823V can detect such circumstances. The IC performs output current monitoring, but not only for the purpose of limiting the maximum output current. The same capability is used to detect “no load” situations. An Open Load Active (“OLA”) feedback is provided if an output is turned on and the output current of an individual channel is less than 0.5mA to 3mA - see figure 3. The system hardware design has the freedom to set the triggering threshold level within this range.

No other driver product designed for the industrial control
When the output driver temperature reaches 150°C, put channels is equipped with an individual temperature sensor. There may be an indication for gradual degradation of the equipment which leaves the equipment flooded. A wiring error, short-circuit during operation or a natural disaster may erroneously be connected to the diagnostic feedback (Vbb). Root causes may include an ohmic resistance of less than 12 kOhm, if the output is disconnected from the load, the output will float at a voltage higher than 2V which in turn triggers the OLI diagnostic feedback (Open Load Current). The switch output could erroneously be connected to Vbb. Root causes may include corrosion or a natural disaster which leaves the equipment flooded. This condition can also be detected by the IC2H823V. Excessive heavy duty operation of outputs may be an indication for gradual degradation of the IC. For this reason each of the output channels is equipped with an individual temperature sensor. When the output driver temperature reaches 150°C the respective output channel is automatically turned off to avoid material damage to the IC.

**Five types of diagnostics on IC-level**

Of all the IC-level diagnostics, Vbb-monitoring is probably the most important one. Vbb-monitoring checks the voltage level on the driver’s output side. The possible reasons for this voltage falling and failing below the normal operation level could be that the power supply is not adequately designed for the loads, or the power supply is simply beginning to fail. It is also conceivable that the electrical connection between the power supply and the switching IC is gradually increasing its ohmic resistance, i.e. corrosion may be at work. In a large number of applications the nominal supply voltage (Vbb) on the factory side is 24V +/-20%. However, if that voltage drops to a level as low as 9V, the outputs are turned off while it is still possible to do so. This is not done without a pre-warning, as a matter of fact, there are two intermittent stages:

- If the supply voltage drops below 16V then an Under-Voltage warning [UV] is issued. At that voltage the performance level of outputs of the IC is not yet compromised. The UV feedback provides a pre-warning. If the supply voltage drops further, i.e. to a level of 13V and below, then a Missing Voltage warning [MV] is sent. At this supply voltage level, the IC outputs are still working. However one may be well advised to perform a controlled system shut-down while it is still possible. Only if the supply voltage drops to 9V or less, all outputs are automatically turned off and a Wait-for-Power [W4P] feedback is triggered. In this case the supply voltage has dropped to a level too low for proper operation - see figure 4.

**Other channel-specific feedbacks**

Even before the switch is turned on, an open load (“wire-break”) can be detected. This is possible because in addition to monitoring the output current, the voltage at the output of the IC is also being monitored. In case of the output being in “off” state a small trickle current of 25µA is flown through the load. IC is also being monitored. In case of the output being in “off” state a small trickle current of 25µA is flown through the load.

**Four additional IC-level feedbacks**

In addition to the temperature monitoring of each of the output channels, the IC has a ninth temperature sensor. This additional sensor provides an IC-level over temperature protection. The threshold is set to 125°C in order to remain below the glazing temperature of standard F84 PCB materials. When this threshold is exceeded all outputs are automatically shut off (“OTP”). While the ISO2H823V delivers compelling benefits over previous generation solutions, it must also be able to retrofit with factory automation systems which are not yet at the end of their operational life. The detection of the presence of an incandescent lamp (used for signaling purposes on the factory floor) is a requirement for many such legacy systems. The LAMP feedback permits the system controller to distinguish between turning on a cold incandescent bulb and a short-circuit.

To attain uncompromised robustness against electro-magnetic interference the communication across the integrated galvanic isolation is save-guarded by multiple proprietary measures. In the unlikely event there were to be disturbance of that communication its occurrence would be flagged to the µC by way of setting the transmit error (“TE”) flag. If this error were to occur repetitively then it would indicate a substantial problem present on PC-level. To verify system status, but also for safety reasons, it can be of importance to be sure that all outputs are in fact off. The IC provides such explicit “ALLOFF” feedback if indeed all outputs are off.

**Preventive diagnostics and full control**

With this impressive list of ten different types of diagnostic feedbacks, the ISO2H823V clearly sets a new standard in diagnostics for industrial control applications. The channel-specific diagnostic as well as the types of channel-specific diagnostic feedbacks can be enabled and disabled on a channel per channel basis. This grants the user the maximum of flexibility and allows the selective use these features to meet application specific requirements.
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Power factor and solid state lighting – implications, complications and resolutions

By Hubie Notohamiprodjo

LIGHTING COMprises APPROxIMately 17.5% of global electricity consumption. As the world transitions from incandescent to solid state lighting (SSL) technology, utilities and government regulatory agencies worldwide are concerned that, as this large segment of the consumption base switches to SSL, it will increase infrastructure costs. This is due to the reactive nature of LED-based solid state lighting, which results in higher distribution currents that adversely affect power factor (PF) and, in turn, create a larger demand on the power grid.

Regulators have been working with utilities companies to enact rigid standards to control the impact of SSL technology on the power grid – see table 1. The move to LED-based solid state lighting promises a significant reduction in the carbon footprint of the electrical power grid simply due to the dramatic reduction in real power consumption. However, if power factor is not managed, the grid will still need to be able to provide a much higher power level than is actually needed at the load, eliminating a significant portion of the benefits of moving to solid state lighting.

Historically, incandescent bulbs have had near-perfect power factor. Therefore, solid state lighting is being held to a much higher PF standard compared to legacy AC/DC power supplies. In most cases, power supplies are free from any form of power factor regulation for supplies rated up to 75W. However, for solid state lighting, PF regulations typically kick in as low as 5W or below.

In order to effectively design an LED-based luminaire, designers need to understand power factor, the impact LED drivers have on it, and different techniques for integrating power factor correction cost-effectively in the LED driver design.

Understanding power factor

Power factor is a simple, unit-less ratio of real power to apparent power. Real power is the power used at the load measured in kilowatts (kW). Apparent power is a measurement of power in volt-amps (VA) that the grid supplies to a system load. In a highly reactive system, the current and voltage, both angular quantities, can be highly out of phase with each other. This results in the power grid needing to supply a much larger reactive power to be able to supply the actual real power at any given time – see figure 1.

\[
\text{Power Factor} = \frac{\text{kW}}{\text{kVA}} \quad \text{kVAR} = \sqrt{\text{kVA}^2 - \text{kW}^2}
\]

Fig. 1: The power factor is the ratio of real power (kW) to reactive power (kVAR).

The ratio of the reactive power to the real power is called power factor (PF). This basically means that for an equivalent real power consumed by a highly reactive load, for example 5W, the actual current that the grid needs to supply to the load in order to provide the real power has to be higher than the real power by the power factor ratio. For the previous 5W example, for a load with a PF of 0.5, the grid needs to provide 2x the current actually required by the load at any given time. This adverse impact on the power grid does not apply to incandescent lighting, which is purely resistive and has a unity power factor.

Solid state lighting that incorporates power factor correction can reduce the impact of the change from incandescent to LED based lighting by increasing the power factor to near unity by adding circuitry to the LED driver that corrects for the reactive input impedance.

LED drivers and power factor correction

LEDs have a non-linear impedance as do their drivers, causing the power factor to be inherently low. In order to combat this, the driver needs to compensate for power factor to increase that ratio as close to 1 as possible. When you take into consideration one LED lamp and its impact on the overall PF for an industrial warehouse or shopping mall, it is relatively insignificant, but the sum of all the lighting elements in a large commercial space can significantly impact the overall power factor and correction for either individual bulb or for the ballasts that drive those bulbs needs to be implemented.

Both active and passive methods exist for PFC. Passive PFC solutions typically consist of passive input filters and offer some cost benefits, but since passive PFC optimizes for a specific input voltage and current condition, when those conditions change, the power factor also decreases. In the case of dimmable luminaires, passive PFC is not acceptable as the power factor will vary broadly across the full operating brightness range of the bulb. Active PFC needs to be incorporated to adequately maintain high PFC across load and line conditions.

With active PFC, there are approaches that use the main power conversion stage to compensate for the power factor (single-stage – figure 2a) and approaches that use an independent pre-regulator stage to provide the PFC (two-stage – figure 2b). Each approach has its benefits; the most obvious is that with a single-stage approach, the cost to implement is minimized since part of the PFC work is done in the main power conversion stage. Determining which topology best suits the end applications requires a deeper analysis of each type of converter.

With a single-stage LED driver, the main power stage converts the input voltage to a usable DC voltage and current for driving the LEDs. Since there is only one power stage, the driving of the main power stage needs to be managed to increase the PF close to unity. Since the measure of power factor depends upon how linear the input of the driver looks to the mains input voltage, the modulation topology determines what the input impedance of the converter looks like to the mains.

The best approach to maximize power factor is to use a constant-on time approach, which effectively creates a voltage-
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controlled current source, or a highly resistive-looking input impedance. The peak current through the primary side of the transformer is directly proportional to the on-time of the primary drive. This inherently has a high PF, near 1. While the constant on-time architecture offers the benefit of high power factor, the trade-offs are often times unacceptable.

Normally operated in DCM mode, the peak currents are very high and have two major consequences, high stress on the passive components and high current ripple on the LEDs. The high stress on the input capacitors can degrade the lifetime of these key components and lead to reduced operating lifetime on the bulb. The excessive current ripple on the output reduces the quality of the light output by adding flicker to the light output as well as degrading efficiency and increasing self-heating due to the ripple current through the output capacitors.

Using a constant current mode operation instead of constant on-time alleviates the ripple current on the output and reduces the stress on the passive components in the circuit, but due to the inherently reactive nature of the input impedance, the power factor diminishes significantly.

Finding an alternative approach that combines high PF and low ripple current while minimizing the impact on the passive external components is key to finding the optimal low-cost solution in a single-stage LED driver.

The iW3626 shown in figure 3 is an example of a single-stage, high PF LED driver that combines a high PF driver with the ability to minimize the output ripple. The technology to accomplish this resides in the core of digital engine that monitors input voltage and current along with the output conditions by monitoring the primary side of a power transformer. The digital core allows for modulating the drive to the main power transistor, in this instance a power bipolar junction transistor. The proprietary modulation technique in this example allows the end user to program the desired minimum power factor at 0.7, 0.8 or 0.9, or no power factor at all. Along with the minimum power factor comes a corresponding output ripple. This flexibility allows the designer to optimize the circuit for either output ripple (with no PFC) or for PF (with moderate output ripple), or for a balanced, high PF and low output ripple design.

An additional LED driver characteristic important in solid state lighting, and also regulated by the international lighting standards shown in table 1, is total harmonic distortion (THD). As a general rule, when THD is low, power factor tends to be high (>0.9). But, with single-stage conversion technology, normally there is a trade-off between output ripple, THD and PF. The iW3626 uniquely combines low output ripple and high PF with THD at an acceptable level for most applications.

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**Table 1: Regional standards for power factor and total harmonic distortion**

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<th>US</th>
<th>DoE</th>
<th>EnergyStar</th>
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<td>Efficiency</td>
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<td>PF</td>
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<td>&gt;0.85</td>
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<td>Efficiency</td>
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<td>PF</td>
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tHD is of particular interest in the US market, while in Europe, the IEC61000-3-2 establishes harmonic requirements for power supplies. When the end application demands low tHD, high pf and low output ripple, two-stage approaches fit the bill.

