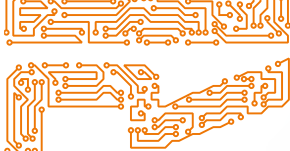
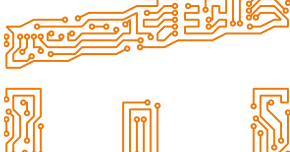
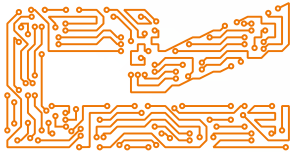
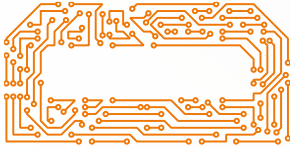




Premier Farnell

THE EMBEDDED INTERVIEWS 2018





Ralf Buehler, SVP Sales and Marketing

Recent advances in embedded systems design are allowing engineers and makers to use off-the-shelf hardware and software to create complex products faster and more easily than ever before.

Today, microcontrollers are generally differentiated by on-chip peripherals and software from the vendor. Semiconductor vendors are no longer just suppliers of silicon, and the complexity of peripherals, drivers and other software means that they specialise in particular markets.

These interviews with some of the leading engineering personalities in the largest and most innovative embedded processor companies reveal how they build knowledge of the needs of their customers so they can deliver integrated hardware and software that are better solutions to the challenges of developing modern embedded products.

We are delighted that such influential leaders in the embedded world have given their time to this book, and hope you find their interviews helpful and interesting.

Ralf Buehler



An Interview with Cliff Ortmeyer

Global Head of Solutions Development Premier Farnell

Cliff has an electrical engineering degree and has worked in the electronics industry for 26 years in a variety of engineering and marketing management positions.

He has been with Premier Farnell since 2012, most recently as the Global Head of Technology Product Marketing and Solutions Development. Previously, Cliff worked for STMicroelectronics and Coilcraft in positions ranging from Applications Engineering to Market and Business Development.

Cliff holds multiple patents and is an electronics enthusiast who has a passion for understanding and leveraging new technologies.

His current focus is on the role of new technologies and trends and how they impact the future of developing new markets such as IoT through makers and engineers alike.

What are the most popular MCU families/solutions supplied by Premier Farnell?

Premier Farnell stocks popular MCUs from a broad range of semiconductor suppliers. A few of the most popular are the ST Microelectronics STM32 series, NXP Kinetis, Texas Instruments MSP430 and Simplelink, and the Microchip PIC32 and Sam9.

Why do you believe these are the most popular solutions?

Each of these MCU families is unique in its own way. They are each designed for a specific application, from low power IoT edge devices to high performance controllers for automotive & industrial applications. Their performance and speed, as well as development platforms, tool chain, resources and ecosystems built up around these controllers inspire confidence in developers. These families have been in the market for a number of years, demonstrating a good track record in reliability, performance and user ability.

If you could solve one challenge that would help improve the world of embedded design, what would it be?

I would create an overall ecosystem/platform where designs and learnings can be shared securely in order to work towards generating a strong dependable interaction between all new technologies. A common platform with shared open standards to allow for secure device interaction between a number of designs from different designers.

How does Premier Farnell's range of MCUs help customers meet the specific requirements of their applications?

Premier Farnell has a wide range of application specific controllers that are available in a variety of different packages. We have a full range of the most popular MCUs through to FPGAs - from simple 8-bit DIP MCUs to the most popular 32-bit MCUs in all package types and the latest SoCs/FPGAs for application specific development. With this type of breadth, we enable the development of simple controls to state-of-the-art AI systems for both low volume prototyping to high volume production.

What do you think are the core on-chip peripherals?

Something that creates a full system on-chip, which has its own capability to receive, process and communicate (wirelessly) with some intelligence to it. If something goes wrong it should be able to tell what's wrong.

The ability to have bi-directional communication with the outside world - to send and receive information in a variety of ways including both wired and wireless communication. For example, something like Ethernet, I2C, SPI to receive wired information and BLE, Wi-Fi, LoRa for wireless, along with some type of debug function, like JTag. If motor control specific peripherals (timers etc) are also included, this would add a lot of versatility as well.



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THE BIGGEST
APPLICATION IN THE
NEXT 2-5 YEARS WILL
PROBABLY BE AI

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CLIFF ORTMEYER
*GLOBAL HEAD OF SOLUTIONS DEVELOPMENT,
PREMIER FARNELL*

Additionally, on-chip peripherals should be as low power/ high performance and flexible as possible to allow designers the flexibility to utilize the peripheral in as many types of application as possible – such as high performance synchronous motor control timers and A/Ds that can be that can be easily configured for lower power / performance applications.

A lot of the focus in the embedded space is around 32-bit. Is Premier Farnell focussing on 32-bit MCUs or do your customers want other processor families?

Premier Farnell has a strong focus on 32-bit at the moment, mainly because our customers get value in cost per bit with these MCUs. This doesn't mean we're abandoning the 8-bit, there's still a large customer base using these, it's just the 32-bit microcontrollers are the preferred controllers for many embedded designs due to their performance in relation to their power consumption and performance/price ratio.

Nevertheless, many legacy design platforms still use 8-bit MCUs due to opportunities for code reuse, power consumption and cost. We are committed to meeting the needs of all our customers so continue to stock a range of 8-bit MCUs.

Arm dominates the 32-bit embedded microcontroller market. What are the advantages and disadvantages of this situation?

Yes, Arm is leading due to cost per bit, but they also offer a wide range of MCU performance for many different applications.

As The Development Distributer it's our responsibility to continuously place the latest technology in front of the customer. Having a common architecture allows designers more flexibility when choosing platforms from different manufacturers while still using the same development tools. I don't see this as a disadvantage. If anything, it creates competition and drives forward the creation of continually improving MCU technology.

Development boards are important tools for engineers. Which boards are most popular with your customers?

Development boards play a crucial role in any product design cycle – idea, evaluate, prototype, test, manufacture. They provide a great platform at early stage of design to help easily evaluate a specific type or range of controllers/processor or even to help understand a specific type of technology. For example, if you're looking at using LoRa communication but have never done so before, a LoRa development board can be a great place to start.

Designers can also easily add functionality to their boards using accessories and add-on/daughter boards or HATs and the final hardware design can then be taken directly from the development board design and customised to fit individual project requirements. It's also important to state that there's a whole host of support channels for our development boards from "Getting Started" and "How to.." videos available on our element14 Community website, to our hardware customisation services.

Raspberry Pi, BeagleBone Black and Arduino are the most popular boards at the moment; other popular platforms are the ST Microelectronics Nucleo Boards and Discovery platforms, Microchip Curiosity family of boards, and the TI Launchpads.

How does Premier Farnell's range of development boards meet the needs of your different customers?

Premier Farnell carries a large range of boards for different customers. We have boards focussing on MCU evaluation and development, boards that provide a platform for specific technologies, for example, LoRa communication, and complete solution kits such as our expansive range of IoT cloud enabled solution kits or large single board computer range. All of these boards offer a complete solution, ready to be implemented into an end product.

