

IoT Solutions and Technology

A Business Unit of Adlink and Formerly PrismTech

Connect the Unconnected,
Stream Anywhere,
Control the Edge
with Vortex Edge
from ADLINK



Transportation

Industrial
Automation

Defense
and Aerospace

Modeling
and Simulation

Robotics

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and Agriculture

IT and Networks

Smart Energy
and Utilities

Smart Cities

Healthcare
and Medical Devices



Cover Story

IoT Solutions and Technology

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- Vortex Edge: Connect the Unconnected, Stream Anywhere, Control the Edge
- Vortex Edge Makes IoT Simple

Headlines

- Microsoft Spreads Open Enclave SDK, Integrates With Azure IoT Edge
- SMARC Module for IoT and Industry 4.0 Apps
- Qualcomm launches 9205 chipset for IoT, wearables, and smart cities
- Huawei Is the No. 1 IoT Platform Vendor, Says IHS Markit
- ADLINK Technology Partners with Lenovo to Extend IoT and OEM Business Reach
- SUSE announces plans to operate as a fully independent business
- Ultra-low power accelerometer BMA400 from Bosch for IoT and wearables
- What is Industry 4.0? Here's A Super Easy Explanation For Anyone
- Microsoft is breathing life into IoT devices with an innovative algorithmic approach

Daniel Dierickx
CEO & co-Founder
at e2mos
Acting Chief Editor



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Chips & Embedded
Systems Market Expertise*

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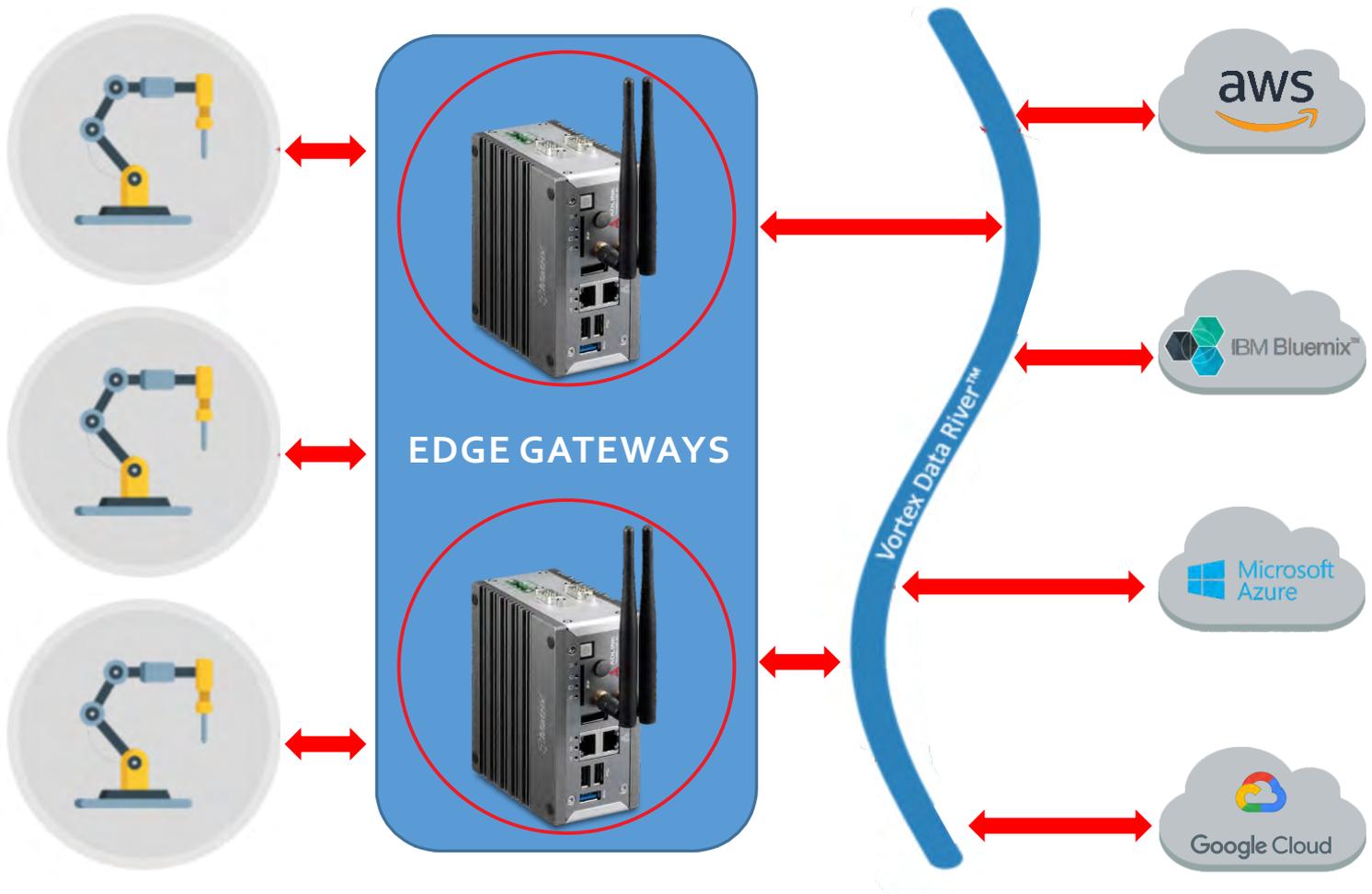
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- Coaching - Filling the gaps Upgrade your Customer Database
- Massive Global Market Reach with our PREMIER Database

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Vortex Edge

Product Summary:

Connect the Unconnected, Stream Anywhere, Control the Edge



At ADLINK we believe in vendor neutral solutions that are secure, scalable and can evolve with your needs in a world where disruption can change the rules of engagement, almost overnight. Vortex Edge is the flexible platform that brings together the best hardware, software and services to create holistic solutions to the challenges of the Internet of Things (IoT).

The available Vortex Edge microservices are:

- Vortex Edge OT Connect
- Vortex Edge Cloud Connect
- Vortex Edge Data Store Connect
- Vortex Edge Persistence
- Vortex Edge Visualization

These can be combined in any combination along with smart gateways, certified sensors and expert DAQ remote I/O modules, as required, to provide a fully featured Vortex Edge installation.

Get your IoT project up and running quickly with a Vortex Edge [Digital Experiment](#) [Contact Us](#) for more details.

Useful Resources

[Vortex Edge Overview Brochure](#) PDF
Introduction to Vortex Edge

Vortex Edge™ Makes IoT Simple

A unique mix of edge hardware, data connectivity software, and services to get your data moving in the correct format to who needs it, where it needs to be, precisely when it needs to be there.