The main difference between single-stage and two-stage approaches is the obvious addition of a second conversion stage. The additional conversion stage does the power factor correction while minimizing the total harmonic distortion. Not only does the initial conversion stage remove the line frequency from the main output voltage, removing flicker from the light output, it also adds flexibility for integrating dimming technology and reduces in-rush current which benefits the passive components on the input. Two-stage approaches can use either a boost converter or a simple chopping circuit for the initial stage. The full boost converter offers higher efficiency, higher PFC and lower THD across a broader line voltage range compared to a simple chopper circuit.

The iW3630 is an example of a two-stage LED driver for solid-state lighting applications that require high PF (>0.95), low THD (<15%) and low output ripple – see figure 4. The first stage is a full boost converter operated in a constant on time architecture to optimize power factor and minimize THD. This stage converts the mains voltage into an intermediate voltage, decoupling the output from the mains voltage and frequency.

The second, main power conversion stage then converts the intermediate voltage into usable DC voltage and current for driving the LEDs. This can be an isolated or non-isolated stage depending upon the needs of the end application. With the iW3630, whether the application is isolated or not, there is no need for an optical feedback device because the main feedback is derived from the primary side of the transformer, using iWatt’s PrimAccurate technology.

With regulations dictating power factor requirements for solid state lighting, designers need to incorporate power factor correction circuits into the driver design. A clear understanding of the end requirements based on the intended application of the luminaire determines the type of power factor correction that needs to be implemented. Whether single-stage, cost-driven solutions for residential lighting, or two-stage performance-driven solutions for commercial and industrial applications, the driver technology now exists to enable a brighter, greener future.
Identifying the best power supply for your test application

By Robert Green, James Niemann, and Qing D. Starks

MOST ELECTRICAL ENGINEERS believe they have a good understanding of power supplies because they are relatively simple, single-function DC devices designed to output controlled voltages. However, there is much more to them than this description would suggest. Although a review of a power supply’s specifications should always be a part of the selection process, other characteristics should also be considered.

Investigate the power envelope

The most significant decision is ensuring that sufficient power is available to energize the device under test (DUT). Different types of power supplies have different power envelopes. A power supply with a rectangular power envelope as shown in figure 1a, the most versatile type, allows supplying any current to the load at any voltage level. A supply with multiple rectangular envelopes for multiple ranges (such as the two-rectangular envelope shown in figure 1b), permits higher values of one parameter at the expense of the other parameter, so it can output a higher level of current but at a lower maximum voltage. Supplies that output a hyperbolic envelope offer a more continuous transition than a multi-range power supply, with one parameter inversely proportional to the other – see figure 1c. High power output supplies tend to have multi-range or hyperbolic envelopes.

Determine the noise performance

Noise from external sources may cause problems when powering a circuit that operates at a very low voltage or a circuit that uses or measures very low currents. The supply itself is one source of noise, which can be broken into two components: normal-mode noise and common-mode noise. Normal-mode noise is generated across the supply’s output terminals due to the supply’s internal circuitry. Common-mode noise is earth-referenced noise originating from the power line and stray capacitance across the main transformer. For sensitive circuits, linear power supplies provide much lower normal-mode output noise than supplies designed using switching technology but have lower power-conversion efficiency and can be bulkier and heavier. Switching supplies typically offer more output power in a smaller enclosure. For noise-sensitive circuits, a linear supply can have just one-fifth to one-tenth of the noise (5mVp-p vs. >50mVp-p) of a switching supply. Whenever this current flows through an impedance, the noise ed whenever changing voltages, such as AC voltages and transients (dv/dt) on either the primary or the secondary windings of an isolation transformer, couple current across the barrier. Whenever this current flows through an impedance, the noise

Assess common-mode noise current

Linear power supplies generally have lower common-mode noise than switching supplies. Common-mode noise is generat-

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voltage generated can degrade load (or DUT) performance or cause load-monitoring measurement inaccuracies. Sources of common-mode noise include voltage transients from rectifier diodes (on the secondary) turning on and off and either the 60Hz line movement or the abrupt voltage transient common with a switching power supply’s primary circuit.

Figure 2 shows a simplified block diagram of a power supply. The quality of the transformer’s construction, including sufficient shielding between the primary and secondary windings, can minimize the stray capacitance between primary and secondary. With minimal coupling capacitance, the noise current flowing through the load won’t generally affect the load’s operation or impact measurements on the load. If the transformer’s primary and secondary aren’t sufficiently shielded from each other, then the coupling capacitance can be large and milli-amps of current can flow into the load, creating performance problems and load current measurement errors. For low power and sensitive components, modules, or end products, evaluate the power supply for low common-mode performance. Keithley’s Series 2200 power supplies have common-mode currents of less than 10μA.

Check isolation from Earth ground

One further indication of the quality of a power supply is the isolation of its output from the power line. A power supply with high isolation further minimizes noise on the supply’s output.

A good level of isolation impedance includes parameters greater than 1GΩ in parallel with less than 1nF and shielded well enough to support less than 5μA of common-mode current. Unfortunately, few instruments meet or exceed these guidelines.

Low frequency 60Hz designs may meet the common-mode current specification but fall short of the DC resistance and capacitance figures; switching designs may have low capacitance and higher DC isolation but excessive common-mode current. In some applications, the DC isolation resistance and capacitance are more important than common-mode current.

One case in which the high impedance is important is when a supply is powering a circuit driven by a linear amplifier. In this situation, the power supply is part of the load on the linear amplifier and a large power supply capacitance can create stability problems for the amplifier.

Alternatively, a supply being used to power a low voltage resistive divider or a very low current measurement circuit may need low common-mode current, regardless of the isolation impedance.

Generally, the higher the isolation, the lower the noise coupled through the supply from the AC power line. The problem becomes more complex when the application involves other instruments. In this case, insufficient DC isolation in the power supply can provide a conduction path for a high common-mode current from one of the other instruments. For any particular power supply application, it’s crucial to understand the effect of the power supply isolation resistance and capacitance on the DUT, and the path or loop where the primary and secondary common-mode currents flow in order to determine if a noise voltage (common-mode current × impedance) will be developed and whether the noise will be excessive.

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Ensure sufficient isolation between channels of a multi-channel power supply

If a DUT requires individual isolated power supply sections, then either a number of individual isolated supplies or a single multi-channel output power supply will be required. If using a multi-channel power supply, always ensure that the isolation between the power supply channels is greater than the isolation required between the DUT circuits. However, that’s not always easily determined just by reading a multi-channel power supply’s data sheet. Some power supplies don’t actually provide isolation between channels. However, Keithley’s Model 2220-30-1 dual-channel programmable DC power supply and the 2230-30-1 triple-channel programmable DC power supply shown in figure 3 have two and three fully isolated channels respectively. When the isolation between circuits in a DUT is critical, consider actually measuring the power supply’s isolation between its channels.

Maximize output accuracy

If tight control of voltage at the load is essential for research experimentation, device characterization or production testing, then a careful review of the power supply’s output accuracy and read-back specifications are important. However, that accuracy can be compromised if the supply is controlling the voltage at its output terminals. What’s needed is feedback control right at the DUT, which means the supply should include sense connections (remote sensing) that can be connected to the DUT where the power leads are connected. The sensing circuits measure the voltage at the DUT so that the supply can compensate for any voltage drop in the test leads – see figure 4.

No matter how accurate the power supply output is, there’s no way to guarantee that the programmed output voltage is the same as the voltage at the DUT’s load. This is because a power supply with two source terminals regulates its voltage only at its output terminals. However, the voltage that is important to regulate is at the DUT load, not at the power supply’s output terminals.

The power supply and the load are separated by lead wires that have a resistance (RLead) determined by the length of the lead, the conductivity of the conductor material, and the geometry of the conductor. The voltage at the load, without remote sensing, is:

\[ V_{Load} = V_{Programmed} - 2 \cdot V_{Lead} = V_{Programmed} - 2 \cdot I_{Load} \cdot R_{Lead} \]

If the load requires high current, then I_Load is high and V_Lead can easily be a few tenths of a volt, especially if the power supply leads are long, as can be the case in an automated test rack. A voltage at the load could easily be 80mV to 160mV lower than the desired voltage (with 2A to 4A flowing through a five-foot length of 0.004Ω/foot, 16-gauge wire).

The remote sensing technique solves the problem of voltage drop in the leads by extending the power supply’s feedback loop to the input of the load. Two sense lines from the power supply are connected to the DUT power inputs. These sense leads are voltage measuring lines that connect to a high impedance voltage measuring circuit in the power supply. Given that the voltage measuring circuit is a high input impedance circuit, the voltage drop in the sense leads is negligible. The sense lead voltage measurement circuit becomes the feedback control loop for the power supply. The voltage at the load is fed back to the power supply by the sense leads.
IGBT gate drivers feature on-board optical fibre interface for large-scale plants

The TD-BD-IGFB05K IGBT (Insulated Gate Bipolar Transistor) gate driver released by Tokyo Electron Device (TED) features an on-board optical fibre interface that enables control of 1700V/1200A class IGBTs on a single board. As plants for solar power generation, wind power generation and industrial-use inverters grow in size, systems for controlling high-voltage and high-current loads are becoming more complex. However, the reliability of such systems that use cables to connect with control boards cannot always be assured because of “noise,” the effects of lightning, etc. The TD-BD-IGFB05K, sold by TED under the “inrevium” brand, is a general purpose IGBT gate driver that enables simultaneous control of two 1700V/1200A class IGBTs. It has been developed by adding an optical fibre interface to TED’s conventional IGBT gate driver TD-BD-IGGD05K.

The TD-BD-IGFB05K is connected to a control board with an optical fiber, and directly connected with an IGBT module, so the risk of being impacted by “noise” or lightning is reduced, improving the security and reliability of the system. Alongside the TD-BD-IGFB05K, TED has released the TD-BD-IGCC05K, which is a downsized version of the existing TD-BD-IGGD05K. The 130x130mm TD-BD-IGFB05K has a dielectric strength voltage of 5000V, it takes 15V to 24V as input as well as a signal input via an optical fibre, and outputs 3.8W of power at 20A maximum on two channels. It is short circuit protected.

Tokyo Electron Device
www.teldevice.co.jp
1-cell Li-Ion/Li-polymer battery protection ICs

Ricoh Europe has launched two new 1-cell Li-Ion / Li-polymer battery protection ICs, the R5475 and R5478 for use in rechargeable portable electronic devices. The 2.9x2.8x1.2mm chips offer advanced features including electronic safety measures for the charge and discharge process in order to assure a failsafe operation of the battery pack. The Li-Ion battery protection IC monitors the charge and discharge process and intervenes as soon as the process is at risk of going beyond the safe operation range of the battery cell. They offer standard detection circuits for example, over-charge voltage, over-discharge voltage, excess-discharge current and short protection. Optional latch circuits for example, over-charge voltage, over-discharge voltage, excess-discharge current and short protection. Optional latch circuits for example, over-charge voltage, over-discharge voltage, excess-discharge current and short protection. Optional latch functions for the over-charge and over-discharge monitoring circuits are available. A latch function keeps the chip interrupted from the charge or discharge process while an auto release function tries to resume the process to normal after a time out period and when the interrupt condition is resolved to normal.