For makers and hobbyists, as well as for educational purposes, we have the CodeBug and micro:bit, as well as Raspberry Pi and Arduino. Moving to more professional applications, we stock a number of boards and add-on boards that

help transition makers into professional developers as well as boards for traditional electronic design engineer development, including those for more commercial/industrial development such as FPGA development using our Xilinx range.

What feature or function would you like to be able to add to a development board?

Functionality largely depends on application. Ideally, I would want to see all the functionality I require for a specific application all on one development board. This could be included on the main platform or as an add-on board/HAT. For example, an industrial control application developer would expect to see functionality such as motor control, an HMI interface and robust industrial connectivity all on one board.

A developer of wearable devices would need to have sensors and low power functionality on their development board.

Software is becoming an increasingly greater part of embedded design. What do you offer to support software development?

Software is essential for embedded design. Software drives hardware! The two don't exist without each other.

Our extensive range of software tools support a number of different areas of embedded design. Specifically, for software development we have C, C+, C++ compilers and operating systems, as well as middleware such as Segger and Micrium. We carry computer aided design software for both electrical PCB design (ECAD such as Autodesk EAGLE, Altium CircuitStudio) and mechanical design (MCAD such as Fusion260). We also supply software to support test and measurement such as LabVIEW, MatLab, and Simulink, as well as for tools from Tektronix and Keysight products, just to name a few.

What do you think are the most exciting applications for MCUs?

As MCU/MPUs are core to most electronic designs it is hard to pick the most exciting. However, the continued reduction in power consumption combined with wireless connectivity will open up a whole new realm of possibilities for connected devices that will drive the continued adoption of IoT.

On the more powerful side of things, the adoption of AI in almost any area of life will lead to the most revolutionary technology/application developments thanks to the sheer access to affordable processing power.

What will be the biggest application in the next 2 years? What about 5 years time or in 10 years?

The biggest application in the next 2-5 years will probably be AI. The implementation of AI will become more and more prevalent in our daily lives. Within 10-15 years – it's hard to say, we might be headed towards a scenario where AI and machine learning has drastically changed how we live and how certain services are performed. For example, I can see AI significantly altering our lifestyles, how we commute (transportation), our healthcare system – how drugs are administered, patients monitored etc.

There is a lot of focus around IoT applications. What do you think will be the largest IoT applications using MCUs? How much of your MCU business do you expect to be driven by IoT?

Most IoT applications use some form of electronic control that incorporates an MCU/ MPU. Areas such as consumer electronic devices such as wearables, or even automotive, will naturally use the largest volume of MCUs/ MPUs. As more and more electronic devices become connected to other devices and systems, I believe that a large percentage of all MCUs/MPUs will in some form or another be used in some type of IoT application.



An Interview with Jack Ogawa

**Senior Marketing Director,
IoT Compute and Wireless
Business Unit, Cypress
Semiconductor**

Jack Ogawa is senior marketing director of the ICW Business Unit at Cypress. In this role, he is focused on embedded security solutions for IoT applications.

He has served senior leadership roles in sales and marketing for processing devices such as programmable logic and MCUs, as well as wired and wireless connectivity devices.

Most recently, he has focused on business development for secure IoT applications. He started with NFC and secure elements for Smart Home applications.

At Cypress, he is responsible for secure MCUs that deliver a comprehensive secure compute solution.

Briefly explain your most important MCU families/solutions?

Our latest MCU family is PSoC 6. PSoC 6 MCUs are built on an architecture that is optimized for the Internet of Things (IoT). Our homes, cities, and vital services are becoming smarter, requiring connectivity, increased processing, and data security while operating on batteries. PSoC 6 MCUs meet these needs by offering an ultra-low power, dual-core architecture with hardware-based security.



Why are your solutions unique? What is the “secret sauce” that makes them so good?

Almost all embedded systems are mixed signal; they have both digital and analog components. PSoC MCUs have a long history of being an industry leader in mixed-signal solutions, offering configurable, easy-to-use digital and analog peripherals and a microcontroller in a single device.

A particular highlight is our CapSense technology, which is widely regarded as the most robust and best performing capacitive sensing solution

If you could solve one challenge that would help improve the world of embedded design, what would it be?

Now that connectivity is ubiquitous, data and network security are vital. Securing an embedded design is complicated, and spans chips, firmware, and application software both locally (in the device) and in the cloud.

If there were an easy way to assess the security of an IoT device and identify corrective actions that meet cost and performance requirements, that would be very valuable.

How do you balance the competing requirements for low cost, high integration, processing performance, integration of communications and peripherals as needed with the need for low power?

It is not so much balancing, but more of a prioritization for semiconductors. We prioritized low-power, processing capacity, and security as design objectives for PSoC 6 MCUs because these areas are vital for IoT applications.

Security is an increasingly important requirement for embedded design. How are you addressing it?

Security is a key strength of PSoC 6. Secure embedded designs generally implement policy, cryptography, and secure asset protection. Policies are user-defined, so you need a programmable solution to support them. Additionally, many policies now rely on multiple factor authentication, using a traditional secure asset like a certificate and a physical factor such as location, proximity, fingerprint, etc. PSoC 6 MCUs are great for incorporating sensors in a design, and provide CapSense for touch and proximity sensing.

Cryptographic algorithms are well known, but performance is important. PSoC 6 MCUs include cryptographic accelerators that offer fast responses to authentication challenges.

Finally, PSoC 6 MCUs are built upon an architecture that uses hardware features to isolate memory locations. This makes it possible to provide hardware-based isolation that is similar to secure element devices. PSoC 6 MCUs offer these capabilities in a single chip.

What will be the biggest application in the next 2 years? What about 5 years time or in 10 years?

IoT devices will naturally evolve from just sensing and transmitting information to becoming an extension of the cloud application. Distributed processing architectures improve reliability and capability – automobiles are an example.

There will be an increasing demand for devices such as PSoC 6 MCUs that deliver secure processing capabilities without undue power and cost penalties.

A network diagram with various icons representing IoT and security concepts. The icons include a padlock, a car, a key, a heart, a person with a headset, a camera, and a document. The diagram is set against a dark blue background with red lines connecting the nodes.

“ SECURITY IS
A KEY STRENGTH
OF PSOC 6 ”

JACK OGAWA
*SENIOR MARKETING DIRECTOR,
IOT COMPUTE AND WIRELESS BUSINESS UNIT,
CYPRESS SEMICONDUCTOR*



An Interview with Geoff Lees

Senior Vice President and General Manager of Microcontrollers at NXP

Geoff Lees is Senior Vice President and General Manager of Microcontrollers at NXP Semiconductors. Before joining NXP, Geoff served as Senior Vice President and General Manager of Microcontrollers at Freescale Semiconductor, Inc. Before joining Freescale in 2011, Geoff spent 13 years with the microcontroller business at NXP and Philips Semiconductors. He was responsible for the introduction of the industry's first 32-bit ARM Flash microcontrollers, and also led the development and launch of the first Cortex-M0 and dual-core M4/M0 architectures. He served as Vice President and General Manager of the Industrial & Multi-Market division. He has more than 30 years of industry experience focused on microcontrollers and has served in various positions in systems design, software and applications engineering and management in industrial, distribution and semiconductor companies.