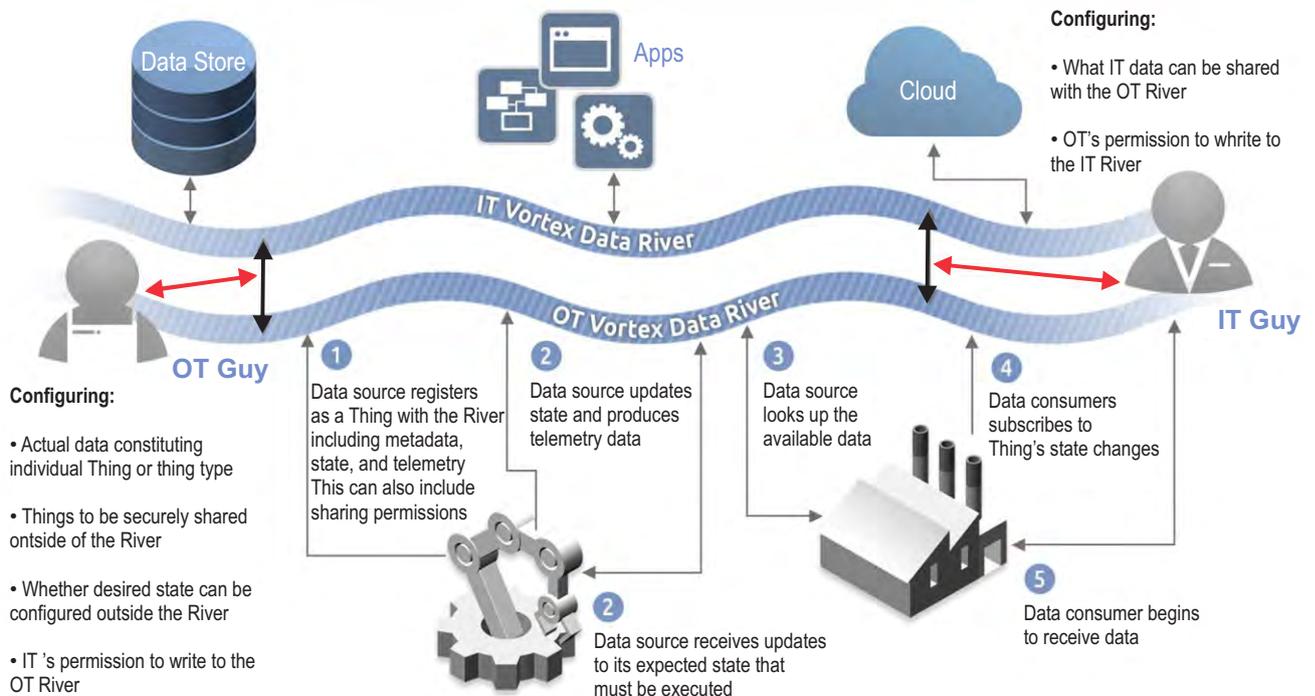
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Converting IT and OT



Edge Hardware

+ Can Include:

- Data extraction devices
- IoT gateways
- Industrial servers
- Embedded systems & modules
- Sensor packs
- Smart vision cameras
- Machine condition monitoring hardware

Data Connectivity Software

+ Can Include:

- Universal communication protocols
- Cloud connectivity
- Real-time data streaming connectivity
- Peer to peer networking
- Edge connectivity

Services = Vortex Edge®

Can Include:

- Device management
- Analytics
- Visualization
- Storage
- Data subscription management
- Professional services

Microsoft Spreads Open Enclave SDK, Integrates With Azure IoT Edge



Dan Meyer
November 21, 2018
10:56 am MT

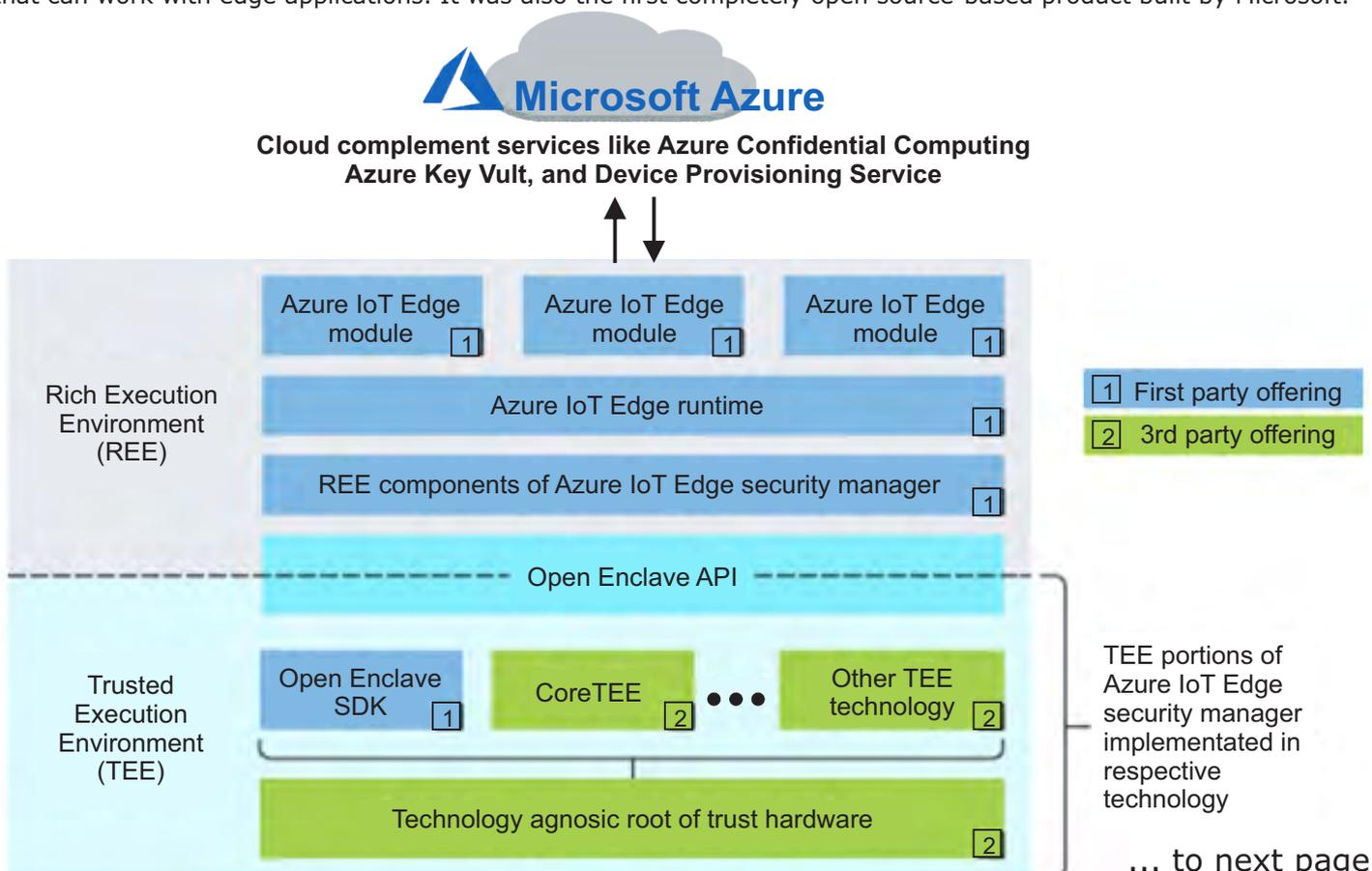
Microsoft continued to flesh out its \$5 billion investment into the IoT and edge space with its latest push targeted at the developer community. The company launched cross-platform availability of its Open Enclave SDK that helps manage devices deployed in edge network architectures. It also previewed the integration of that platform into its Azure IoT Edge security manager.