Ricoh
www.ricoh.com/LSI

LED drivers output from 18 to 200W for indoor and outdoor solid state lighting

The GenLume series of LED Drivers delivered by ERG Lighting offers a wide range of efficient and reliable drivers with output power from 18W to 200W, including exclusive easy-to-install wiring compartments that eliminate the need for a J-box. Applications include signage, outdoor lighting, strip lighting, and industrial illumination (such as high-bay lighting in warehouses and factories). Offering the SLD, XLD and XLA series of LED drivers from GRE Alpha Electronics under the GenLume brand, ERG Lighting offers a 3-year warranty and full engineering support from their headquarters in Endicott, NY, along with 34 years of experience in building power supplies for the optoelectronics market. ERG Lighting maintains a wide range of GenLume product in stock, with no minimum order requirement. And, with a full range of state-of-the-art manufacturing equipment in house, ERG Lighting can also build custom solutions when needed. The GenLume XL and SLD series are designed to operate with the highest efficiency and reliability at extreme environmental temperature and humidity conditions. These drivers operate over a wide temperature range of -40°C to 60°C without derating and are available with IP 65 option for operation in wet outdoor applications. User-adjustable output voltage and current are also standard features that make them the most versatile drivers on the market. The energy-efficient XLA series is a premier line of LED drivers that delivers smooth and flicker-free AC line dimming. This series is provided with either a 90-132 VAC input or a 180-264 VAC input option.

ERG Lighting
www.erglighting.com

DC-DC converters offer improved efficiency, isolation, and thermal performance

CUI Inc has introduced the company’s second generation of low power, board mount dc-dc converters with improved efficiency, isolation, and thermal performance compared to existing products. The unregulated dc-dc modules are available in 1 W and 2 W configurations, featuring 1.5 kVdc isolation and anti-static protection up to 8 kVdc. The PDS and PES series are designed with an ultra-wide operating temperature range of -40 to 105°C, offering a rugged and reliable solution for converting and/or isolating dc rails within a range of industrial, telecom, security, and machine control applications. The PDS and PES families are housed in compact, industry standard SMD, SIP, and SMT packages. Providing nominal inputs of 3.3, 5, 12, 15, and 24 Vdc and a range of single and dual output voltage configurations, the dc-dc converters are highly efficient, offering efficiencies as high as 89% in the 2 W models. To further enhance the series’ performance across the entire load curve, the modules have been designed to greatly reduce power draw under light and no load conditions. The new family of dc-dc converters also comes standard with continuous short circuit protection, providing an additional layer of protection for sensitive loads.

CUI
www.cui.com

Full-bridge controller delivers wide operating temperature range

With the the H-grade version of its LTC3722-1 a phase-modulated full bridge DC/DC controller with adaptive or manual zero voltage switching (ZVS), Linear Technology makes this IC available for applications subject to high ambient temperatures. The LTC3722-1’s ZVS delay control and adjustable synchronous rectification timing optimize efficiency while reducing transformer size and electromagnetic interference, making it well suited for isolated high power applications of up to several kilowatts. The chip’s adaptive zero voltage technology is accomplished by sensing the bridge MOSFETs and input voltage, allowing the converter to adapt to any change in load current, temperature, component tolerances, driver circuitry delay or input voltage variations. Additional features include fixed frequency current mode control, adjustable current limit, leading edge blanking, soft start, short-circuit protection and programmable slope compensation. An accurate 5V low dropout regulator provides up to 15mA to power auxiliary circuits. The H-grade version operates up to a junction temperature of 150°C, compared to the E- and I-grade versions’ 85°C maximum junction temperature. The H-grade product is tested and guaranteed to the maximum junction temperature of 150°C, making it ideal for automotive and industrial applications which are subjected to high ambient temperatures.

Linear Technology
www.linear.com
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TDK-Lambda selector tool features dedicated Vega AC-DC power supply configurator

TDK Corporation has introduced an upgraded TDK-Lambda Rapid Selector which replaces a parametric search wizard to enable designers to select from a total of more than 3000 different AC-DC and DC-DC products; additionally combining Vega and NV configurators. “The most important, recent change with the introduction of the upgraded Rapid Selector is to integrate the dedicated Vega AC-DC Power Supply configurator program. The selector now covers all product ranges,” explained Paul Goodwin, Product Manager at TDK-Lambda EMEA. The Rapid Selector also brings some enhancements relating specifically to the Vega range of configurable power supplies; these include: Quick configure will now offer Vega units if these are appropriate (for both AC input and DC input).

View configured product:
- automatically show results for both Vega and NV products
- single-step process (enter the part number, click view)

Configure a Vega (previously this was only available on the Vega stand-alone configurator program) Request a quote from the offered results All features available on desktop or mobile devices

In addition, series connected "C" modules for NV350 and NV700 are now available from 48 V up to 64 V. The TDK-Lambda Rapid Selector can now select from a total of more than 3000 different AC-DC and DC-DC products from over 100 different product ranges. In addition, the configurable/modular products range is offered.

TDK Corporation
uk.tdk-lambda.com

Step-down switching regulators with built-in 800mOhm power MOSFET

Rohm Semiconductor’s BD9G101G series of step-down switching regulators feature a built-in 800mΩ power MOSFET and provides a 0.5A DC output with excellent line and load regulation for smart power management, in a small SOT23 (SSOP6) package. The operating frequency is fixed at 1.5MHz, allowing the use of a small inductor and a ceramic capacitor in order to reduce space requirements. All phase compensation components are integrated as well. The input voltage can vary from 6 to 42V, the internal reference voltage is set to 0.75V with an accuracy of typical ±1.5%. Suited to facilitate step-down switching designs, the new device offers first-rate thermal resistance and multiple protection features such as internal over current protection, under voltage locked out and thermal shutdown. The operating temperature spans from -40 to +105°C while the maximum junction temperature lays at 150°C. Areas of deployment are industrial distributed power and automotive applications, battery powered equipment and medical OA instruments.

Rohm Semiconductor Europe
www.rohm.com
Critical factors in air-mouse system design

By Steve Scheirey

MOTION CONTROL IS coming to Smart TVs in the form of in-air mice. MEMS sensors and sensor fusion algorithms provide the foundation for wireless, 3D cursor control, which bring exciting new interaction opportunities to the TV. While the basic interaction design for these air-mice comes from the familiar PC mouse, there are vital, additional considerations which impact the implementation. This article will dive into what separates an in-air mouse from a standard mouse, and reveal how systems engineers are solving some of the most pressing challenges facing in-air cursor control.

So let’s start with the foundation for in-air, 3D motion control: the mouse. The design of the mouse as an input device for point-and-click control is based on decades of research and testing by human factors engineers. It was first created in the 1960s, adopted for commercial use in the 1980s, and is still in wide use today because it solves a fundamental problem for point-and-click control of a graphical user interface (GUI) on a display. The two most important and distinguishing characteristics of all computer mice are bounded pointing and non-linear ballistics cursor movement.

Bounded pointing, also known as relative pointing, is a feature whereby the mouse cursor stays bounded on the screen at all times. Bounded pointing was an explicit choice by human factors engineers who determined that it was better to decouple the movement of the mouse from the cursor on the screen. The advantage is that the cursor is always visible. This gives the user a feeling that they are in control and haven’t “lost the cursor.”

Non-linear ballistics cursor movement means that cursor movement is not a 1:1 mapping with mouse movement. When the user moves the mouse fast, the cursor accelerates and moves with a larger velocity toward the target. When the user moves the mouse slower, the cursor slows down and moves with a smaller velocity. This helps in two ways. The acceleration means less effort is required to move the cursor across the screen. The deceleration enables the user to more effectively hit smaller targets on the screen.

These mouse dynamics form the foundation of air-mouse cursor control. Smart TVs present a similar GUI on a display to that found on a PC, and therefore bounded pointing using non-linear ballistics cursor movement, just like a PC mouse, were chosen for the interaction architecture. However, these dynamics were necessary but not sufficient for usable in-air operation in the living room. This is because there are other important, non-obvious and non-trivial algorithms required to make an air-mouse user friendly.

These requirements result from the different ways in which a PC mouse and TV air-mouse are used. The PC mouse is used in a well-defined, standard setting—a user sitting at a desk using a PC in front of them, while interaction with the PC is the main focus of activity. The air-mouse is typically used in a living room, where a user can be sitting, standing or lying down, holding the controller at any angle, and where their main goal is to find and consume content. This contrast creates three key challenges for air-mouse systems engineers, and solving these challenges will be the focus of the rest of the article.

Challenge 1: An air-mouse has no simple wired connection

The numerous potential positions of the user in the room make a wired connection between the air-mouse and the PC impossible. Therefore, communication must take place over RF link, with a trade-off between RF packet rate and battery life. In addition, 3D in-air movement must be mapped and translated into a 2D cursor, which has to be processed in the OS and shown on screen. This introduces a significant issue in the system: latency. Humans expect instantaneous results to physical actions, and therefore expect immediate response when using motion control. But given the complicated data collection, transmission and processing needed to map motion to cursor control as described briefly above. The question becomes: “how fast is fast enough?”

Our studies show that the target latency of the motion control system should be 30-50ms. Above this level, latency is noticeable to even novice users and usability is affected – see figure 1. In testing we have observed decreasing target selection effectiveness with significant overshoot in systems with latencies of 60ms and above. Associated with this overshoot and lack of accuracy was an increase in user fatigue, making the latency targets an essential foundation for a successful motion control system.

Challenge 2: An air-mouse does not have the benefit of a flat surface with friction

The lack of the desk which the PC mouse rests on, and the friction which stabilizes movement, increases the impact of unintentional movement on cursor control. Specifically, hand tremor and movement caused by button clicks in air-mice is not only distracting but incredibly harmful to the user’s ability to navigate the interface. So it is essential to remove human tremor and make the cursor more stable on the screen during in-air operation. A common approach to this is using a simple low pass filter to eliminate all movements with an input velocity of under 5°/ second. However, this also affects small intentional movements, creating what is known as a motion ‘dead zone’ and damaging...
the ability of the user to accurately select small objects. This in turn constrains the UI design. It is important to distinguish tremor from intentional movements, and treat the two separately. This task is not simple, as tremor varies from individual to individual, varies based on remote control design, and varies based on the specific posture of the user at that time. The solution must undergo significant testing, specifically of the remote control design as size, shape, weight, balance and button layout all affect the level of tremor seen. This testing is important from concept through prototyping and should cover the full range of use cases for motion control, with users in various postures and positions relative to the TV. Additionally, unintentional motions caused by pressing a button have to be identified and removed. This can be done by freezing the cursor on the press of a button, and by the action executing on release of the button rather than the press of a button, which typically causes the larger unintentional motion – see figure 2.

**Challenge 3: There’s a difference between the ‘two foot’ and the ‘ten foot’ environment.**

PC mouse users generally sit around two feet from their monitor, looking straight on. Living room air-mouse users can be sitting, standing or lying down in many different orientations, at different distances, and at various angles with respect to the TV. The use of the remote control must be comfortable and usable in all these positions, and the user should be able to focus on the content on the TV, regardless of how the remote is being held. This makes it essential that the orientation of the remote is compensated for. This feature, called “Orientation Compensation”, translates the device frame of reference into the user frame of reference. So when the user moves the remote to the left, the cursor will move left, even if the remote control is held with roll. This means that the user is not required to hold the remote control exactly parallel to the floor or point the remote directly at the TV in order to use it – see figure 3. A person can lie on the sofa at a 30 degree viewing angle to the TV, and make small wrist motions, and control the cursor in a more relaxed manner.

This article barely scratches the surface of the challenges facing engineers seeking to design the most efficient motion control interfaces for Smart TVs. We saw when air-mice first entered the market around 2003, they were met with mixed reviews, as issues around latency, precision, and in-hand ergonomics were very apparent to reviewers and users alike. However, adoption has followed the maturation and improvement of the technology, and today major brands such as LG, TCL and Roku are making air-mouse products an essential part of the user experience for their products. The new interactions are helping consumers find more content, more enjoyably, and we’re convinced that the growing momentum behind motion control technology will change how consumers use TVs every day.