Briefly explain your most important MCU families/solutions?

The i.MX and Layerscape processors. Both are Arm-based and are complementary. Layerscape is designed for high-end data processing and communications. The i.MX covers a broad market, including consumer, automotive, etc.

At the lower level we have the Kinetis, which is also Arm-based. It's more vertical, providing connectivity for applications such as IoT. 15 years ago, it was the first Arm 32 flash microcontroller and now there is a massive variety in this family. We have almost 25K customers for this product.

Why are your solutions unique? What is the "secret sauce" that makes them so good?

We launched the first Arm 32-bit flash micros. The first one was associated with internet connectivity - it was designed to serve the new wired connectivity by providing a 56K modem. We've always been at the higher performance end of spectrum. So, we have strength in applications such as energy conversion, motor control and wireless connectivity.

In the last five years, we have focussed a lot on software. Today, it's not about providing broad enablement, such as Android, it's important to provide product application layer solutions. Today many of the design challenges are in software and this is reflected by the fact that half of our engineering team are software engineers.

If you could solve one challenge that would help improve the world of embedded design, what would it be?

Today low power is an intrinsic requirement - a must-have. But you also have a spectrum of performance targets, depending upon the application. We use design techniques across all families to get the right balance.

What makes a great on-chip peripheral? How do you optimise the performance of peripherals as well as the microcontroller core?

It's all down to software. You can have best hardware, but if software can't exploit it the customer can't access it. 20-30 years ago, engineers had to exploit hardware to a greater level than competitors. Today, reuse and open source means the primary requirement is compatibility. This means a good peripheral with good ecosystem tools is more valuable.

We design peripherals that can have multi-generational use. These are universal peripherals: we can scale them up and down within a processor family, so we don't need to do separate designs. By building in a modular or scalable way, we get software compatibility.

Drivers allow peripherals to be dealt with by higher level system software. Our engineering teams optimize drivers. Sometimes we can get access to high performance features and bring this up to open source software, creating "rich drivers" for Android, Linux and more standardised Real-time operating systems (RTOSs) such as FreeRTOS, Arm Embed OS, UCOS.



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**BY BUILDING IN A
MODULAR OR SCALABLE
WAY, WE GET SOFTWARE
COMPATIBILITY.**

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GEOFF LEES

*SVP AND GENERAL MANAGER MICROCONTROLLERS,
NXP*

It's possible to optimize power by 5:1, 10:1 or many times more by optimizing software over generic open source and the benefits are much greater than can be achieved by optimizing the hardware. Software is so important that compiler developers can out-perform hardware improvements when it comes to power management.

A lot of the focus in the embedded space is around 32-bit. Do you see this as the best opportunity today, or do you also expect other families to drive your growth?

32-bit has been my focus since we launched the first Arm flash MCU 15 years ago. The company made a big commitment then, and we've been fortunate to work closely with Arm. We did have an early experience with MIPS, but that market disappeared.

Arm dominates the 32-bit embedded microcontroller market. What are the advantages and disadvantages of this situation?

An important consideration is that distributors are concerned about the number of architectures they support. Ideally, they want to have one architecture to support, so Arm is a real benefit for them. This really matters to us, as about 2/3 of our business is in the distribution market.

The ecosystem goes past a "tipping point", and this is why Arm is the standard. In the microcontroller space the core is less important, but ecosystems are becoming more and more important - the Arm hardware standard enables the ecosystem.

RISC-V is an interesting development: open-source hardware might be competitive, but we have no issues with with Arms' model. No silicon manufacturer can successfully do it alone, unless the standard has been there for ever - e.g. x86.

Security is an increasingly important requirement for embedded design. How are you addressing it?

It's important to bring a complete set of solutions as you must deal with network security/vulnerability and physical device security at IoT nodes. NXP has a specialization with payments and bank cards, so we have a lot of expertise in this domain.

The key is standardisation. The software ecosystem can let things down, and although there is a lot of talk about hardware vulnerability, the software framework can let down the whole system. It's an industry problem: individual manufactures can't do it alone. We also need

certification. Today minimum requirements are defined by cloud providers, for example authentication. This should be driven harder.

Development boards are important tools for engineers. What's special about your boards that make life even better for your customers?

For the Kinesis boards we partnered with Premier Farnell, who co-designed and co-manufacture the boards.

Some designs are complex: for embedded developers DDR memory presents the biggest challenge. In fact, we have to specialize in it ourselves to get the right design, and lots of competitors are facing the same challenge. Some hardware, particularly RF design, is out of reach for the majority of customers.

In four to five years, the high-end performance will be so specialized that only a few high-end manufacturers will be able to produce it. So, we could see modules as a solution to solve problems, and we are currently using 3D packaging to overcome challenges that can't be easily solved on the board within the package. Today engineers generally buy modules for certification reasons, but in the future it will be driven by design reasons. For example, you may have 90+% of smartphone in a module. IoT, however, is less demanding and we will still have lots of customer hardware in 5-10 years.

Do you think software development tools are best provided by the silicon manufacturer or an independent tools company?

The driver is best provided by the silicon manufacturer. Independent tool companies are listening to the community. There's a number of layers of specialization, so you can't say all development tools should be provided by one or the other.

What do you think are the most exciting applications for your MCUs/MPUs?

In the last 5 years, IoT is one of the most interesting and fast-evolving area's, as well as driver information systems in vehicles. We see IoT crystallizing into core segments; personal devices, smart home, smart vehicle, smart office, and more.

Today there is a focus on edge node processing because the requirement for processing is increasing at a very fast rate. Some of the drivers for this are machine learning, security and connectivity.