Eustace Asanghanwa, senior program manager for Microsoft's Azure IoT business, explained in a blog post that the expanded reach of the Open Enclave SDK will allow developers to write trusted applications that can run in trusted environments within Arm and Intel chip architectures. Those environments are known as enclaves, which are secured parts of a chip architecture.

"This broad applicability across different enclave technologies and integration with IoT Edge greatly simplifies the work developers must do to protect data and devices at the edge," Asanghanwa wrote.

The Open Enclave SDK provides a consistent API surface and secured hardware abstraction to support trusted computing application development. It basically abstracts the developer away from having to deal with hardware security. Microsoft open sourced the platform early last month.

The SDK builds on Microsoft's Azure Sphere. That platform supports the building of secured microcontroller devices that can work with edge applications. It was also the first completely open source-based product built by Microsoft.



Microsoft Spreads Open Enclave SDK, Integrates With Azure IoT Edge

... from previous page

The Azure IoT Edge security manager platform protects devices and components deployed into the Azure IoT Edge architecture by rooting the identity and sensitive workloads in secure silicon, or what it also described as a hardware security module (HSM). The platform was initially announced last year, and hit general availability this past June.

Gartner recently noted that security is the most significant area of technical concern for organizations deploying IoT systems.

"However, by 2023, we expect to see the deployment of hardware and software combinations that together create more trustworthy and secure IoT systems," said Nick Jones, research vice president at Gartner, in a report. "We advise CIOs to collaborate with chief information security officers (CISOs) to ensure the right staff are involved in reviewing any decisions that involve purchasing IoT devices and embedded operating systems."

Microsoft's \$5B Pledge

Microsoft in April pledged \$5 billion in spending toward IoT and edge technologies over the next four years. That pledge came a week after a companywide reorganization announcement that prioritizes Microsoft's cloud and edge products and services over Windows.

It has since moved on a number of IoT and edge fronts.

In September, Microsoft rolled out general availability of its overarching Azure IoT Central platform. That platform was initially launched as a preview late last year. The Azure IoT Central platform is a software-as-a-service (SaaS) product that allows a customer to rapidly provision an IoT service.

Microsoft also added support for the use of digital twins on its Azure IoT platform. The model uses its Azure IoT Hub platform to connect IoT devices and sensors that keep the digital model up to date with the physical world.

Digital twins are software models of physical items. This allows for the ability to model and monitor a physical item in real-time without actually touching the current status of that item.

IDC predicts the IoT space will generate \$772.5 billion in revenues this year, a 14.6 percent increase compared with 2017. Software is expected to be the fastest growing segment of the IoT space with a 16.1 percent compound annual growth rate over the next five years.

"Software creates the foundation upon which IoT applications and use cases can be realized," noted Carrier MacGillivray, VP of IoT and mobility at IDC.

SMARC-sAMX8X Module with economical, powerful Quad-Core i.MX8X Processor for IoT and Industry 4.0 Applications



Expanded SMARC Portfolio for Secure, Powerful Applications on Networked Terminal Devices

Augsburg, Germany, October 30, 2018 – Kontron, a leading global provider of IoT/Embedded Computing Technology (ECT), has introduced the new SMARC-sAMX8X module. The module distinguishes itself by its low power consumption, forming an ideal base for networked terminal devices in industrial environments thanks to its powerful NXP i.MX8X processor in Dual Core or Quad Core configurations. With dimensions of 82 by 50 mm, it can be deployed flexibly and is designed for operating in an extended temperature range of -40°C to +85°C. Kontron presented the new SMARC-sAMX8X alongside other boards and modules based on the latest Intel®, AMD Ryzen™, i.MX8, and Layerscape processors at electronica 2018

SMARC-sAMX8X will be available in three standard variants. The QuadX+, DualX+ and DualX processors offer up to four Cortex A35 cores clocked at 1.2 GHz. An additional Cortex-M4 core can be used for minor management tasks within the system, which traditionally a separate controller would have been required for. The new module features three GByte LP-DDR4 memory, a Dual Channel LVDS interface for HDMI or DP displays, up to two Gigabit Ethernet (GbE), up to three PCI-Express (PCIe) and six USB 2.0 ports, as well as one USB 3.0 port. Between 2 and 64 GB of eMMC 5.0 onboard storage serve as bulk memory. Additionally, the SMARC-sAMX8X offers an SDIO card slot as well as four serial interfaces, one I2S, four I2C, two SPI, one MIPI CSI, twelve GPIO, and two CAN interfaces. The SMARC-sAMX8X utilizes Uboot as bootloader and Yocto Linux as operating system.

The SMARC-sAMX8X module supports Kontron's Security Solution APPROTECT powered by Wibu-Systems. Based on an optionally integrated Wibu-Systems security chip combined with a specifically developed software framework, it provides IP- and copy/reverse engineering protection. Additionally, Kontron's APPROTECT Licensing also allows pay per use, time based trial versions, or to enable/disable features.

Qualcomm launches 9205 chipset for IoT, wearables, and smart cities

The new modem is intended for vendors creating IoT applications suitable for LPWAN networks.

By Charlie Osborne | December 17, 2018 -- 12:30 GMT (12:30 GMT)

Qualcomm has launched the 9205 LTE modem, a chipset designed for Internet of Things (IoT) applications which require Low-Power, Wide-Area Networks (LPWAN).