**Fig 2: Low pass filters can cause a motion ‘dead zone’ which makes it difficult to select small objects.**

**Fig 3: Orientation Compensation translates motion from the device frame to the user frame.**
Opening up new user-interaction scenarios with Time-of-Flight measurements

By Marc Drader and Laurent Plaza

STMICROELECTRONICS RECENTLY UNVEILED an all-in-one module embedding both a wide dynamic ambient light sensor and a robust ranging sensor along with an infra-red light emitter. The first member of ST’s FlightSense product family, the VL6180 uses direct time-of-flight (ToF) technology to precisely measure the time the light takes to travel to the nearest object and reflect back to the sensor located right next to the emitter – see figure 1. The speed of light in air has a well-known value, and can be used to reliably convert time into distance regardless of the target object’s properties such as reflectance, unlike conventional amplitude based optical proximity sensors.

The fundamental sensing technology underlying this sensor is a “Single Photon Avalanche Diode” (or SPAD), which is integrated on a single chip along with everything else except the light emitter. The single photon avalanche diode must be reverse biased beyond its breakdown voltage, which puts it in a very sensitive state, called Geiger mode. When an incoming photon impacts the sensing area, it splits an electron-hole pair. These are subsequently accelerated due to the high electric field and go on to cause a chain reaction, generating an avalanche current in a very short amount of time. This very fast response time, combined with extreme sensitivity, make SPADs a perfect match for time-of-flight constraints and allow them to output two independent measurements: the amplitude of the light reflected back from a target is calculated by simply counting the photons, and the distance of a target is based on the time-of-arrival information from each photon detected.

Fig. 1: The VL6180 time-of-flight IC integrates a robust ranging sensor along with an infra-red light emitter.

Simply detecting a single photon that has travelled from the module to a target object and back to the SPAD detector is not enough to determine the distance. This is because the emitted pulse of light is not infinitely small. We use very short optical pulse, which is essentially a stream of photons, whose arrival time follows a Poisson distribution. When the SPAD detector is triggered, it is not possible to know whether the event detected was due to a photon on the leading edge of the emitted pulse, or from the middle or end of the pulse. To complicate matters further, it is also not possible to know whether an event was detected due to a photon emitted by the module, or whether it was simply a photon from background ambient lighting that triggered the system. To understand whether a photon is correlated to the emitter, or is simply background noise, we need to repeat the optical pulse many times, and essentially build up a histogram to separate the signal from the noise.

Even though the system is accurate – see figure 2, independent of the target object's reflectance, the detector does need a certain amount of photons in order to confirm the distance. If not enough photons are received back from the target because it is too far, with too low reflectance, then no range will be reported. The net effect is that a high-reflectance target such as a human hand can be detected well beyond the 10cm spec (up to 25cm away), whereas worst-case low reflectance targets such as black wool gloves top out around 10cm. One dimensional (1D) gestures, for applications such as accurate volume control and reliable automatic loudspeaker mode switch demonstrated at Mobile World Congress 2013, can be implemented because of the robustness in detecting all kinds of targets and delivering absolute distance measurement.
With two independent outputs (amplitude and distance), it is now also possible to remove the ambiguity between certain types of gestures. At its simplest, we can look at a single sensor and two gesture. When a user moves a hand sideways through the field-of-view of a conventional amplitude-based optical sensor, the signal varies from very low (as the hand begins to reflect light back to the sensor), to very high (as the hand passes over the middle of the sensor, and light is reflecting back from all parts of the illuminated target), then back to very low as the hand exits the field of view. The exact same waveform can be seen if a hand comes down vertically: low signal when it’s far away, high signal when it gets close to the sensor, and then back to low signal when the hand exits the field of view, either vertically or horizontally. The “sameness” of the sensor response to these two gestures makes it impossible to differentiate. However, if we add distance data, then it’s suddenly very clear as shown in figure 3.

Building on this, we envisage a system with multiple ToF sensors, spread around a screen or an interface. We can effectively build a very low resolution depth-map of the scene in front of the object in question. A swipe or a flip could be differentiated as shown in figure 4. Even though both moves in the same direction, a flip of the hand contains much more Z movement than a swipe, which can’t be detected by conventional optical sensors but will be detected by a ToF sensor.

**Fig. 3:** With time-of-flight measurements, multiple outputs eliminate ambiguity for gesture detection.

**Fig. 4:** Swipe and flip actual graphs.
Exploiting depth sensing for 3D interfaces and complex image analysis

By Michael Delueg

NOWADAYS INTELLIGENT SENSOR networks have entered many application fields ranging from building and industrial automation to traffic management or medical applications. Intelligent sensors are able to process the sensor inputs on the sensor node and trigger actions autonomously. This allows intelligent sensor networks with information sharing even on bandwidth constrained networks or serial busses. The availability of powerful embedded processors makes it possible to process the input of high-bandwidth sensors like image sensors in real-time for complex image analysis tasks.

With the advent of the Kinect as input unit for their console, Microsoft has sparked developments in the area of gesture recognition, novel user interfaces and depth sensors. A depth sensor is an image sensor which provides distance information for each pixel. They usually don’t provide color information, but an accurate and robust 3D representation of the scene with X/Y/Z coordinates for each pixel. This eliminates computational overhead for obtaining the 3D data in the next processing stages which is needed for a stereo vision system. Since the sensor output is already robust 3D data analysis functions can be implemented efficiently – see figure 1.

There are a couple of depth-sensing technologies in existence. Bluetechnix uses PMD (Photonic Mixer Device) sensors from pmdtechnologies based on the Time-of-Flight (ToF) technology which is more robust than Kinect’s structured light technology. ToF-sensors use a LIDAR (Light Detection and Ranging) approach for distance measurement.

The target is illuminated by an active IR light source and the distance to the object is calculated based on the backscattered light. The PMD sensor chip uses a modulated light source with a frequency range of 5 to 30MHz. The phase shift between the emitted light and the reflected light at the receiver in conjunction with the known modulation frequency and speed of light can be used to calculate the distance to the object. The depth resolution of the sensor is in the centimeter range or below in good conditions. The use of a modulated IR light and the phase measurement make the sensor robust against difficult ambient light conditions. The whole scene is captured in one shot for high frame rates up to 160fps, limiting motion artifacts.

System design considerations

A system design for an intelligent 3D sensor based on this technology needs to address the following topics: illumination, sensor, optics, power, processing unit and connectivity. While Time-of-Flight is a scalable technology, the choice of field of view (FoV) and range is an important decision. The sensor’s lens and the beam of the illumination LEDs must be adjusted accordingly to illuminate the complete FoV of the sensor evenly.

Typical setups for close range applications like a gesture control have a FoV of 90° or more and a range below 1m while people tracking applications might go up to 3-5m but still need to cover the same FoV. At greater distances the FoV usually becomes smaller because too much power is needed to illuminate the area and the area a single sensor pixel represents becomes too big for meaningful analysis. Today’s ToF sensors feature a resolution of 160x120 pixels. The achievable range is mostly limited by the amount of power which is available to illuminate the whole scene and still get enough reflected light from the target to get accurate measurements. For each scenario the system designer has to balance an equation of range, FoV and frame rate versus power consumption, heat generation and system costs to achieve an optimal result.

The processing unit controls all functions of the sensor and the illumination unit. It processes the raw sensor data and performs enhancements like lens correction or noise reduction. The additional resources can be dedicated on the user application. In terms of connectivity different scenarios are possible. PC based applications may rely on USB to stream the complete image data and power the sensor over USB. Ethernet allows long cable lengths and high bandwidth and the integration into existing IP security infrastructures. In sensor networks bus topologies play an important part when covering large areas with multiple sensors in a line or grid. A 4-wire cable with RS485 plus power supply is a robust choice for chaining multiple intelligent 3D sensors to cover a large room or monitor a conveyor belt. For all connectivity choices the needed bandwidth can scale from several kBit/s to several MBit/s depending on the amount of processing done on the sensor.

People tracking and counting

Multiple applications for such an intelligent 3D sensors deal with people counting, tracking and behaviour analysis. In opposition to HMI applications like gesture recognition these applications cannot rely on the cooperation of the people and require very robust sensor data. A good example for such a use case is people counting in public transportation which provides very important data sets for the operators – see figure 2. During rush hour light barriers or infrared sensors have difficulties to
handle people standing close together and pushing in or out of a vehicle. To get accurate results the heads need to be counted. The People Counter is mounted above doors or gates looking downwards to the floor with a FoV of 90° as shown in figure 3.

Only the heads are seen by the sensor. Human heads have a specific shape which can be identified in the Depth image. Once such a shape has been detected it will be marked in the so called blob matrix as part of an object of interest. If the blob matrix has been created the tracker tries to identify each object of the new frame if it is part of an already existing object or a new one. If the object is already known the characteristics of the object will be adapted according to the information in the new frame. If the object is new it will be added to the object list. If one or more objects leave the region of interest the characteristics of the objects will be analyzed if they are valid. The counter value according to the direction will be increased and the objects will be deleted. The people counter can be integrated in existing installations by using an Ethernet or RS485 interface. The Ethernet interface enables a complete depth and amplitude image stream for later analysis or for security reasons.

Aside of the tracking of people interactive user interfaces are entering daily life. The key element to every form of gesture and pose recognition is the detection of individual persons and to obtain an accurate skeleton model of the body, the limbs and even separate fingers.

Fig. 2: People counting flow chart from raw sensor data.
Once the skeleton model in 3D for all joints is obtained, the user can accurately point at objects providing a 3D vector to the system to trigger actions. With the high resolution of the sensor and the high frame rate, efficient finger tracking can also be performed to enable sophisticated gesture recognition as shown in figure 4.

The 3D data provided by the sensor is used to derive additional characteristics of tracked or counted objects. As example an autonomous vehicle counter consists of an object presence detector, a vehicle classifier, a feature extractor, a counting application and the interface to an infrastructure management system. The sensor is typically mounted in a top-down view position several meters above a road. That is the standard mounting position for road traffic surveillance and traffic management applications. For toll collection systems or parking management systems the sensor is mounted in a side-front-view position looking towards incoming vehicles providing a good view of the license plate. Design and implementation of algorithms for object presence detection, vehicle classification and feature extraction benefit the depth image. The software is typically organized as a chain of image processing steps.

Object presence detection is the first system task in many such applications. Such systems are nowadays often based on conductor loops or ultra-sonic sensors. Both technologies are well introduced, rather cheap, but require a certain effort in installation and cabling between sensors and processing logic. The task of installation has significant impact on the costs of vehicle counting applications. The ToF-sensor gives the ability to replace those technologies, to reduce cabling effort and to add quality and new functionality to the system. The software identifies significant changes in the depth images as an indication of object flow and segments the indicated regions of consecutive depth images for further object classification. The goal of object classification is to identify different types of vehicles. This filter stage may drop all kinds of detected objects that do not classify as vehicles. The algorithm identifies shape of bonnet, shape of windshield, and also measures width, height and length of the vehicles. These parameters are used to classify vehicles into trucks, vans, SUVs, sedans, motor-cycles, etc.

Additional features of a vehicle from the depth image are detected and notifications can be passed to the infrastructure when the vehicle has entered a specific zone in the depth image. That feature may be used to trigger further activities of the infrastructure. Toll collect systems or parking management systems may need to read the license plate. The ToF-sensor aids that task by identifying the location of the license plate. It identifies the license plate as a cube-shaped, prominent structure in the depth image and passes the location information on to a license plate recognition.