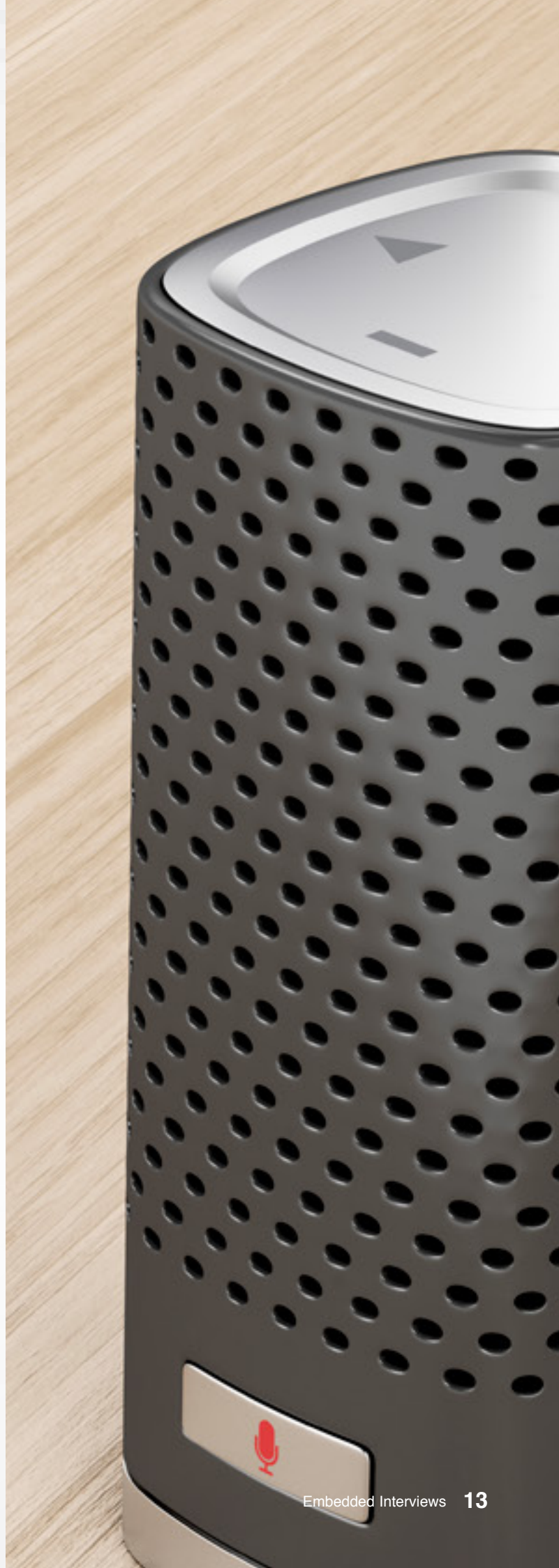
What will be the biggest application in the next 2 years? What about 5 years time or in 10 years?

Products that are part of the network, perceptibly or imperceptibly, e.g. smart home. Devices will lean on other devices and learn because capabilities as a system are much bigger. So, we will see a lot of network, and network learning technology as well as voice recognition and video streaming.

So far, we have seen technology appear before need, which leads people to say, “do we need it?” Ultimately, however, it is taken for granted. We use the expression “aware” devices such as voice-activated assistants become “aware”, and we will either start believing they have an intelligence, or they will simply be more useful. Awareness will increase by order of magnitude.

Lately there has been a lot of focus on Machine Learning. What opportunities do you see that Machine Learning brings to the connected world? Do you expect to be incorporating Machine Learning in your embedded processor enablement?

We’ve not seen a lot of machine learning except voice and facial recognition in embedded applications. Today, people program with algorithms that are pre-set. This will change *en masse* to heuristics. Working with a range of cloud providers has enabled us to deliver voice services to NXP customers. We are also working on reference designs, helping with machine learning and producing AI developers’ kits. AI will become part of software engineering, not a separate field, but it could change the way software is developed.





An Interview with Andy Harding *Director Broad-based Solutions Renesas Electronics*

Andy Harding is Global Director of Partner and Channel Marketing at Renesas Electronics.

Having qualified as an electronics engineer in the 1980s, he spent several years developing microcontroller based naval communication systems before moving into the electronic component business.

Having worked as an application engineer in distribution, he joined Hitachi in 1989 (latterly Renesas) where he has held various positions in both sales and marketing management.

Briefly explain your most important MCU families/solutions?

Frankly they are all important, for different reasons. We strive to give customers a choice. Low power, high performance, integration, processors, platforms... if you want to be the market leader you need to meet the broadest range of needs.

Why are your solutions unique? What is the “secret sauce” that makes them so good?

That’s an excellent question and one I could wax lyrical about for many hours. The fundamental “secret sauce” is process technology which enables outstanding performance and high integration. Especially our zero-wait state flash which has incredible history of reliability & data retention. But it goes beyond the silicon... Several years ago, I was part of a small team in Renesas that was tasked with architecting our next generation MCU strategy. The conundrum we faced was that everyone knew the market would be looking for an Arm core solution (for reasons I’ll explain elsewhere) but that putting an Arm core inside would make us just another “me too” vendor in an already crowded market. What we found was that we needed to think beyond the silicon device, to complete platforms which would differentiate by shortening design cycles, simplifying design starts and improving total cost of ownership.

How do you balance the competing requirements for low cost, high integration, processing performance, integration of communications and peripherals as well as the need for low power?

Well there are lots of topics combined in this question. Low cost, high integration (and processing performance) all require a smaller geometry process.

Finer geometries mean lower operating power consumption, but higher leakage. Then special design techniques are needed to optimize. And to really get the best results you need to look at the application requirements and address these from a system level, rather than device level.

Communications peripherals introduce the topic of system architecture. Is it better to have an application processor with a separate communications device (allows for more flexible platforms) or to have a completely integrated solution (reduces cost, but limits choice)?

What makes a great on-chip peripheral? How do you optimise the performance of peripherals as well as the microcontroller core?

Frankly most of the differentiation is in the peripherals already. We can integrate more memory than most customers need and run it at full speed with no wait states, and our 32-bit MCUs are operating at clock frequencies of 240MHz, with highly efficient instructions. Optimising the peripherals is usually a question of targeting specific applications. For instance, we have dedicated motor control timers which offer zero cross detection as well as VCA which simplifies control.

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IF YOU WANT TO BE THE
MARKET LEADER YOU NEED
TO MEET THE BROADEST
RANGE OF NEEDS.

ANDY HARDING
DIRECTOR BROAD-BASED SOLUTIONS,
RENESAS ELECTRONICS

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A lot of the focus in the embedded space is around 32-bit. Do you see this as the best opportunity today, or do you also expect other families to drive your growth?

Well no doubt the 32-bit market grows fastest, but 16-bit is also growing albeit at a slower pace.

Arm dominates the 32-bit embedded microcontroller market. What are the advantages and disadvantages of this situation?

Of course, there are benefits – many engineers know Arm, there are common tool chains. But there are disadvantages also. That's why Renesas has been offering its own MCU cores so we can address features required by different customers. But increasingly the market has been commoditized through Arm. Which of course drives prices down which is also good for customers.

Security is an increasingly important requirement for embedded design. How are you addressing it?

We have a rich set of security IP which we are selectively introducing into our MCU families based on application requirements.

Development boards are important tools for engineers. What's special about your boards that make life even better for your customers?

We tend not to spend too much energy or money designing cheap giveaway boards which sit on desks and gather dust! We prefer to create real useable design tools.

Software is a larger and larger part of embedded design. What do you offer to support software development?

This is the raison d'être of the Synergy platform. We recognize that customers have more software engineers these days than hardware. And if we can get them programming at a higher level (API), not spending time on non-differentiating code (drivers, middleware etc.), then they can save time & money and focus on differentiating their products in the market.

Do you think software development tools are best provided by the silicon manufacturer or an independent tools company? Why do you say this?

Really you should word that question differently. The question is not about the label you attribute to the company. Rather it's about the resources you have, their expertise. For sure there is no point asking a bunch of chip designers to write software. But if you employ people with that expertise with good software architects, then there's no reason why any company could not be successful in software. There are some additional benefits of software being written by software engineers in the device manufacturer....and that is that you can design software with silicon in mind, deriving much more performance.