The US chip giant said on Monday that the modem has been purpose-built for devices and applications which operate on LPWAN, which includes wearables, asset trackers, health monitors, security systems, smart city sensors, and smart meters.

The new Qualcomm 9205 LTE modem supports global multimode LTE category M1 (eMTC) and NB2 (NB-IoT) as well as 2G/E-GPRS connectivity in one chipset.

In addition, the modem contains application processing power provided by an Arm Cortex A7 -- up to 800MHz -- with support for ThreadX and AliOS Things "The integrated applications processor avoids the need for an external microcontroller to improve cost-efficiency, and device security," Qualcomm says.

The chipset also includes geolocation positioning capabilities such as through GPS, Beidou, Glonass, and Galileo, as well as bolstered security at the hardware level by way of Qualcomm's Trusted Execution Environment. Cloud service support is also available



TechRepublic: [Qualcomm XR1 chip could bring faster, cheaper AR/VR to the enterprise](#)

An RF transceiver which supports bandwidth between the 450 MHz to 2100 MHz bands has also been integrated into the front-end, which the tech giant says is a "commercial first" in the cellular IoT space.

Qualcomm says that in comparison to its predecessor, the 9205 modem is 50 percent smaller and more cost-effective. The modem has also been designed to reduce power consumption by up to 70 percent while idle.

Developers interested in using the chipset are able to access a software development kit (SDK) suitable for use when custom software in use on the applications processor.

The SDK comes with pre-integrated support for cloud platforms including Alibaba Cloud Link One, China Mobile OneNET, DTSTON DTCloud, and Verizon ThingSpace

See also: [Qualcomm: Meet the new boss of everything mobile](#)

"The innovations included in the Qualcomm 9205 LTE modem are critical to support many of the six billion IoT devices expected to use low-power, wide-area connectivity by 2026," said Vieri Vanghi, vice president of product management at Qualcomm Europe. "LTE IoT technologies are the foundation of how 5G will help connect the massive IoT, and we are making these technologies available to customers worldwide to help them build innovative solutions that can help transform industries and improve people's lives."

CNET: [Qualcomm's newest chips promise Google smartwatch battery boosts](#)

According to Qualcomm VP of Product Management Vieri Vanghi, the chipset has been in development for the past 15 months and there are now over 80 licensees, with more than 110 designs already completed and certified or in the final stages of design.

Designs based on the modem are expected to become commercially available in 2019.

In related news, earlier this month Qualcomm announced the Snapdragon 855 mobile platform. The latest chipset in the product family sports an X50 5G modem for both sub-6 GHz and mmWave frequencies, Wi-Fi 6 support, QTM052 antenna modules, and Qualcomm's fourth-generation artificial intelligence (AI) engine.



About Charlie Osborne

Charlie Osborne is a cybersecurity journalist and photographer who writes for ZDNet and CNET from London. PGP Key: AF40821B

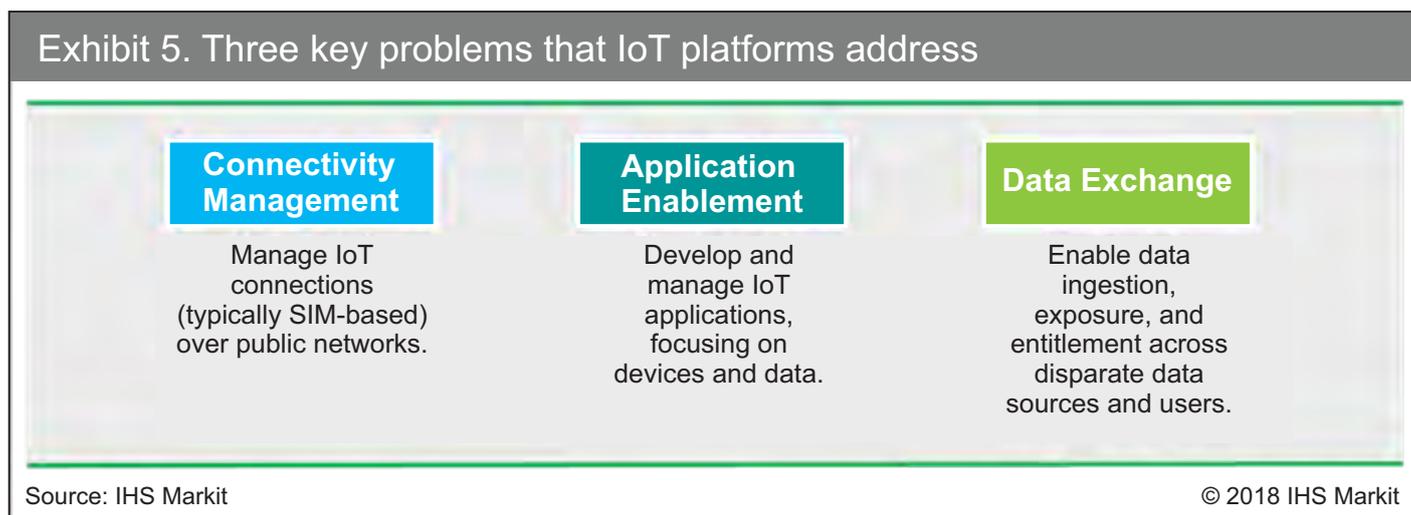
Huawei Is the No. 1 IoT Platform Vendor, Says IHS Markit

By: Ali Longwell | December 19, 2018 - 11:29 am MT

Huawei ranked as the No. 1 IoT platform vendor according to a new scorecard from IHS Markit. Cisco, Microsoft, and PTC rounded out the top four positions.

The IHS Markit "IoT Platforms Vendor Scorecard" evaluated nine vendors based on the context of both market presence and momentum. Market presence was determined by evaluating the number of devices managed by the vendor's IoT platform, financial strength, and the vendor's strategic commitment to the IoT market. Market momentum was measured by the growth rate of the devices managed on the platform, the range of IoT functions, the breadth of vertical markets it targets, the strength of its IoT ecosystem development efforts, and its technical innovation on the platforms.

The other vendors evaluated in the report were Alibaba, Amazon Web Services (AWS), GE, IBM, and SAP.



According to Sam Lucero, the report author and senior principal analyst of IoT at IHS, Huawei excelled at a number of the categories evaluated. Particularly, Huawei led in the number of devices managed through its IoT platform, and the growth of those devices. Additionally, he noted its commitment to the IoT market and its technical innovation.

Huawei has a number of enterprise IoT products. The primary product is its cloud-based IoT Connection Management platform, which is access agnostic meaning it works with any network connections. It also has an edge computing IoT (EC-IoT) service that integrates open edge computing with cloud management architecture to perform intelligent data processing. The vendor also has a product suite of narrowband IoT (NB-IoT) products, including an operating system and chipset that it launched in 2016.