**An integrated solution**
The Bluetechnix Sentis M100 shown in figure 5 is an example for a commercially available 3D sensor using a PMD PhotonICs 19k-S3 Time-of-Flight sensor with 160x120 pixels and a range of 3m. The onboard Processor, a DualCore Blackfin BF561 enables applications operating at frame rates up to 40 fps. This specific smart sensor is tailored towards the integration into existing housings and can be connected via Ethernet or a RS232/RS485 interface. Additional GPIOs can be used to trigger other devices and actions.
The quick way to build better embedded user interfaces

By Tuukka Ahoniemi

A SOFTWARE FRAMEWORK for user interface and application development with cross-platform capability can help speed-up UI development through rapid prototyping as well as ensure smooth and fluid interaction within the overall application.

Joined-up thinking is a great idea that often proves difficult to achieve in practice. This also holds true in creating a user interface (UI) for an embedded device. When considering the design of a software application, it may seem obvious that the UI should not only be extremely easy to use but should also interact smoothly with the underlying application. However, the design approaches preferred by UI designers and the technologies used by software developers have not historically matched very well.

Embedded software has a lot to do with hardware, which typically requires low-level, hardcore C-programming whereas UI designers, focusing on the usability and clarity of the application, would work most naturally and productively using a high-abstraction level markup language – the kind of language that allows a smooth transition from a visual concept to an executable software code. Arranging for these two approaches to converge and, moreover, combine to produce a workable result and a productive workflow, is tough.

As if enabling a smooth and integrated workflow for UI designers and developers isn’t hard enough, there are often additional requirements for performance. Unlike desktop computers, embedded devices often have very limited performance while possibly being required to deliver very strict real-time responses. This means that additional, hardware specific performance optimisations for the software are necessary to result in a finished product.

On top of all this, add in a requirement to target multiple operating platforms, and the picture becomes even more complicated; particularly so if it is necessary to optimise the UI differently for use in various contexts, such as in a car or on a mobile device.

Cross-platform environment

Markup languages used to describe graphical UIs take advantage of the fact that the end users do not expect the UIs of various devices to differ radically from each other and tend to prefer the comfort of familiarity augmented with incremental improvements that can be easily grasped and exploited. This is reflected in relatively slow evolution of new design elements that subsequently become common on many different types of devices; examples are the evolution of buttons, sliders and, more recently, accordions used to present large numbers of options clearly on a small-size screen. Markup languages help designers avoid reinventing the wheel by enabling the creation of reusable script code or markup that allows designers to quickly import and configure UI features.

QML is the markup language of the Qt development framework. It allows the declaration of object hierarchies and state-based application logic, and can also be used in other application domains beyond UI design. In effect, QML helps bridge the gap between UI designers and the application developers. QML is well suited to the development of UIs; for example, a plugin allows QML files to be exported from popular graphical design tools such as Adobe Photoshop or the open-source Gnu Image Manipulation Program (GIMP).

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The Qt framework is conceived for creating cross-platform applications and UIs for C++. It allows applications to run natively on various devices such as desktops, tablets, or handhelds using popular operating systems. By building in support for the target system, Qt allows developers to achieve a better-optimised result more quickly than traditional porting of the design to multiple platforms. With QML and built-in C++ support, Qt allows teams both to speed up user-interface development and to streamline integration of the UI and the main application.

More recently Qt Quick (Qt UI Creation Kit) has been released to provide a faster and more flexible framework for creating more fluid user experiences meeting the demands of embedded and mobile marketplaces. Qt Quick separates the declarative user-interface design and the imperative programming logic. The presentation layer of the UI is written with QML, yet it retains a C++ backend that takes care of rendering and allows direct access to platform services from the QML presentation layer. This approach also allows QML to be extended with graphics such as OpenGL 3D objects written in C++. Qt Quick is included in a variety of third-party development environments. QML files can be created and developed using any text editor. The syntax and structure of QML documents are very human-friendly, unlike in many other markup languages. Alternatively, Qt Quick features the Qt Creator development environment, which provides powerful editing tools to help quickly code new UI designs.

Qt Creator provides tools to implement features such as shapes and text, and to enhance them by configuring aspects such as colour and animations. The Qt toolbar allows the designer to select various options and automatically generates the appropriate QML code for these. From version 2.1, Qt Creator also supports a special design mode that can be used to gain a quick visual confirmation that the UI is developing as required. A single mouse click is used to switch into or out of design mode, and Qt Creator also provides access to on-screen reference documentation via hovering the mouse cursor over the chosen code element in the document. This provides helpful information to configure various aspects of the element, such as animations.

Since QML contains only basic UI controls such as Rectangle, Image, Text, MouseArea and BorderImage, users can build up their own compound elements to create the desired look and feel. This is easy to do within QML, and compound elements can be re-used throughout the UI and also between different projects. New compound UI elements are created in a hierarchical way so that it is easy to re-write an early mock-up of a UI control later with an improved iteration. This allows an agile and incremental process for creating the UI through rapid prototyping.

**Rapid optimisation for multiple platforms**

Qt’s cross-platform capabilities allow developers to do prototyping and development work on a desktop PC without having their actual embedded target hardware in place. The deployment to the target device can be done later independently when the hardware is ready. This means the fully developed UI will run as expected on the target hardware.

Often the only requirement, for cross-platform applications, is to scale the UI to suit the different screen sizes on various devices or platforms. Qt performs this scaling by default. In some cases, however, the same application is taken across very different screens and use environments. The designers would then wish to re-optimise the UI layout from device to device, for example to suit differing use contexts such as on a mobile, in-car or on a desktop. Naturally, a UI layout made for a full desktop screen wouldn’t suit a mobile phone and vice versa. By separating the declarative UI design from the code logic, Qt Quick provides the flexibility to change only the thin presentation layer, written in QML. The C++ backend containing most of the functionality can be re-used in its entirety. As QML is a high-level and productive markup language, re-writing the thin UI layer for another layout is very straightforward, and again, can be done incrementally in parts.

**QML prototyping workflow**

Most developers experiment when writing QML, using a creative trial and error approach; it is fun to play around with QML and incrementally approach your desired output. However, some thought is required in the beginning of a project to decide a suitable UI approach and to create a framework for it. This is not provided automatically, since QML contains only basic UI controls and layout managers. Aspects to consider include whether the UI has different views or a stack-based page navigation, whether there are static parts such as a tab navigator and a status bar, or whether there is simply a plain main view with pop-up dialogs.

A practicable way to begin user-interface development with QML is to use a basic element such as Rectangle to position placeholders.
One by one, these can be replaced with the correct shapes and texts. More complex features such as graphics can be added at a later stage. This gives design teams the flexibility to begin working with actual prototype products at an early stage and gain a clear understanding of how the UI will work even before the user-interface designers have finalised any graphics.

The UI can be quickly deployed to multiple devices, taking advantage of the cross-platform capability of the Qt framework, so that usability tests can be carried out for all of the target products and markets. Feedback from end-user workshops can be used to make quick alterations on the host desktop to produce a new version. The QML files can be immediately replaced dynamically without having to recompile and deploy the actual software.

To summarise, the following practical example illustrates a typical user-interface development flow using QML. The first UI mock-up is made with QML Rectangles and layout managers acting as placeholders for the actual elements – see figure 1. In the second iteration, a custom Slider element has been implemented. This is done quickly, once again using only rectangles and not graphics – see figure 2. However, it is now made functional and can be used to test the UI. Some of the graphics have also been brought in. As the purpose of the application is to rotate the 3D element (a globe), at this stage the sliders would only rotate the blue rectangle. The 3D element is implemented in the third iteration shown in figure 3.

By this stage usability tests had showed that two dimensions were adequate to rotate the globe, and the third slider was removed. The sliders were also moved to the appropriate edges of the globe to provide a more intuitive action. The menu was also implemented. Before the application was finalised, testing showed that the sliders could be eliminated completely in favour of dragging the globe. The drag functionality was quickly implemented, and the sliders removed completely to create the finished, simplified user interface with natural interaction – see figure 4. Without using an incremental approach or having technologically separated UI designers and developers, the latter might have just implemented the first—and last—design given to them, resulting in something like iteration number 2.
Time for a new UI programming paradigm

By Jason Clarke

WITH THE UBQUITOUS usage of smartphones, tablets, and other mainstream screens, traditional products that once had analog displays are now being modernized with digital user interfaces (UI). From thermometers to air conditioning control panels to car dashboards, even the simplest and smallest embedded devices often feature graphical user interfaces (GUIs). Therefore, manufacturers are focused on delivering quality electronic products with intuitive, easy-to-operate UIs – all without slowing down the development process.

Fast time-to-market means that the design, prototyping, and testing phases must go quickly and smoothly. In general, good project planning and efficient working processes can help with this goal, but what does that specifically look like for UI development? Let’s take a look at the typical development paradigm and identify the sticking points.

The problems with traditional UI design

The conventional development cycle for embedded GUI products is typically as follows. In the planning stage, the hardware and software features for the product are defined. The user experience (UX) or UI design team creates a mockup of the GUI using desktop digital graphics tools, such as Adobe Photoshop or Illustrator. Then the engineering team recreates the design file or image in their programming environments, such as Eclipse or native Linux desktop tools, to make it work with the embedded hardware system. The programmers can then re-engage the designers during the alpha or beta phase of product testing to give feedback on the UX based on what they’ve already created.

At first glance, this process may seem straightforward and simple enough. However, upon closer examination, there are several time wasters and flawed development techniques that can be spotted:

• Serial, linear workflow
• Minimal collaboration and communication between teams
• Inaccurate UI prototyping
• Inefficient development toolsets

Some people may claim that these obstacles are simply “the nature of beast” when it comes to embedded UI design. However, in an ideal world, what would an alternative to these hindrances look like? Is there an alternative that could overcome these challenges and speed up time-to-market?

Introducing a new UI programming paradigm

Perhaps what needs to happen is the establishment of a completely fresh and original UI programming model. By addressing each of these inefficiencies with an unconventional approach, a new process for designing, prototyping, and developing embedded UI products begins to appear.

Improvement #1: Speed up development with concurrent workflows

UI design and embedded UI programming are typically worked on one at a time in a serial fashion. On the surface, this makes sense – how can the code be developed if the programmers don’t know what the GUI looks like? However, this difficulty can be mitigated during the planning stage by creating a very detailed requirements document that defines all the software features and hardware parameters. The designers need to know exactly what data the UI can retrieve from the system, and the engineers need to understand what demands and UI performance requirements the system must accommodate.

Armed from the beginning with comprehensive information about the product’s appearance and functionality, the two teams can work independently yet simultaneously.

If UI designers have a way of actively revising the design throughout the development cycle without extra coding effort, then embedded systems developers would no longer need to write code every time a design change is required, and can concentrate on implementing functionality on the target platform. Much time is saved if both teams are working concurrently in their own areas of expertise – with designers not programming and programmers not designing.

Improvement #2: simplify and streamline collaboration between teams

Designers and programmers developing in parallel may seem like a magic time saver, but each team will be making changes based on a different set of care-abouts. The graphic designer wants to promote usability, interface consistency, and graphic quality, while the embedded developer is focused on processor usage, memory footprint, code architecture, maintainability and scalability. How can optimizations for user experience versus system resources be easily consolidated?

Clearly, communication and integration methods must be in place to help, not hinder, the process. Using a back-and-forth review process between parties may seem logical, but additional lag time is introduced for each interaction. It would be much more efficient if the embedded GUI development tools could automatically display changes, merge edits, and resolve conflicts. Another useful function would be the ability to highlight UI design decisions that may take significant resources to run so
that the graphic designer can make design adjustments early in the development cycle, rather than waiting until the majority of the back-end code has been completed.

Improvement #3: create a true prototype that becomes the end product
Empowering the designer to actively participate throughout development is vital to creating a successful embedded product. However, more often than not, the UX designer creates an interactive prototype of the embedded GUI functionality on a desktop computer, which does not behave the same as the intended target. Since this prototype does not run on or may not even contain real data about the embedded device, the original design file is thrown away and re-implemented by the programmers.