What do you think will be the biggest trend in the embedded market in the next year? What about the next 5 years?

Security technology and communications technology.

There is a lot of focus around IoT applications. What do you think will be the largest IoT applications using your processors? How much of your MCU business do you expect to be driven by IoT?

This is an interesting question. There is a lot of hype around IoT. We need to ask what we really mean. We have for instance a large business in home appliance and now some of those are now being connected to the internet. Shall we then call this an IoT business? If we take that approach then nearly every market is an IoT market.

I prefer to think about IoT in the context of new business models, enabled by the internet, creating new business opportunities. One example I love to talk about is the heating controller my son has in his apartment. It's connected to the internet and his smart phone. So, it knows when he comes and goes. It also knows the weather forecast and can use this and other information to make intelligent decisions on heating the home and save quite a lot on energy costs as a result.



An Interview with Øivind Loe

Senior Marketing Manager IoT Products Silicon Labs

Øivind Loe is a senior marketing manager at Silicon Labs focusing on IoT strategy. He joined Silicon Labs in 2013 following the company's acquisition of Energy Micro, where he started working in 2008 as a digital design engineer and subsequently played a key role in the development of the EFM32 MCU architecture and product portfolio.

Øivind has also served as a design manager at both Energy Micro and Silicon Labs, and has later been responsible for both the MCU and Sensor businesses at Silicon Lab.

He holds a Masters degree in Engineering Cybernetics from the Norwegian University of Science and Technology.

Briefly explain your most important MCU families/solutions?

Silicon Labs' most important MCU-based solutions are our Wireless Gecko SoC and module families. These wireless devices are having a major positive impact on the IoT market, enabling our customers to meet their connectivity needs. We also offer wireless SDKs including protocol stacks and a wide range of evaluation and development kits to get them quickly started with product design. In recent years, we have evolved from a chip-focused company to a comprehensive silicon, software and solutions provider, offering customers what they need to speed time to market and reduce the cost and complexity of their IoT applications.

To get the most out of a wireless MCU, good software is critical, and our SDKs and protocol stacks provide the foundation here. Our hardware and software teams work together to provide a combined solution that offers the best performance. Optimal value is truly found in the integration of software and hardware from a single vendor.

Development tools are also very important. If a customer wants to deploy 200 mesh nodes, they need to have software tools that show them how the mesh is working, and tools that give them insight at the packet level. Customers also care about energy efficiency, and our energy profiler tool can reveal bits of code that might cause an energy spike. This tool is very valuable as it allows engineers to optimize for ultra-low power and long battery life.

On Which Part of the Embedded Market does Silicon Labs Focus?

Within the broader embedded market, we are focusing on applications requiring wireless connectivity. In essence, this is the Internet of Things (IoT). We view the IoT as the most interesting and fastest growing market opportunity. Silicon Labs is uniquely positioned in the IoT because of our wireless expertise and the comprehensive scope of our portfolio, ranging from wireless SoCs and modules to protocol stacks to development tools.

Is providing wireless connectivity just about meeting the latest standards?

Not at all – proprietary wireless is very important for many IoT applications. Our wireless SoCs support both standards-based and proprietary protocols. We also offer multiprotocol connectivity technology that enables our customers to retrofit legacy proprietary wireless systems with standards-based protocols such as Bluetooth and Zigbee.

Sometimes there are really good reasons to use proprietary wireless. For example, sub-GHz communications supports higher output power, special modulation schemes and long-range communications. In Europe, for example, radios for smart metering use sub-GHz to penetrate walls, allowing thermostats to be placed anywhere in the house.

If you could solve one challenge that would help improve the world of embedded design, what would it be?

We believe it's very important to make security simple and reliable for both developers and end users. In addition to integrating hardware security in our microcontrollers and SoCs, we also offer software libraries

and, in the future, will have more advanced security technologies available. Even the smallest design mistake or bug can end up as a security issue, so engineers need to conduct code reviews. Trivial things really matter in security. Simply forgetting to enable security settings or forgetting to change a default password can make an end product vulnerable to an attack.

The question is how to stay ahead of malicious actors who target IoT devices. At a minimum, you need a robust way of deploying updates and patches. Over the air (OTA) updates are becoming more and more important, not only for security but also to enable new features and enhanced functionality.

With some IoT devices designed for 10 years or more operation, maintenance over that period of time can be a challenge, requiring many updates to ensure the device remains secure and useful.

How do you balance the competing requirements for low cost, high integration, processing performance, integration of communications and peripherals as need as the need for low power?

Let's add robust operation to that list of competing requirements. Some of our devices have to operate reliably at temperatures of up to 125°C. Let's also factor in the time required to design and develop an MCU or SoC, which is another important consideration.

While all of these requirements seem contradictory, it comes down to working closely with customers to deliver the right combination of features, performance and cost points for their application needs. The secret is to deliver just what the customer needs and not too much more, as the customer doesn't want to pay for things they don't need. Overall, if the customer doesn't care much about low power, the design challenge is simpler. Ultra-low power makes everything much more complex.

A lot of the focus in the embedded space is around 32-bit. Do you see this as the best opportunity today, or do you also expect other families to drive your growth?

We believe there are still compelling use cases for 8-bit especially for cost-sensitive applications, although 32-bit is going down in cost too. We have a strong 8-bit MCU portfolio and still see that business growing.

We don't see 64-bit MCUs being important in the near term. Multicore architectures will be the next big thing to raise performance. In the server market, however,

there is a need to move to 64-bit processors because of the amount of RAM that must be addressable, but this is not really a concern in embedded applications.

Multicore processors in embedded applications will have cores dedicated to particular functions, such as a low-power sensor interface and a higher performance processor for computation-intensive tasks. In fact, we already have integrated multiple CPUs on some of our MCUs and SoCs, but we just don't expose them to the customer. Sometimes we need a processor to manage the complexity of the radio and don't want to load the main CPU. So, the trend we see is offloading tasks from the main CPU and have other processors handle other functions autonomously.

Arm dominates the 32-bit embedded microcontroller market. What are the advantages and disadvantages of this situation?

You can look at this situation from multiple angles. First, collaborating with an IP vendor like Arm allows Silicon Labs to focus on other development challenges. Twenty years ago, many chip companies made their own CPU cores, which took valuable engineering resources. The rise of Arm has levelled the playing field in the embedded market. One could argue that Arm's dominance limits innovation, because all vendors end up using the same CPUs, but at the same time, Arm is also steadily pushing out new technology, and uniformity is in many ways also a good thing. Going forward, security, machine learning, a general need for more energy-efficient processing power, and other technologies will require more innovation, so either Arm will provide this, or there will be opportunities for other architectures.

What feature or function would you like to be able to add to a development board?

We currently supply a network analyzer and energy monitor on our standard development kits, so we've gone well beyond conventional development boards already. We think it's really all about convenience and making it easier to get customers to build apps.

We also need to remember that there are multiple development journeys. Some developers want to access the microcontroller, particularly if they are new to that product, while others want to use the same kit as a debugger for their production hardware. So our biggest challenge is to fully support these many different use cases, rather than add a particular new feature.