Lucero wrote in an email to SDxCentral that: "Huawei is a key figure in cellular standards development and has played a central role in bringing NB-IoT to the market. This is particularly important given the role the NB-IoT will likely play in facilitating IoT services globally. Related to this, Huawei has worked with operators around the globe on early NB-IoT trials, most importantly partnering with Vodafone on the latter's development of NB-IoT-based services." He also noted that as a mobile virtual network enabler it can build IoT-specific core networks for its customers.

This has been a tumultuous year for Huawei as it battles geo-political issues. The vendor has been facing a lot of pressure from the U.S. government, which banned use of its equipment by domestic telecom operators, and encouraged other countries to do the same. The Australian government also issued a ban on its 5G equipment.

Cisco's No. 2 position on the list was due to the range of IoT functionalities addressed by its platform. This includes its IoT industrial networking, operations management, data management, and security platforms. According to Lucero, two key platforms drive Cisco's IoT ecosystem: its connectivity management processor (CMP), which is based of its 2016 acquisition of Jasper; and its Kinetic architecture, which helps customers securely connect devices, as well as extract, compute, and move IoT data.

Cisco has made a number of IoT investments in the past. After acquiring AppDynamics for \$3.7 billion last January, Cisco shifted the company's focus to IoT. And this year it expanded its intent-based networking concept to support the technology.

Microsoft was boosted by its strong IoT investments and enterprise sales force. Software vendor PTC was lauded for its focus in the market and its broad ecosystem of partners, which includes Rockwell Automation, Microsoft, and Hewlett Packard Enterprise (HPE). It's worth noting that PTC's products are largely focused on the industrial IoT (IIoT) space.

Of the overall IoT market, Lucero said that IHS is seeing "explosive growth in the Chinese IoT market" and a "growing interest in IoT data monetization, particularly in the connected car industry."

ADLINK Technology Partners with Lenovo to Extend IoT and OEM Business Reach

Partnership provides ADLINK with expanded access to IoT opportunities while providing Lenovo customers with new options for innovative edge computing solutions

09-May-2018 -- ADLINK Technology, a global leader in Edge Computing, is teaming with Lenovo to expand ADLINK's reach into the IoT marketplace while enhancing Lenovo's integrated hardware/software solution offerings. Through this new partnership, Lenovo's OEM Solutions business will expand its portfolio of products with ADLINK-provided embedded PC solutions and services.

Introducing the Digital Transformation Kit from Lenovo OEM Solutions and ADLINK



Open this box and unleash innovation

- Bring certainty to proposed IoT computing solutions
- Build and test IoT applications
- Develop mobile IoT applications
- Use the included project blueprints and software activation instructions
- Find it all packaged in a sleek protective case

ADLINK offers a variety of technology building blocks and market-specific IoT platforms to serve various industry use cases. Lenovo, through its OEM Solutions business, offers a full portfolio of hardware products and allows OEM customers to leverage custom solutions and worldwide services from development to deployment. By collaborating, the two companies have bundled offerings that solve critical IoT issues by utilizing the best-in-breed solutions from two industry leaders. These integrated systems will provide customers with a more seamless integration of consumer and industrial building blocks and make it easier for OEM companies to design and innovate new products.

"We are excited to partner with ADLINK and unify these two solutions that will allow customers to benefit from an easy-to-use, all-in-one hardware and software package," said Paul Burke, Director of Lenovo OEM Sales.

With the Lenovo partnership, ADLINK continues to add to its eco-system of industry leading technology partners. The companies are currently focused on the Americas and China markets, with plans to roll-out the pre-integrated hardware/software solutions in additional regions by the end of the year.

"The relationship between Lenovo and ADLINK is mutually beneficial and complements the strengths of each organization," said Elizabeth Campbell, General Manager for ADLINK, Americas. "Lenovo is well known for their reliable workstations and PCs, while ADLINK solutions add rugged performance and software-enabled features to help Lenovo extend its reach into new industries and applications."

About Lenovo

Businesses around the world trust Lenovo, a global, public company with revenues of over \$45B, for their Information Technology needs. Lenovo is among the top three manufacturers of IT products from mobile to desktop to data center and is acclaimed for innovation, quality, reliability, supply chain, and customer satisfaction.

With years of experience serving OEMs, Lenovo understands what's important to you. Choose Lenovo OEM Solutions and stake your reputation on our award-winning portfolio, our global presence, and our record as an industry leader.

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SUSE Partners with Growth Investor EQT to Continue Momentum, Strategy Execution and Product Expansion



SUSE announces plans to operate as a fully independent business

NUREMBERG, Germany |SUSE® announced (July 2, 2018) plans to partner with growth investor EQT to continue momentum, strategy execution and product expansion as an independent business. The completion of EQT's acquisition of SUSE from Micro Focus is subject to Micro Focus shareholder and customary regulatory approvals and is expected to **occur in early 2019**. SOURCE: [SUSE](#)

Having enjoyed seven years of continuous expansion, SUSE is set to be acquired from Micro Focus by EQT, which is a development-focused investor with extensive experience in the software industry. Under Micro Focus ownership and with their investment and support, SUSE has developed as a business, cementing its position as a leading provider of enterprise-grade, open source software-defined infrastructure and application delivery solutions.

In a partnership with EQT, SUSE expects to be equipped to further exploit the excellent market opportunity both in the Linux operating system area as well as in emerging product groups in the open source space. Under the continued leadership of SUSE CEO Nils Brauckmann, SUSE will move to the next stage of its corporate evolution and operate globally as an independent company post-completion of the transaction. To ensure continuity, the SUSE business expects staffing, customer relationships, partnerships, product and service offering, commitment to open source leadership and support for the key open source communities to remain unchanged.

"Today is an exciting day in SUSE's history. By partnering with EQT, we will become a fully independent business," said Nils Brauckmann, SUSE CEO. "The next chapter in SUSE's development will continue, and even accelerate the momentum generated over recent years. Together with EQT we will benefit both from further investment opportunities and having the continuity of a leadership team focused on securing long-term profitable growth combined with a sharp focus on customer and partner success. The current leadership team has managed SUSE through a period of significant growth, and now, with continued investment in technology innovation and go to market capability, will further develop SUSE's momentum going forward."