Rather than creating partial prototypes over and over again, using the prototype-as-product approach can save significant time. The ability to run true UI simulations on embedded targets would let developers test the application on various hardware platforms, force resource constraints on the GUI design, and allow more in-depth UX testing along the way. Plus, the embedded programmers can begin writing the back-end code immediately, and design flaws can be corrected early in the process rather than in the testing phase. Working from a real prototype that runs as well on the desktop as an embedded target can condense development time from months to weeks.

Developing on one common software environment
In order to make parallel workflows, good communication, and true prototyping possible, one approach would be to use a single, integrated software platform—From prototype to deployment. Ideally, this technology should natively and seamlessly integrate with multiple toolsets that are optimized for each team’s needs, rather than forcing the designers and programmers to work with unfamiliar or limited toolsets such as a generic graphical widgets library.

Additionally, this UI development support software should allow the GUI to function separately from the back-end code, while still linking the design and programming efforts with clear integration points. With this capability designers can immediately adjust the UI elements as soon as user feedback is received or as requirements change, and at the same time developers are working on the code.

Real-world examples of integrated UI development
QNX Software Systems created a Bentley Continental GT concept car for the 2013 Consumer Electronics Show, featuring the first ever 17-inch, curved, 1080p DLP center console display. With only eight weeks for UI development, they choose to use Storyboard Suite because of its fast and accurate prototyping, ability to use both Adobe Photoshop for design and Eclipse for embedded programming, and high end performance that keeps up with cutting edge display technology. The digital dashboard in the final creation shows off numerous capabilities such as OpenGL ES 2.0 rich animations and custom shaders, as well as multi-modal input such as multi-touch, pre-touch, voice, and hard controls.

Breaking inefficient habits and making new ones
Staying successful and relevant in the fast-paced world of consumer electronics can be tough, so take advantage of all the latest advancements not only in product technology but also product development tools and processes. Make the investment of switching to this new programming paradigm by using a single, consolidated support software platform to deliver the highest quality UI product at a fraction of the time and effort.

Control and status panels with thin-film backlighting
A manufacturer of bespoke control and status panels, Stadium IGT designs panels ranging from simple illuminated displays to more complex ideograms to graphically indicate system status, with integrated capacitive switches and slider controls, joy-sticks, tracker balls and displays. Panels can be water and vandal resistant and can be operated through front panel thicknesses of up to 13mm thick glass. System designers will appreciate the very low profile and even illumination of these panels thanks to Stadium IGT’s patented “Thin-Film” LED backlighting technology which also offers colour changing LEDs, “secret until lit” signs and high impact product branding options. Operation from a 12V supply removes any high voltage requirement that alternative video monitor based systems may require and allows the use of an N+1 redundant power source for safety critical installations.

Stadium IGT
www.stadium-igt.com

Single-chip solution combines instrument cluster graphics with hardware security
Fujitsu Semiconductor Europe expands its line-up for automotive instrument clusters. MB9EF226 - nick-named Titan - is the newest member of Fujitsu’s FCR4 family, which is based on the ARM Cortex-R4 core. The MCU provides intelligent support for up to six traditional gauges plus the 2D graphics engine IRIS, enabling it to drive a colour display in the same cluster. By including a Secure Hardware Extension (SHE) module, it also offers customers first-class security, since the module is completely implemented in hardware. The MCU will enable innovative driver information systems with an enhanced function set, capable of running more sophisticated software solutions and supporting the AUTO-SAR specification. Titan has also been optimized to perform well in terms of key industry benchmarks such as safety, security and power consumption. Developed at Fujitsu’s MCU Competence Centre in Langen near Frankfurt, the MCU is designed to operate as a single-chip solution for hybrid instrument clusters featuring graphics and gauges. With a core operating frequency at up to 128 MHz, Titan offers more than 200 DMIPS of processing power, plus 2 MB of flash memory and 208 KB of RAM. The MediaLB interface supports applications such as the transfer of graphics data from another electronic control unit, for instance satellite navigation, to Titan.

Fujitsu Semiconductor Europe
www.fujitsu.com
Energy harvesting wirelessly - the secret to M2M’s success

By Frank Schmidt

A FEW YEARS AGO, M2M communication was an expensive niche application that required complex networking. But with technological developments and the flexible capabilities of cloud services, both the infrastructure and the products have made it possible to provide a great deal of information for M2M applications cost-effectively, using wireless modules.

The deeper the interconnection of these devices, the more flexibility is demanded of the technologies. That’s a major reason why energy harvesting wireless technology is increasingly being adopted within M2M devices, products and building automation systems.

Today, M2M is considered a future-oriented growth market with high expectations. The predictions range from over 300 million by 2017 to 50 billion devices connected to the Internet by 2020. Deploying the millions of distributed devices lead to a challenge: how should they be powered and how will they communicate? One solution is energy harvesting wireless technology. Wireless sensors and relay receivers enable simple deployment of intelligent nodes, however, wireless devices require power - historically this meant pulling a lot of wires or installing and replacing batteries. Devices powered by energy harvesters are maintenance-free and independent of batteries or other external energy sources, paving the way to a simpler installation of millions of devices connected to each other and the Internet.

Energy from the surroundings

Due to the energy harvesting principle the wireless modules gain their power from the surrounding environment and therefore work without batteries. In the process, an electrodynamic energy converter uses mechanical motion or a miniaturised solar module generating energy from light. Combining a thermoelectric converter with a DC/DC converter taps heat as an energy source. Even these small amounts of harvested energy are sufficient to transmit a wireless signal. The addition of a capacitor can ensure adequate power storage to bridge intervals when little or no energy can be harvested.

For optimal radio frequency (RF) effectiveness, the radio protocol, standardised as ISO/IEC 14543-3-10, uses sub 1 GHz frequency bands. This provides a safeguard against other wireless transmitters, whilst offering fast system response and elimination of data collisions. In addition, sub-GHz radio waves have twice the range of 2.4 GHz signals for the same energy budget, and better penetration within buildings. As a reference point, duplicating the energy harvesting wireless system at 2.4 GHz system requires about four times more receiver nodes to cover the same area. That increases its cost compared to a sub-GHz solution, for example. RF reliability is assured because wireless signals are just 0.7 milliseconds in duration and are transmitted multiple times for redundancy. The range of energy harvesting wireless sensors is about 300 meters in an open field and up to 30 meters inside buildings.

Building automation as a model for M2M

Energy harvesting devices are particularly attractive as replacements for batteries in low-power electronic systems such as wireless sensor networks, because of the logistics involved in the time-consuming tasks of acquiring, installing, and changing the batteries. Today, energy harvesting wireless technology is very well established providing M2M solutions in the building automation sector, bridging the control of light, HVAC and other fields of building technology to smart home, smart metering and energy management systems.

Wireless and battery-less technology significantly eases energy monitoring and control in buildings with only little intervention into the existing systems. The wireless devices are highly flexible to install so that individual components, wall switches, sensors and relay receivers can be easily networked to form an intelligent system without complex cabling. In addition, dispensing with batteries eliminates the burdensome need to maintain the devices’ energy supply in a regular time period, which can be up to each year.

An example for such a flexible automation system is HVAC control. Here, a thermostat, VAV (Variable Air Volume) or fan coil controller receives information related to occupancy, temperature, humidity, window position or CO2 from the respective batteryless sensors and controls the opening and closing of valve actuators for radiators, or dampers for VAV systems. At the same time, the controller sends status information to a central building automation system, and receives control messages from the BAS system. This enables the building to be monitored from a central location, that can be remote from the building itself, and to implement building wide settings, such as holiday shutdown, for example.

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Self-powered intelligence for heating

Enormous progress is also being made on the product side, leveraging advancements in energy harvesting: revolutionary self-powered radiator valves, from Kieback&Peter for instance, generate energy from the difference in temperature between the hot water and the surrounding air. This energy powers both the communication with a controller or BAS system, and to turn the valve itself. Without cables or batteries, these wireless devices are especially easy to install, and they require no maintenance. In further optimised systems, central equipment such as boilers or air handling units are integrated into the wireless communication system enabling scalable HVAC generation on demand, visible and controllable over the Internet on a PC, tablet or smart phone.

Secure monitoring instead of battery failure

Alarm systems, such as water detectors for example, are a second field, which batteryless wireless technology is opening up, due to its specific features. Here, the reliability requirements are a lot more stringent than those required for lighting controls. A system failure not only means a malfunction but can cause much more serious consequences for other systems that depend upon the equipment being monitored. It’s a fact that more malfunctions are caused by battery failures than by the electronics, especially in large systems. Energy harvesting overcomes this issue.

From everywhere into the cloud

Via gateways, the standard-based energy harvesting technology can also communicate with Ethernet, WiFi, GSM/UMTS/CDMA and other networks for integration in cloud services. Here, all data collected by batteryless wireless sensors is encrypted and transmitted to a cloud service over the Internet. The data packages are encrypted with an AES-Algorithm with 128 bit-keys. Furthermore, every telegram comes with its own rolling code. A forever changing authentication code is generated, based on the rolling code and the AES encrypted data package, and then validated by the receiving system. The same proven mechanism also takes place by locking or unlocking a car with a wireless key. For even higher requirement of data security, application-specific encryption mechanisms can be integrated, too. The gateways connected to a control and visualisation software by TCP/IP can be used to control all relay receivers and sensors bidirectional offering energy management as-a-service. Therefore facility managers, building owners and businesses can monitor important inventory, equipment, assets and energy related information from anywhere at any time, via the cloud. Critical building related data is automatically pushed to the cloud, freeing owners and managers from the often-challenging coordination and expense of hosting onsite servers. One of the major advantages of such a cloud-based solution is that the management system arrives completely pre-commissioned from the manufacturer and ongoing device commissioning is expertly done on behalf of the client and pushed out from the cloud. The users are granted unlimited access to their remote, dedicated virtual server with their own IP address, accessible from a desktop or smart phone.

Future power of energy harvesting

Today, the need for wireless applications with ultra-low power consumption and the advancements in establishing communication standards offer M2M providers new opportunities to innovate and evolve their products and devices. Already the acceptance of international standards is accelerating the development and implementation of energy-optimised wireless sensors and wireless sensor networks associated with M2M environments. In addition to the already established markets for home and building technology, there seems to be a natural progression in its use in smart homes, smart metering and the smart grid as well as solutions for industry, logistics and transportation.
Single-chip solar energy harvester operates wireless mesh nodes

By Julien Happich

AT THE ENERGY HARVESTING & Storage Europe exhibition that took place around mid-April in Berlin, the organisers IDTechEx have granted Sol Chip Ltd (www.sol-chip.com) with the “Best Technical Development of Energy Harvesting” award for the single chip energy harvester it demonstrated there. The company’s so-called Everlasting Solar Battery technology was shown powering a wireless mesh network of what could be various sensors used to implement the Internet of Things, which could also find use in autonomous applications such as smart lighting control, smart water management, environmental and crop monitoring, medical, security and other uses in safety industries.

The demonstration was done jointly with Virtual Extension – www.virtual-extension.com – a company providing the networking nodes within a new networking scheme, VEmesh, operating in the ISM sub-1GHz frequency bands and based on synchronized-flooding technology – see figure 1. The technology provides true bi-directional mesh networking with space diversity and thus completely eliminates the need for routing. In such a network, all VEmesh end-nodes also act as relays, to retransmit data in order to create a mesh modular solution, hence there are no dedicated routers. This also means that the networks don’t need to have self-forming or self-healing features built-in, neither do they require any human involvement. The routers’ elimination means less communication overhead, as well as simpler and less expensive processors, while space diversity eliminates multipath effects and provides no single point of failure.