What do you think are the most exciting applications for your MCUs/MPUs?

Within the IoT, we view industrial IoT (IIoT) as particularly exciting. IIoT gives us a chance to solve real problems with an economic benefit and potentially create new business models. Many of our customers are household names in IIoT, offering numerous products that we interact with in our everyday lives.

Lighting is an area where we expect to see new business models. LED technology reinvented the light bulb so now consumers no longer need to buy multiple bulbs. This means lighting vendors will need to create differentiated products. Building security is another example as it's possible to retrofit almost any building with wireless security systems.

The smart city is also a very interesting area. For example, smart meters in the UK enable people to make better decisions on how to use energy, for example turning off lights when no one is at home. Smart cities can also control or sense what's happening in urban environments to improve safety and security.

The home ecosystem is ripe for development, and we are seeing growth here too. Products that people want include connected thermostats, sensors, lighting controls, security cameras and similar applications.

What will be the biggest application in the next 2 years? What about 5 years time or in 10 years?

We haven't scratched the surface of what's possible with wireless connectivity, processor architectures and security technologies. With the continuing rise of the IoT, the number of important applications will continue to grow. In the next ten years we will see innovations we can't yet imagine. We see so much potential in the IoT: more convenience and value for consumers, and ROI for industrial applications.

What do you think will be the biggest trend in the embedded market in the next year? What about the next 5 years?

For IoT, security is a major enabler. We will see a huge focus on security for the next five years, in particular thinking about security for the whole product lifecycle and from silicon to the cloud. Technically advanced solutions and ease of implementation will be very important to help secure the IoT.



“ LIGHTING IS AN AREA WHERE WE EXPECT TO SEE NEW BUSINESS MODELS. ”

ØIVIND LOE

SENIOR MARKETING MANAGER,
IOT PRODUCTS,
SILICON LABS



An Interview with Laurent Vera

Director EMEA Microcontroller Marketing, STMicroelectronics

Laurent Vera is Marketing Director at STMicroelectronics for the EMEA Region and has held this position since 2011. Laurent joined ST in 1994 in Seoul, where he contributed to business development with major Korean partners, he then spent a few years in France with the responsibility of product lines for consumer and computer applications.

He moved in Edinburgh in 2001, where he contributed to marketing ST's efforts in Imaging. He leveraged these efforts in Asia, where he spent 10 years in locations across the region identifying partners and expanding business for ST's imaging and microcontroller products. Upon his return to Europe in 2001, Laurent has been working with leading European customers on the deployment of new products and services powered by STM32 microcontrollers.

Laurent Vera was born in Lyon, France in 1971 and received his Diploma in Electronic Engineering from The National Institute of Applied Sciences in Lyon, France.

Briefly explain your most important MCU families/solutions?

The STM32 family of 32-bit Flash microcontrollers is based on the Arm® Cortex®-M processor core and offers new degrees of freedom to MCU users. With 12 series of devices, it offers range that runs the full gamut of very high performance, real-time capabilities, digital signal processing, and low power, low voltage operation, while maintaining full integration and ease of development. The large range of STM32 devices is accompanied by a vast ecosystem of tools and software, making this family of products the ideal choice, both for small projects or an entire platform.

We also feature the STM8 family of 8-bit microcontrollers, implemented around a high-performance 8-bit core and a state-of-the-art set of peripherals, which allows fast and safe development through enhanced stack pointer operations, advanced addressing modes and new instructions.

Why are your solutions unique? What is the “secret sauce” that makes them so good?

ST decided to drive the paradigm change to 32-bit MCUs that happened 10 years ago when we introduced our first STM32 powered by an Arm Cortex-M3 core. We understood though that the value of an MCU wasn't in the core itself but in everything around it. Picking a partner that could help us establish a standard for microcontrollers was critical and this is what we did with our partnership with Arm.

The STM32 is more than a core. It is composed of ST's unique IP -- analog or digital -- to serve many different markets, with a wealth of use cases. It is composed of unique data paths and unique power schemes. There are many ingredients which makes our product unique. This ST IP, added on top of the “standard” Arm IP, is one element of our secret sauce.

The other is ST's full range/strong ecosystem approach that ensures designers can find the right MCU for their projects and, with the STM32 Open Development Environment and STM32 Nucleo development system, develop and prototype their designs to quickly get their ideas to revenue.

If you could solve one challenge that would help improve the world of embedded design, what would it be?

I'd like to offer tools that would allow anybody to use and program our products without the need to learn a computer language such as C or C++.

How do you balance the competing requirements for low cost, high integration, processing performance, integration of communications and peripherals as need as the need for low power?

Every design project has a different requirement for balancing cost, integration, performance, and power and we help our customers optimize their projects for their particular goals with more than 800 STM32 part numbers across 12 different series, from the ultra-low power devices at or near the top of the EEMBC low-power benchmarks to the ultra-high performance MCUs at or near the top of the EEMBC performance benchmarks.



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**IN THE NEXT 5 YEARS,
I SEE SECURITY AS A
MAJOR CHALLENGE
FOR THE INDUSTRY.**

”

LAURENT VERA

*DIRECTOR EMEA MICROCONTROLLER MARKETING,
STMICROELECTRONICS*

A lot of the focus in the embedded space is around 32-bit. Do you see this as the best opportunity today, or do you also expect other families to drive your growth?

32-bit MCUs are certainly where the action is today in MCUs. There are still lots and lots of 8-bit MCUs being sold, and this is a good business for ST, but the cost premium of a low-end 32-bit MCU is low enough that most new designs that could be done using an 8-bit MCU is being done using a low-end 32-bit MCU.

Another reason why developers are making this decision is it eases long-term product and brand development: new features can be added to these low-end products using 32-bit MCUs much more easily than they could be added to products using 8-bit MCUs.

Arm dominates the 32-bit embedded microcontroller market. What are the advantages and disadvantages of this situation?

Arm's success in the 32-bit embedded MCU market wasn't a slam dunk. ST was the first major semi manufacturer to promote the Arm solution because we saw the value of a broad, open environment that offered designers outstanding performance, great value, and exceptional tools and ST frankly contributed strongly to that success by offering a great family of MCUs, across the full spectrum of power, performance, integration, and price.

Security is an increasingly important requirement for embedded design. How are you addressing it?

With the growing interconnectedness of products, cybersecurity is becoming a major concern for our customers and we are working with them on solutions at both hardware and software levels. For instance, we are working on a package for Secure Firmware Upgrade. The package will be deployed across our portfolio using the different hardware characteristics of our products and different encoding and authentication schemes.

We also offer solutions to protect against physical attacks with our STSAFE family of IoT secure elements.

Development boards are important tools for engineers. What's special about your boards that make life even better for your customers?

While we offer a range of boards – from low-end discovery boards for MCU evaluation, to high-end evaluation boards, I'll focus on the STM32 Nucleo

boards, which allow anyone to try out new ideas and to quickly create prototypes with any STM32 MCU.