Johannes Reichel, Partner at EQT Partners and Investment Advisor to EQT VIII, added, "We are excited to partner with SUSE's management in this attractive growth investment opportunity. We were impressed by the business' strong performance over recent years as well as its strong culture and heritage as a pioneer in the open source space. These characteristics correspond well to EQT's DNA of supporting and building strong and resilient companies, and driving growth. We look forward to entering the next period of growth and innovation together with SUSE."

Market and SUSE Potential

SUSE expects to be well positioned to further realize its potential with backing from EQT to fuel its momentum and build on the progress made under Micro Focus.

SUSE believes the acquisition is well timed as the market driven need for digital transformation, built on open source software-defined infrastructure (SDI) and application delivery technologies, is increasing. Organizations are invariably increasing their focus on open source technologies and solutions to transform their businesses.

With its heritage in open source software, strong brand and array of market leading software-defined infrastructure and application delivery solutions, SUSE is ideally positioned to capitalize on this market dynamic, creating tremendous value for customers and partners.

Stability and Continuity

In keeping with its 25 year history, SUSE intends to remain committed to an open source development and business model and actively participate in communities and projects to bring open source innovation to the enterprise as high quality, reliable and usable solutions. This truly open, open source model, where open refers to the freedom of choice provided to customers and not just our code, is embedded in SUSE's culture, differentiates it in the market place and has been key to its success.

About SUSE

SUSE, a pioneer in open source software, provides reliable, software-defined infrastructure and application delivery solutions that give enterprises greater control and flexibility. More than 25 years of engineering excellence, exceptional service and an unrivaled partner ecosystem power the products and support that help our customers manage complexity, reduce cost, and confidently deliver mission-critical services. The lasting relationships we build allow us to adapt and deliver the smarter innovation they need to succeed – today and tomorrow. For more information, visit www.suse.com.

About EQT

EQT is a leading investment firm with approximately EUR 50 billion in raised capital across 27 funds. EQT has portfolio companies in Europe, Asia and the US with total sales of more than EUR 19 billion and approximately 110,000 employees.

EQT was founded in 1994 together with Investor AB, Scandinavia's largest industrial holding group and part of the Wallenberg group. Having a long-term and responsible approach to ownership is EQT's way of creating value in the portfolio companies and to society at large. EQT invests in good companies with a mission to achieve sustainable growth, operational excellence and market leadership, in short future proofing companies.

Bosch Sensortec

Ultra-low power accelerometer BMA400 from Bosch for IoT and wearables



Bosch Sensortec's BMA400, an ultra-low power MEMS acceleration sensor for IoT and wearable applications, is now available worldwide through distributors.

- No-compromise performance for smart homes and always-on wearables
- Ultra-low power consumption and intelligent power management
- Honored with CES 2018 Innovation Award
- Available worldwide through Bosch Sensortec's distributors



2 x 2 x 0,95 mm

Thanks to its low current consumption, embedded plug-and-play step counting and activity recognition features, the BMA400 substantially extends battery lifetime of wearables such as smart watches and fitness trackers. It can wake up automatically when it detects motion and returns to sleep mode when the movement ends, thus avoiding waking the main application processor. This feature significantly reduces battery consumption to extend charging intervals.

For Internet of Things (IoT) applications like indoor climate systems and security systems in smart homes, the BMA400's continuous measurement capabilities and always-defined bandwidth make it an ideal choice for hassle-free usage. For example, it can avoid false alarms, by distinguishing between genuine alarms like broken glass and false signals coming from random vibrations. Its ultra-low power consumption means replacing batteries is a far less frequent chore for homeowners. These best-in-class qualities led to the BMA400 winning the prestigious CES 2018 Innovation Award in the category Embedded Technologies.

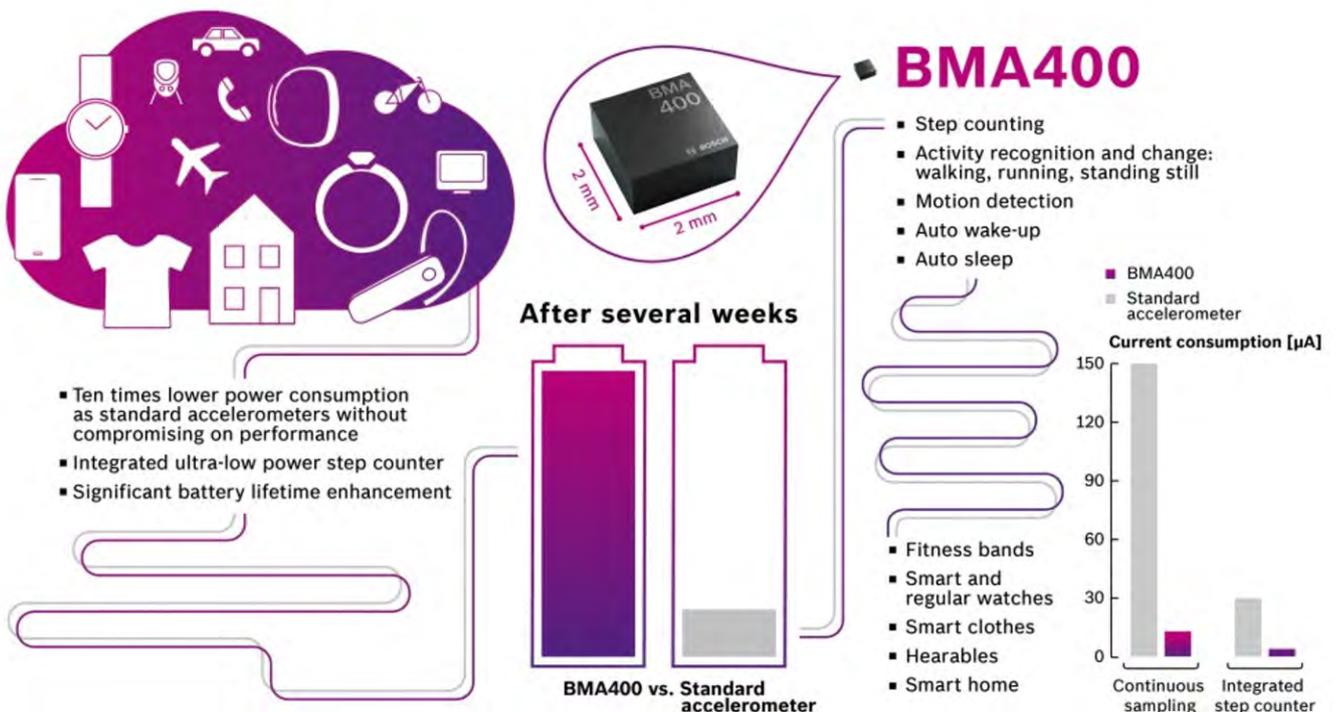
Ultra-low power plus high performance

Until recently, engineers specifying an accelerometer have had to choose between low power and high performance. Now, the BMA400 has changed that by combining ultra-low power consumption, outstanding performance and advanced features, such as a built-in step counter that uses only 4 μA . The BMA400 draws ten times less current than existing accelerometers. Hence, there is no longer any need for design compromises.