Altogether, this translates into lower power requirements, which enable battery-powered applications to reliably run for many years on a single cell battery. This is where Sol Chip’s Energy Harvester comes-in. Once integrated into the nodes as suggested in the block diagram of figure 2, they eliminate the need for a replaceable battery. Sol Chip’s technology as shown in figure 3 combines a photovoltaic cell with all the components required to produce six selectable voltage levels: 0.7 volt, 1.4 volt, 2.1 volt, 2.8 volt, 4.2 volt, 8.4 volt, all in a single package measuring about 20x20mm.

Each selectable voltage delivers a different current, with a maximum power output of about 8mWatt in full daylight (from 60 to 100 μWatt under typical office lighting, depending on the ambient light). The cell can also deliver several voltage and power levels simultaneously, from separate pins. Both companies expect to commercialize evaluation kits in the last quarter of this year.

Before the demonstration was run on Sol Chip’s energy harvesting device, the sub-GHz mesh network had been proven based on a two-chip reference design combining Microsemi’s ZL70250 chip scale package RF transceiver (as suggested in the block diagram of figure 2) and Virtual Extension’s VE209M wireless mesh controller. Again, key to the system’s pure reliance on energy harvesting cells is the ultra-low power operation. The ZL70250 CSP operates in the unlicensed frequency bands between 795 and 965MHz and delivers a data rate of 186kbps at 2mA of current. The fully bi-directional mesh network is claimed to support an unlimited number of nodes/hops – in the thousands, with built-in unicast and broadcast capabilities. Evaluation kits are available now from Microsemi and Virtual Extension.

![Fig. 1: Synchronized-flooding versus multiple-hop routing networks.](image1)

![Fig. 2: Block diagram of the energy-harvesting VEmesh module.](image2)

![Fig. 3: Sol Chip’s Energy Harvester unit.](image3)
Fully flexible design platform helps OEMs validate new energy harvesting cell concepts

Canova Tech and ON Semiconductor have joined forces to develop a fully flexible design platform that enables OEMs to test and validate their energy harvesting cell concepts or applications using Canova Tech’s ETA Platform harvester module. The silicon-proven IP allows any type of harvesting cell, be it thermo electric, solar, piezo or magnetic, to power an energy harvesting application with sensor, display and actuator. All of this is software managed by ON Semiconductor’s LC87F7932B microcontroller integrated into the platform. The LC87F7932B realises 0.45 µA average power consumption in RTC mode, and 1.5 µA total average power consumption while controlling LCD display, RTC operation, while a 12-bit ADC intermittently operates for temperature measurement. Particular features of this design platform include a universal harvesting interface block able to collect energy from piezo-electric bend- ers, solar cells, thermoelectric generators (with mV range boost). A maximum power point tracking (MPPT) architecture permits to implement sophisticated and specific algorithms to optimize power transfer. Whatever storage element is selected (supercap, rechargeable battery, capacitor, solid state battery), the ETA platform will store energy in it and monitor the charge process. Digital IOs are available to interface with external circuitry. Programmable PWM generators can drive relays or industrial actuators. Wake-up pins can be configured to generate interrupts or complex actions. Each block has been designed to be programmable by an external microcontroller. An internal activity manager can perform specific tasks in a time base or in case of specific events. It can generate alarms or cascade other programmed actions. The development tool along with all documentation and datasheets are available off-the-shelf to shorten overall development time and enable highly creative concept validation for industry automation, building automation, health care and other applications.

Canova Technology
www.canovatech.com

Energy harvesting wireless switch transmits on-off data over a 300m range at 868MHz

The energy harvesting wireless switch offered by Cherry Corporation comes as a 25x9.4x23.9mm unit that communicates its switching status wirelessly over the 868MHz or 2.4GHz RF band. The switch does not require complex wire assembly and RF transmission is powered by the mechanical actuation of the switch (8N and a total travel of 3.4mm generating two times 0.2 up to 0.5mW), which means that no batteries need to be changed or disposed. With a Lifetime up to 1.000.000 operations and rated for operation in the -40 to +85°C temperature range, each switch comes with a unique ID that excludes mutual interference between different RF-switches. Flexible pairing allows the operation of several receivers with one switch (and vice versa). The wireless range is 10m at 2.4GHz and over 300m at 868MHz (line of sight).
First 8-channel PWM HD audio processor with dual asynchronous sample rate converters

Texas Instruments has introduced the industry’s first 8-channel pulse-width modulator (PWM) audio processor with dual asynchronous sample rate converters (ASRCs) integrated on a single chip. The HD-compatible TAS5548 allows home and pro audio designers to seamlessly mix two audio sources, providing design flexibility and cost savings compared to competitive solutions that require two chips. It accepts sample rates from 8 kHz to 192 kHz and converts them to a fixed rate of 96 kHz or 192 kHz, eliminating the need to create, store and change coefficients. This simplifies the design of digital multi-channel products, such as Blu-ray home-theater-in-a-box (HTIB), A/V receivers, mini/micro combos, and soundbars. The TAS5548’s 40-kHz audio bandwidth is compatible with Dolby True HD and DTS-HD. Designers can optimize their products with rich audio processing capabilities, such as 7-band parametric equalization (EQ), bass and treble tone control, volume and loudness control, dynamic range compression (DRC), and input and output mixing. Two integrated 4-channel ASRC cores allow audio system designers to switch sample rates without changing coefficients, while native processing at 96 kHz for 8-channel output enables ultra-low out-of-band noise and jitter suppression. An extra microphone and I²S input combines with the ASRC’s ability to mix two different sample rate sources.

Texas Instruments
www.ti.com

Single point LED lighting array with tuneable colour output

The Tiger Zenigata LED array is presented as the first single point light source to feature ‘tuneable’ colour temperature output, enabling light output colour to be smoothly adjusted to optimise comfort, productivity and well being. The Tiger Zenigata LED module features independently controllable intermeshed ‘stripes’ of yellow (cool) and orange (warm) phosphors (hence the ‘Tiger’ derivation). 168 blue LED chips are coated by strips of different blends of red and green phosphors, which create the warm or cold white light components. A dual-channel LED Driver is used to independently adjust the output of each LED ‘stripe’ and so changes the overall colour temperature output of the array. The circuit for the 2700K ‘stripe’ is made up of 96 chips arranged in eight parallel strips of 12 LEDs. The 5700K ‘stripe’ is created from 72 chips in six parallel strips. Each ‘stripe’ needs a forward voltage of 37V at a maximum Power Supply of 700 mA. Any colour temperature between 2700K and 5700K can be realised and depending on the colour temperature chosen the luminous flux emitted ranges from 1,900 to 2,200 lm. The Tiger Zenigata achieves a maximum of 92 CRI for cold white and up to 94 CRI for warm white. With a circular LES of 17 mm in diameter, the Tiger Zenigata delivers the optical characteristics of a single-point light source.

Ismosys
www.ismosys.com

Win one of five Sabre Lite i.MX6 development board platforms

The development platform for i.MX 6Quad from element14 (built to the Freescale SABRE Lite design) is an evaluation platform featuring the powerful i.MX 6Q, a multimedia application processor with Quad ARM Cortex-A9 cores at 1.2 GHz from Freescale Semiconductor. This month, Freescale and element14 are giving away five such platforms, worth £128.06 each, for EETimes Europe’s readers to win. The platform helps evaluate the rich set of peripherals and includes a 10/100/Gb Ethernet port, SATA-II, HDMI v1.4, LVDS, parallel RGB interface, touch screen interface, analog headphone/microphone, micro TF and SD card interface, USB, serial port, JTAG, camera interface, and input keys for Android. The i.MX 6Quad processor represents Freescale Semiconductor’s latest achievement in integrated multimedia applications processors. It includes 2D and 3D graphics processors, 3D 1080p video processing, and integrated power management. The processor provides a 64-bit DDR3/LVDDR3-1066 memory interface and a number of other interfaces for connecting peripherals, such as WLAN, Bluetooth, GPS, hard drive, displays, and camera sensors. The SABRE Lite development kit ships with a USB cable, an RS-232 cable, a serial cable, an Ethernet cable, a 5Vdc (4A) power supply, a MicroSD card pre-loaded with the Linux BSP from TimeSys, and a quick-start guide.

Check the reader offer online at www.electronics-eetimes.com

2.6x2.6mm 3D-TOF camera chip delivers millimeter resolution

The fully integrated 3D time-of-flight (TOF) camera chips epc600 and epc610 from Espros Photonics are highly advanced sensor systems designed on a 2.6x2.6mm footprint. Only a few passive components and a couple of LEDs are required to build a distance sensor with stunning performance. The manufacturer claims that measuring ranges of hundred meters and over can be achieved at a resolution in the millimeter range. Measurement cycle times of less than one millisecond are possible. The chips will find use in a multitude of industrial applications such as light control sensors, distance monitoring, proximity detection, gesture control, contact less push buttons, or security and surveillance systems.

Espros Photonics AG
www.espros.ch
USB video card delivers feature-rich H.264 compression

In addition to measuring only 38x70mm while drawing only 1.5W of power, Sensoray’s Model 2253S USB video card has also met the rigorous safety, health, and environmental standards of the European Union in order to attain the CE mark. The latest software release from Sensoray allows MP4 files to be edited in Adobe Premiere with AV sync preserved. The unit’s on-screen display text has also been doubled to 160 characters.

The Model 2253S can also perform as a decoder, converting the compressed audio/video stream into standard analog video and audio signals, as well as offering closed-caption support for H.264 streams. It is well-suited for uncompromising capture of multiple video sources, such as radar and sonar processing, remote video surveillance and traffic monitoring. Sensoray provides an SDK for the Model 2253S that includes drivers, programming examples and comprehensive documentation for both Windows and Linux operating systems.

Sensoray
www.sensoray.com

Embedded Workbench certified for functional safety development

The build chain of the IAR Embedded Workbench for ARM tool suite has been certified by TÜV SÜD for the development of safety-related applications. IAR has also announced the availability of a special support agreement for customers working with safety-critical systems. IAR Embedded Workbench for ARM has been tested and approved according to the requirements on support tools put forth in International Electrotechnical Commission (IEC) 61508, the international umbrella standard for functional safety, as well as International Organization for Standardization (ISO) 26262, which is used for automotive safety-related systems. The assessment has covered the relevant parts of IAR Systems’ development processes, as well as the safety-related customer documentation and the customer support.

IAR
www.iar.com/safety

Acoustic adhesive vent protects portable electronics

The GAW113 acoustic vent from W. L. Gore & Associates’ Portable Electronic Vents group is designed to provide dust and splash protection for acoustic openings in portable electronic devices such as scanners, two-way radios, tablet and laptop PCs. To function properly, portable electronic devices require acoustic openings that enable sound to enter and exit the system. If these openings are not adequately protected, contaminants such as dust and water can enter the enclosure and compromise the acoustic performance. The GAW113 vents are a proprietary non-woven composite material that adheres to the acoustic openings, providing a water spray efficiency of 90% with the ability to capture particulates as small as 5 microns (µm). It is a dark gray in color to provide a neutral complement to device designs and has a thickness of only 0.47mm. With an improved spray resistance to IP54 testing, a thinner profile and less than 2dB of acoustic transmission loss, the GAW113 vent provides superior performance to vents comprised of woven material.