The STM32 Nucleo boards all share the same connectors, allowing them to easily be extended with a large number of specialized application hardware add-ons including Arduino Uno rev3 (for Nucleo-64 boards), Arduino Nano (Nucleo-32 boards), and ST morpho connectors. The STM32 Nucleo boards also integrate an ST-Link debugger/programmer, so there is no need for a separate probe. On top of this we offer a comprehensive STM32 software HAL (hardware abstraction layer) library together with various software examples that seamlessly work with a wide range of development environments including what had been the ATOLLIC TrueSTUDIO that we acquired last year, IAR EWARM, Keil MDK-Arm, mbed and GCC/LLVM-based IDEs.

All STM32 Nucleo users also have free access to the mbed online resources (compiler, C/C++ SDK, and developer community) at www.mbed.org allowing to build a complete application in only a few minutes.

Software is a larger and larger part of embedded design. What do you offer to support software development?

ST offers the STM32Cube to provide a comprehensive software tool that significantly reduces development efforts, time and cost. It consists of two main components; STM32CubeMX and STM32Cube embedded software libraries. In addition, earlier this year ST acquired TouchGFX, a highly advanced GUI solution for embedded applications that enables the development of high-end graphics on all devices and systems.

Do you think software development tools are best provided by the silicon manufacturer or an independent tools company? Why do you say this?

Software development tools should be available from both silicon sources and from independent sources. This enables an ecosystem where the silicon manufacturer can provide more of the low-level code to interact closely with the hardware, while the independent sources focus on areas where they can add more value and have greater expertise.

What do you think are the most exciting applications for your MCUs/MPUs?

There are so many innovative products using our STM32 that it is difficult to pick a single one. I recently ran into a company in Northern Europe that showed me a kind of sparring partner for football (soccer). It was

composed of motors and a net. The “keeper” would throw the ball back to you like it was a real player. You could select the speed, effects... depending on your level and your desired work out, it was very innovative stuff, and really good entertainment for kids.

What will be the biggest application in the next 2 years? What about 5 years time or in 10 years?

Who knows? Every year customers launch products that did not exist, and no one predicted, a few years earlier. There is potential in many markets, including home automation and industry 4.0. The STM32 motto is “releasing your creativity” and the more technology we embed in our products, the more our customers surprise us with disruptive ideas!

What do you think will be the biggest trend in the embedded market in the next year? What about the next 5 years?

In the next 5 years, I see security as a major challenge for the industry.

There is a lot of focus around IoT applications. What do you think will be the largest IoT applications using your processors? How much of your MCU business do you expect to be driven by IoT?

IoT is a buzz world, covering many segments, such as wearables, home automation, and Factory 4.0. Factories are moving at a very fast pace now, putting and using data in the cloud, saving cost and space with automation, connecting all the new machines. I see really big potential in this market. In Factory automation, design cycles are long but we can see a big wave of products on their way.

From a product standpoint, IoT is driving the performance of our products. We always need more integration, more memory, and more processing power, and when we launch new, enabling products, they encourage increased design complexity.





An Interview with Adrian Fernandez

*Microcontroller Development
Experience Manager,
Texas Instruments*

Adrian Fernandez is the Microcontroller Development Experience Manager at Texas Instruments. In this role, he is responsible for defining the microcontroller development ecosystem and augmenting the way developers interact with TI's microcontroller

portfolio through hardware and software tools. Adrian also founded the TI LaunchPad™ Development Kit Ecosystem – an offering of open source, easy-to-use modular hardware kits that enable developers to iterate through rapid prototyping and quickly move to production.

Through this ecosystem, Adrian has helped define and release tools that get developers to market quickly with differentiated solutions, while ensuring product/market fit. Adrian holds a B.S. degree in Electrical Engineering from the University of Texas at Austin, concentrating on embedded systems and digital signal processing.

An Interview with Henry Wiechman

*Embedded Processor
Software Marketing
and Strategy,
Texas Instruments*

Henry Wiechman is a Connected MCU Software and Tools Product Manager at Texas Instruments. In his current role, he helps define the ecosystem for our SimpleLink™ platform of wired and wireless MCUs.

Henry has over 25 years of product line and business management experience in TI's catalog and focused end equipment businesses. He has helped define and launch a number of different embedded processing families and their associated ecosystems including support for a variety of operating systems and development environments. Henry has a B.S. degree in electrical engineering from Kansas State University and an M.B.A. from the University of Texas at Austin.



Briefly explain your most important MCU families/solutions?

The SimpleLink™ MCU platform is comprised of Arm-based MCUs for connected applications, both wired and wireless. They support a diverse customer set because they allow engineers to innovate quickly. We call this “nimbleness” from a development perspective.

Our MCUs offer a range of different connectivity options, particularly highly integrated wireless, and provide a strong portfolio with the right peripherals, memory, analog and radios.

We're also not just releasing silicon. Support for the platform is provided through a suite of tools and shared software development kit (SDK). The SDK provides software components with code portability across the platform. The ability to port from one member to another is important for nimbleness.

Can you give an example of how code portability is important to your customers?

One example of how engineers might benefit from portability is if they were designing a thermostat. They could choose to develop an ethernet connected device, and then realise Wi-Fi is what the market wants. Our SDK allows for a large portion of the software investment to be reused in creating the new product. Today a lot of customers are spending the majority of their time on software, so reuse of code is very important.

The portability also means a customer can enter market with portfolio of products, not just one.

Why is nimbleness so important?

Interestingly, customers may not be aware they need it. They just know they need to develop product A. But, when they release product A, sometime down the road they see the market changing. If customers don't think about nimbleness, they are at a disadvantage when the market changes. Nimbleness allows them to quickly pivot; to grow and change with the market.

It's important to remember that nimbleness isn't just flexibility; it has an element of speed. The common development environment, common SDK, common software architecture all contribute to making it easy to transfer code from one product to another.

Why are your solutions unique? What is the “secret sauce” that makes them so good?

It’s a bit of portfolio and a bit of individual product: each device has its own unique skills. The engineer ultimately picks the device that best meets their needs, and we can’t predict what “knobs” they will need on the MCU. So, we have a broad offering to give them the choice they need to bring their unique take to solving a particular challenge. We use a plug-in concept, where we combine leading edge embedded processors with our large and differentiated analog portfolio. So, the plug-in concept lets you add a sensor, actuator, etc. very easily.

Sometimes it really is down to a particular feature. The MSP432 MCU has a high-resolution ADC – its 16-bit effective resolution at up to 1MSPS is unique. Typically to achieve this performance, an engineer would need to specify an external ADC. We’ve integrated it using the analog expertise inside the “analog expertise inside TI”. It provides more detail in measuring temperature, motion or moisture.

Lots of our radios are optimised for performance and low power. Power consumption is the key focus for all devices in portfolio.

From a software perspective we have many years of development of our software stack for optimised solutions. The nimbleness I mentioned earlier is important as the customer may need to migrate from one device to another, so they are not choosing just one product, but instead investing into our platform.

If you could solve one challenge that would help improve the world of embedded design, what would it be?