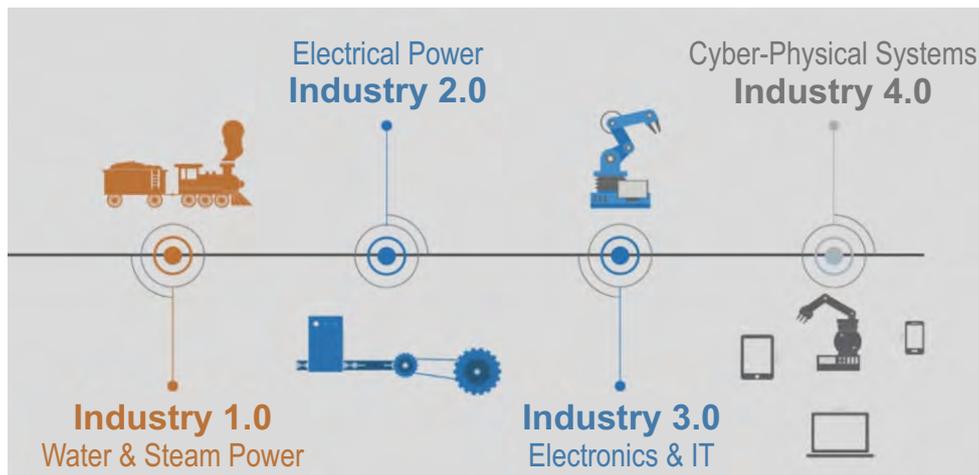
Additional product features

With its built-in voltage regulator, the BMA400 delivers stable performance over a wide supply voltage range. It offers flexible device tuning for power consumption, noise and ODR (output data rate) parameters. The BMA400 has a current consumption of 14 μA at highest performance, continuous measurement and a noise density of $180\mu\text{g}/\sqrt{\text{Hz}}$. This drops to just 1 μA and below in the device's ultra-low power self-wake-up mode. The compact size of only $2.0 \times 2.0 \times 0.95 \text{ mm}^3$ and the integrated plug-and-play step counter make the BMA400 easy to design into new types of wearables such as regular watches and jewelry.

Further information on the BMA400 can be found in the BMA400 video at the Bosch Sensortec YouTube channel.



Time to Understand Industry 4.0



What is Industry 4.0? Here's A Super Easy Explanation For Anyone

By: Bernard Marr, Contributor | Sep 2, 2018, 11:59pm

We're in the midst of a significant transformation regarding the way we produce products thanks to the digitization of manufacturing. This transition is so compelling that it is being called Industry 4.0 to represent the fourth revolution that has occurred in manufacturing. From the first industrial revolution (mechanization through water and steam power) to the mass production and assembly lines using electricity in the second, the fourth industrial revolution will take what was started in the third with the adoption of computers and automation and enhance it with smart and autonomous systems fueled by data and machine learning.

Even though some dismiss Industry 4.0 as merely a marketing buzzword, shifts are happening in manufacturing that deserves our attention.

Industry 4.0 optimizes the computerization of Industry 3.0

When computers were introduced in Industry 3.0, it was disruptive thanks to the addition of an entirely new technology. Now, and into the future as Industry 4.0 unfolds, computers are connected and communicate with one another to ultimately make decisions without human involvement. A combination of cyber-physical systems, the Internet of Things and the Internet of Systems make Industry 4.0 possible and the smart factory a reality. As a result of the support of smart machines that keep getting smarter as they get access to more data, our factories will become more efficient and productive and less wasteful. Ultimately, it's the network of these machines that are digitally connected with one another and create and share information that results in the true power of Industry 4.0.

Industry 4.0 applications today

While many organizations might still be in denial about how Industry 4.0 could impact their business or struggling to find the talent or knowledge to know how to best adopt it for their unique use cases, several others are implementing changes today and preparing for a future where smart machines improve their business. Here are just a few of the possible applications:

Identify opportunities: Since connected machines collect a tremendous volume of data that can inform maintenance, performance and other issues, as well as analyze that data to identify patterns and insights that would be impossible for a human to do in a reasonable timeframe, Industry 4.0 offers the opportunity for manufacturers to optimize their operations quickly and efficiently by knowing what needs attention. By using the data from sensors in its equipment, an African gold mine identified a problem with the oxygen levels during leaching. Once fixed, they were able to increase their yield by 3.7%, which saved them \$20 million annually.

Optimize logistics and supply chains: A connected supply chain can adjust and accommodate when new information is presented. If a weather delay ties up a shipment, a connected system can proactively adjust to that reality and modify manufacturing priorities.

Autonomous equipment and vehicles: There are shipping yards that are leveraging autonomous cranes and trucks to streamline operations as they accept shipping containers from the ships.

... to next page

What is Industry 4.0?

Here's A Super Easy Explanation For Anyone

... from previous page



Adobe Stock

Robots: Once only possible for large enterprises with equally large budgets, robotics are now more affordable and available to organizations of every size. From picking products at a warehouse to getting them ready to ship, autonomous robots can quickly and safely support manufacturers. Robots move goods around Amazon warehouses and also reduce costs and allow better use of floor space for the online retailer.

Additive manufacturing (3D printing): This technology has improved tremendously in the last decade and has progressed from primarily being used for prototyping to actual production. Advances in the use of metal additive manufacturing have opened up a lot of possibilities for production.

Internet of Things and the cloud: A key component of Industry 4.0 is the Internet of Things that is characterized by connected devices. Not only does this help internal operations, but through the use of the cloud environment where data is stored, equipment and operations can be optimized by leveraging the insights of others using the same equipment or to allow smaller enterprises access to technology they wouldn't be able to on their own.

While Industry 4.0 is still evolving and we might not have the complete picture until we look back 30 years from now, companies who are adopting the technologies realize Industry 4.0's potential. These same companies are also grappling with how to upskill their current workforce to take on new work responsibilities made possible by Internet 4.0 and to recruit new employees with the right skills.



Bernard Marr Contributor

Bernard Marr is an internationally best-selling author, popular keynote speaker, futurist, and a strategic business & technology advisor to governments and companies. He helps organisations improve their business performance, use data more intelligently, and understand ...