W. L. Gore & Associates
www.gore.com/gaw113
XMC module supports any platform’s specific I/O or storage needs

The XPort5005 from Sarsen Technology is a new XMC module that can be quickly configured to support a platform’s specific I/O or storage needs. By supporting up to three Mini-PCle cards, the XPort5005 provides a flexible platform for hosting everything from wireless modules (WLAN, cellular, GPS) to communication modules (MIL-STD-1533, CAN, ARINC-429), and anything in between. As the industry’s first XMC to leverage the widely supported Mini PCI Express I/O and mSATA storage module markets, the XPort5005 offers a flexible solution for meeting current and future platform requirements. The module has sites for two Full-Height Mini-PCle cards and a Half-Height Mini-PCle card. All three sites support x1 PCle 2.0 and a USB 2.0 interface for added flexibility. Each site also provides a mini-SIM socket for use with cellular modules. Alternatively, the two Full-Height Mini-PCle sites can be populated with mSATA modules to meet your solid state storage requirements. The card supports operational temperatures from -40 to +85°C for conduction cooled applications and -40 to +70°C for forced air cooled applications.

Sarsen Technology
www.sarsen.net

Quad core ARM chip aims at software defined networks in the data center

LSI has introduced a 28nm family of communication processors designed to accelerate network performance while supporting increasing traffic loads throughout the enterprise. The Axxia 4500 is LSI’s first ARM technology-based communication processor family designed for enterprise and data-center networking applications as well as evolving Software Defined Networks (SDN). By combining networking accelerators and Virtual Pipeline technology with ARM’s power-efficient Cortex A15 cores and scalable interconnect, the new Axxia processors are specifically designed to address the performance challenges facing next-generation networks. The networks that carry the data are being tasked to do more than ever before, and the Axxia 4500 communication processor family is purpose-built to deliver the high performance required by these demanding trends. The Axxia 4500 processor family includes LSI field-proven acceleration engines that incorporate decades of communications solutions expertise. The new processors also include up to four ARM Cortex-A15 cores with a CoreLink CCN-504 coherent, QoS aware interconnect in 28nm process technology. The addition of LSI Virtual Pipeline technology allows equipment developers the ability to essentially reconfigure the processors for optimal performance on a packet-by-packet basis. The Axxia 4500 processors also include up to 100Gb/s of L2 switching function to reduce board space and bill of material costs.

LSI
wwwlsi.com

STMicroelectronics satellite-tracking ICs find fix with GALILEO

STMicroelectronics’ Teseo II single-chip satellite-tracking ICs were successful in the first ground location test using Europe’s own independent navigation system, Galileo. The tests were conducted in collaboration with the European Space Agency (ESA). In March 2013, the first position fix of longitude, latitude and altitude using the four Galileo satellites currently in orbit was performed by the European Space Agency at its Technology Centre in the Netherlands and by ST at its GNSS (Global Navigation Satellite System) software development labs in Naples, Italy. ST and ESA conducted the historic static and dynamic tests using a rooftop antenna with a clear view of the satellites (static) and from a mobile test-bed unit travelling in a normal user environment (dynamic). The Teseo II receiver was able to track and produce a 3D fix over the entire path of the mobile unit, using only the 4 Galileo IOV (In-Orbit Validation) satellites. ST and ESA plan to continue the joint tests, initially as a combined multi-constellation fix with GPS and/or Galileo satellites, then later in the year, when more Galileo satellites are available.

STMicroelectronics
www.st.com

Bluetooth all-in one module with antenna targets automotive use

Alps has developed the “UGZZC–G Series” Bluetooth all-in-one module with antenna for automotive use, enabling wireless connections between automotive equipment such as car audio systems and mobile devices. Products that use Bluetooth require Bluetooth SIG certification and certification specified in radio legislation in each country. The same certification has to be obtained also for the end equipment after the Bluetooth module has been installed and with the antenna included, meaning an enormous amount of time and effort is spent on examination and testing. Having incorporated the antenna and Bluetooth protocol stack into the module, Alps is responsible for obtaining for the module not only Bluetooth certification but also certification required by radio legislation in relevant countries. The module also has a built-in serial flash memory enabling storage of up to 3,000 phone book data entries and incorporates sorting and other functions for managing that data, thereby helping to reduce the software development workload of equipment manufacturers. ALPS’ addition of a module integrating antenna, Bluetooth protocol stack and memory to its current lineup of All In One modules helps to reduce the design, testing, software development and certification burden for end equipment. The UGZZC–G Series measures 29.0x36.1x8.0mm, operates from a 3.3V supply over the -20 to +75°C temperature range.

Alps Electric Europe
www.alps.com
Real-time, video processing system blends multiple channels

RFEL’s HALO low power, real-time video processing unit targets image-based surveillance, capable of multiple video inputs processing for optimum feature extraction and image quality. The unit runs RFEL’s high performance video processing blocks on the latest FPGAs to perform intelligent fusion of multi-modal imagery, such as from a visible and IR sensor. The goal of image fusion is to form a composite image based on selecting the best features from both images on a per pixel basis. Image stabilisation is supported even when the platform is subject to severe vibration, and when imagery is sparse in features or of low contrast. Contrast enhancement maintains high performance operation in marginal lighting conditions, visible and IR. Noise reduction is used to optimise operation in low ambient light and for ensuring robust image fusion. HALO also supports digital zoom, lens distortion correction, image overlay and compression standards. The unit operates from 4.7 to 27V DC. Housed in a rugged 105x105x80mm enclosure, the full system weighs less than 400g. HALO is also available as a board-only OEM variant and as a system-on-module variant.

RFEL
www.rfel.com

À la Minute!

One System, many Applications
The LPKF ProtoLaser U3 is the perfect multipurpose tool for micro manufacturing in the laboratory.

Learn more at: www.lpkf.com/protolaserU3
Avnet Abacus launches thermal management microsite

Avnet Abacus has launched a Thermal Management microsite which provides an online hub for users to easily source, select and purchase a wide variety of thermal management products from leading manufacturers. The thermal management product offering features fans and blowers (axial, radial); heat sinks (extrusions, board mounted, bonded fins, folded fins, liquid cold plates, max clip); and thermal conductive materials.

To assist customers with product selection, the microsite contains technical data and outlines the key design considerations for choosing a suitable thermal management solution for their particular application.

Avnet Abacus
www.avnet-abacus.eu

Multi-channel wireless transmitter offers remote control of frequency channels

LPRS has released the latest version of the CDP-TX-05MP-R compact size multi-channel transmitter module from Circuit Design, featuring additional control pins for remote frequency channel control. The CDP-TX-05M-R and CDP-RX-05M-R are low power narrow band FSK transmitter and receiver modules, designed for industrial applications operating at sub 1-GHz. The modules contain most of the components necessary for radio transmission in very compact packages. The RF channel is fixed but selectable within 4 pre-programmed channels. The receiver is double-super-heterodyne and equipped with a SAW filter, ensuring high sensitivity and very good selectivity for long range communication.

LPRS
www.lprs.co.uk

Surface mount 32.768kHz crystal is only 1.6x1.0x0.5mm

River Electronics manufacture what are believed to be the smallest crystals in the world with the ubiquitous 32.768kHz crystal reduced to a 1.6x1.0mm footprint, only 0.5mm high. This latest product has been developed for smart card applications where the crystal is imbedded within the thickness of the card as part of the control and security circuit. River micro crystals are also manufactured from 12 to 80MHz as SMD AT cut fundamental designs in packages measuring as little as 1.2x1.0x0.33mm and as micro SMD oscillators from 1.5 to 400MHz, in packages as small as 1.6x1.2x0.7mm, but also in conventional resistance welded leaded and pre-formed SMD HC-49/U03 units. The devices are qualified to AEC-Q200 standards and operate at up to +105°C for some of them. Total Frequency Control distributes the full range of River Electronics micro crystals and oscillators from their UK office at Storrington in West Sussex.

Total Frequency Control
www.tfc.co.uk

DesignSpark PCB Version 5.0 features online design rule checking and buses

RS Components has unveiled the latest release of DesignSpark PCB, the company’s professional software for schematic capture and PCB layout. DesignSpark PCB Version 5.0 integrates two additional features within the free design tool - online Design Rule Checking and buses - which have been introduced to further reduce design times for engineers and to minimise errors during the design process. This new release builds upon the previous version of DesignSpark PCB announced in October 2012, which provided access to the industry-leading ModelSource component library, PCB quote service and BOM quote functionality.

RS Components
www.rs-components.com

Acal BFi opens new UK custom centre with integrated mix of services

Acal BFi has consolidated its value-add services from across the UK into a new, dedicated UK Custom Services Centre as part of a GBP 2million investment. The new centre will provide customers with a highly responsive and integrated mix of services to stimulate innovation and accelerate time to market. Based in Wokingham, the Custom Services Centre will offer best-practice & standards-based (ISO 9001:2008) assembly services to support the UK’s resurgent electronics manufacturing sector. It will provide a single centre of excellence in the UK and combines a number of Acal BFi’s technology specialists with customisable in-house assembly and test facilities.

Acal BFi
www.acalbfi.com
Thirty years of DC/DC power technology

By Patrick Le Fèvre

THIRTY YEARS IS A LONG TIME in this extremely dynamic electronics industry of ours. I choose this somewhat arbitrary measure of time because it was in late April of 1983 that Ericsson entered into the power module market with the launch of the world’s first high-frequency-switching DC/DC power modules. These modules were called the PKA family and were designed to power ‘distributed power architecture’ systems. Compared to competitive devices, the modules were five times smaller and offered 20 times higher reliability. Actually, the company had started work a few years before in 1977 beginning with research into high-frequency-switching DC/DC converters and the establishment of the company’s first advanced design facility for miniaturized DC/DC converters; but it was 1983 that the company truly announced its intentions.

The inexorable level of innovation in this sector of the industry over the past three decades has been impressive with significantly increased levels of integrated functionality, increased power density with the introduction of new size formats such as quarter-, eighth- and sixteenth-brick, not to mention massively increased levels of energy efficiency up to the mid 90 per cent range. But perhaps two of the most significant trends in the industry over this time have been at the system level, each offering substantial possibilities to reduce overall power consumption.

Firstly the move from the ‘distributed power architecture’ that dominated in the 1990s to the ‘intermediate bus architecture’ (IBA). Introduced in 2000 within the telecoms and datacoms sector, the IBA board-level power architecture uses master intermediate bus converters (IBCs) to convert a traditional 48V(DC) distribution-level power line used in telecoms typically a static 12V(DC), feeding DC/DC point-of-load (POL) regulators which supply the final load voltages at logic chip levels of 5V and below. The second is the transition from analog to digital control of power converters. The PM-Bus standard, based upon SMBus, was created in 2005 and provides a method to communicate with converters over a digital communications bus. This has been followed over the past few years with the introduction of very high efficiency and high power density advanced bus converters that are fully digitally controllable and programmable; in addition to a wide range of digitally controlled POL regulators. It has been in the past couple of years that digital power has moved from the early-adopter phase to the early majority. Based on Ericsson research estimates, somewhere close to 50 per cent of digital-power based supplies were used in the telecom/datacom sector.

Companies are being motivated by the unprecedented benefits offered by this technology to increase reliability and reduce energy consumption and the total cost of ownership. Looking forward to the next few years, we expect to see innovation in a number of areas. Already being deployed in a few high-end telecom/datacom applications, dynamic bus voltage technology provides the possibility to dynamically adjust the power envelope to meet load and traffic conditions. The development of new algorithms will make control-loop auto-compensation increasingly stable for a wider range of applications, guaranteeing good DC/DC performance and meaning that designers will not have to worry too much about the number of capacitors or board parasitic impedances. And finally, one more innovation in the next few years that we expect is the combination of digital control and monitoring with the development of new Gallium Nitride based power transistor technology, delivering even higher power efficiencies.
Keep abreast of the latest industry news with our newsletters

www.electronics-eetimes.com/newsletters