The balance between hardware and software: to have more hardware to be available for particular tasks. We already have multi-core devices that use a combination of hardware accelerators. Customers may struggle in finding the optimum hardware/software partitioning for their application. An advisor tool to partition across different cores, etc. that finds the best approach for each application would be good.

What Other Things Could You do to Help Customers?

Today when customers are trying to build a system, the developer has to look online to build their BOM (Bill of Materials). Frankly, it’s pretty much luck as to whether they find the best part. The best way is to provide a complete system solution and we’re starting to get closer: TI Design reference designs is one approach. Currently there are a bunch of companies pitching a part number, whereas TI is trying to look



“ I THINK VOICE WILL
MOVE BEYOND NOVEL
HOME AUTOMATION
AND BE PART OF
OUR LIVES. ”

ADRIAN FERNANDEZ
*MICROCONTROLLER
DEVELOPMENT EXPERIENCE MANAGER,
TEXAS INSTRUMENTS*

at the application from top down to make things fit together. So, we have a shared SDK, plug-in concept to integrate external components and the TI LaunchPad/BoosterPack kit ecosystem.

TI LaunchPad development kits all have same connector, enabling plug and play system level design which means developers can get to system level solutions more quickly.

What makes a great on-chip peripheral? How do you optimise the performance of peripherals as well as the microcontroller core?

Finding the common denominator. We want to provide a platform to answer as many of the problems that our customers have to solve as we can. So, we need to have suite of products that can serve the majority of the customers.

Sometimes the requirements of different applications can be quite similar. For example, a pedometer needs an LCD, battery management, communications and an accelerometer. This isn't that different from a connected temperature sensor – you just swap the accelerometer for a temperature sensor. They are very different applications but share a similar block diagram. So, although our customers have a broad range of end equipments, there is a lot of shared functionality.

We actually prototype different end equipments. We have a team that looks at the requirements and trade-offs between hardware and software. Often the fastest way to create a solution is to use a general-purpose device, but as the application requirements stabilise, then it's possible to look at putting things into hardware. For example, adding accelerators to optimise a device for cost/power. We look at hardware and software as a trade-off to find the sweet spot of where TI can add value.

Code compatibility means customers can mix and match the hardware to hit particular sweet spots. We have TI Designs showing them how to use TI devices that also provide software to create products. This helps jump-start customers as well as providing useful internal analysis. We also learn from our close relationships with key customers.

Arm dominates the 32-bit embedded microcontroller market. What are the advantages and disadvantages of this situation?

It's a good thing because it allows silicon manufacturers to differentiate beyond the core with their peripherals, wireless network processors, etc. It means we can try to solve the system level problems. If engineers are to get a differentiated product, they need to look outside of the core.

Of course, TI also has proprietary cores – the MSP430 MCU is a 16-bit ultra-low power family. In this case a proprietary core allows us to provide unique capabilities ranging from the low power consumption to FRAM memory. So, we believe there are valid reasons for going with a 3rd party core like Arm or building an MCU with proprietary core.

Security is an increasingly important requirement for embedded design. How are you addressing it?

One example is the SimpleLink CC3220 wireless MCU, it's a Wi-Fi SoC with an Arm MPU. We're trying to fully comprehend security top to bottom, so in the IoT this means security at the chip level, over the air, at the server and up to the cloud. We're doing as much as we can within our circle of influence, so we're providing features such as AES encryption and memory partitioning based on authentication.

We also work with cloud partners: we have 25+ different cloud services that we support meaning we don't pigeon-hole our customers. The cloud is complementary, so where TI's ability to ensure security ends, the cloud partner takes over and we just need to ensure a smooth handoff.

Development boards are important tools for engineers. What's special about your boards that make life even better for your customers?

It's all about use cases. We provide out of the box boards that showcase the silicon and its capabilities across all TI LaunchPad hardware. As the customer moves from example code to development, they can keep using the same LaunchPad kit. All these boards have an on-board debugger, so the engineer needs only one piece of hardware and no external dongles/debugger.

Beyond that, it's all about our development tools and resource explorer, which helps customers move from evaluation to development. Then can use booster packs to add additional functionality there are 85-plus different ones from LCDs to batteries to mics to accelerometers. It means our customers can quickly and rapidly build a system prototype.

Obviously, customers eventually have to build hardware, but we've chose to produce all launchpad and booster packs as open source hardware, so they can easily be used as reference designs.

What feature or function would you like to be able to add to a development board?

I'd like the SimpleLink SDK to be able to tell an engineer they need to use this TI LaunchPad and these three BoosterPack plug-in modules. It would be great to be able to click a button that takes design files for each of these boards and merges them into one schematic. I'd love it to be possible to move from 4-5 boards to something on one PCB, just by clicking order now.

Do you think software development tools are best provided by the silicon manufacturer or an independent tools company? Why do you say this?

The main reason a silicon manufacturer will develop their own tools is that it allows to get close to silicon and understand nuances, extracting maximum performance. Another reason is to be able to work across TI product lines, enabling them to plug into the one environment. This doesn't just mean programming the core, but configuring accelerators and peripherals in an optimised manner.

Ease-of-use is subjective. Customers can become loyal to a look and feel of an IDE, so we want to offer 3rd party capabilities to customers who like a particular environment. We try to enable a many 3rd parties as realistically possible so customers that have an interface they prefer can choose that and still get advantages from all the silicon. It's all about making sure the customer achieves max silicon entitlement.

What do you think will be the biggest trend in the embedded market in the next year? What about the next 5 years?

Being able to do more and more in the cloud. When trying to do embedded development, engineers needed to buy a licence, install in PC, download software, etc. We are already seeing more and more development in the cloud. Cloud-based development will allow teams to innovate more quickly as a result of better collaboration.

There is a lot of focus around IoT applications. What do you think will be the largest IoT applications using your processors? How much of your MCU business do you expect to be driven by IoT?

Home automation and being able to control things with voice. Alexa, Cortana and Google Home are all examples of this trend. We are already contributing with a voice recognition plugin that allows key phrase

recognition. Low power microcontrollers, such as the SimpleLink MSP432 MCU, have the right balance of low-power operation and high performance capabilities. Including these low power MCUs allows the majority of the system to stay in a low power sleep mode and only wake up when the low-power MSP432 detects a certain key phrase. Devices like the SimpleLink MSP432 MCU and our voice recognition software plugin allow smart speakers to recognize key phrases such as "Alexa" and "OK Google". I would like to see voice in industrial and automotive, and I think voice will move beyond novel home automation and be part of our lives.

In the industrial market it won't be just about connecting, but also preventive maintenance and advanced diagnostics. Because of the cost of line down situations, I think that number of diagnostics will be very significant. The more we can make them interact with a user interface that is as natural and intuitive as possible will be important.

In the longer term – 10 years away - IoT devices will start interfacing and interacting with each other, and we'll need lots of glue logic to enable edge node A to talk to edge node B. This will probably mean consolidation will happen. Interaction will happen automatically and IoT devices will make more and more complex decisions on their own.

Finally, another long-term trend will be that more and more systems are "self-powered" or run with such little power they are generating their own power.



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