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Microsoft is breathing life into IoT devices with an innovative algorithmic approach



Fast, accurate, stable and tiny –
Breathing life into IoT devices with an innovative algorithmic approach

December 6, 2018 | By Microsoft blog editor

In the larger quest to make the Internet of Things (IoT) a reality for people everywhere, building devices that can be both ultrafunctional and beneficent isn't a simple matter. Particularly in the arena of resource-constrained, real-time scenarios, the hurdles are significant. The challenges for devices that require quick responsiveness—say, smart implants that warn of impending epileptic seizures or smart spectacles providing navigation for low-vision people—are multifold. Small form factors and tiny microcontrollers mean that the training and prediction, via machine learning, that would make these devices smart and helpful must take place in the cloud, requiring significant amounts of data to be amassed and uploaded in real time. This introduces very real hurdles in areas such as connectivity, bandwidth, latency, power, and even privacy and security. For an individual prone to seizures, enjoying a swim in the community center pool, timing (latency) is everything, and the ability to leave the house for an entire day on a single charge (power) is survival itself. In the case of smart spectacles, constantly uploading video to the cloud, too, would soon cause bandwidth, latency, and power concerns and almost certainly introduce privacy issues.

The solution then would seem to lie in the area of making machine learning and prediction algorithms that currently reside in the cloud local to the devices themselves. And yet the hardware capacity of such devices is severely constrained, often relying on IoT endpoints having just 2 KB of RAM and 32 KB flash memory.

“We are trying to change the IoT paradigm fundamentally.”
– [Manik Varma](#), Principal Researcher, Microsoft Research India



The EdgeML team at Microsoft Research India has been examining this challenge from the point of view of machine learning and is building a library of ML algorithms—the EdgeML library—intended to have a range of both traditional ML algorithms, as well as deep learning algorithms, including the use of recurrent neural networks (RNNs) that could be used to build such devices and tackle some of these applications. RNNs are powerful deep learning models in how they make use of sequential information and incorporate context from previous inputs; just as humans don't start thinking from scratch every second, RNNs are networks with loops in them that allow information to persist.

Squeezing RNN models and code into a few kilobytes could allow RNNs to be deployed on billions of IoT devices, potentially transforming many existing challenges for individuals and communities across myriad life scenarios. Downsizing the RNN also could significantly reduce the prediction time and energy consumption and make RNNs feasible for real-time applications such as wake-word detection, predictive maintenance, and human activity recognition.

The problem is that RNN training is inaccurate and unstable as the time interval over which the sensor signal is being analyzed increases. And in the types of resource-constrained and real-time applications that we're talking about above, an additional concern is RNN model size and prediction time.

In FastGRNN: A Fast, Accurate, Stable and Tiny Kilobyte Sized Gated Recurrent Neural Network—being presented at the 32nd Conference on Neural Information Processing Systems (NeurIPS 2018) in Montreal, Canada—Aditya Kusunapati, Prateek Jain, and Manik Varma of Microsoft Research India, along with Manish Singh of the Indian Institute of Technology Delhi and Kush Bhatia and Ashish Kumar of the University of California, Berkeley, introduce innovative new architectures for efficient RNN training and prediction on severely resource-constrained IoT devices too tiny to hold existing RNN models.

FastGRNN stands for Fast, Accurate, Stable and Tiny Gated Recurrent Neural Network algorithm, designed to address the twin RNN limitations of inaccurate training and inefficient prediction. It turns out that FastGRNN matches the accuracies and training times of state-of-the-art unitary and gated RNNs but has significantly lower prediction costs. Models range from 1 to 6 KB for real-world applications.

“We asked ourselves, how can we get machine learning to actually run on such severely resource-constrained microcontrollers and IoT devices,” recalled India's EdgeML team member and Principal Researcher Manik Varma. “The traditional IoT paradigm has been that these devices have been too weak to do AI, so everyone thought that all the data had to be sent to the cloud and all the decision making would happen there. But, unfortunately, this traditional paradigm cannot address lots of critical scenarios where you need to make decisions on the device itself.”

The team set out to conquer the four challenge areas presented by localizing machine learning on the microcontroller itself: bandwidth, latency, power, and privacy/security.

... to next page

Microsoft is breathing life into IoT devices with an innovative algorithmic approach



... from previous page

They had started this project roughly two years ago and turned heads at ICML 2017 when they published two papers (Bonsai and ProtoNN) showing how they had managed to deploy traditional machine learning on the world's tiniest devices—microcontrollers smaller than a grain of rice, such as the ARM Cortex M0 with just 2 KB of RAM, and miniscule IoT boards, such as the Arduino Pro Mini, based on an 8-bit Atmel ATmega328P microcontroller operating at 8 MHz without any floating point support in hardware, with 2 KB RAM and 32 KB read-only flash memory.

It may have been the first time anyone in the world had gone so small with machine learning—and it got some serious attention.

“We are tackling critical scenarios beyond the pale of the traditional IoT paradigm, where it is not feasible to transmit sensor data to the cloud due to latency, bandwidth, energy, privacy, or security concerns and where the decision making needs to happen locally on the IoT edge or endpoint device itself.” – Manik Varma

Intent on building upon the success, the team intensified its focus on the more challenging problem of deep learning. In an IoT world, almost everything happening takes the form of a time series. Think of the case of a moisture sensor embedded in the soil on a farm taking periodic readings on water moisture at a specific location; based on a series of chronological readings, it would make a decision on whether to irrigate that particular location. The state of the art for analyzing time series is RNNs. And so, they started looking at leading RNNs as a way of solving the size and resource problem.

But RNNs have a couple of issues. One is that they are not very easy to train. Most RNNs and other deep learning methods are trained based on gradient descent—type algorithms. Unfortunately, in the case of RNNs, the gradients are not very stable. They explode in some directions (to infinity) and vanish (to zero) in others. This has been a problem for RNNs since the time they were developed. Researchers have come up with many ways to solve this problem. One is unitary RNNs, which restrict the range of the state transition matrix's singular values. Unfortunately, they also increase the model size, as they require a larger number of hidden units to make up for the loss in expressive power. Therefore, unitary RNNs are not ideal for these tiny devices, where you want to conserve memory and make predictions as quickly as possible.

Gated RNNs, another idea that researchers have experimented with to address this issue, stabilize training by adding extra parameters. Gated RNNs can deliver state-of-the-art prediction accuracies, but the models themselves are sometimes even larger than unitary RNNs.

The EdgeML Team came up with another approach.

“What we realized is, if you take the standard RNN architecture and just add a simple residual connection, it stabilizes the RNN training and it does so provably,” said Varma. “It only has two extra scalar parameters—as compared to an RNN—and it gets you better accuracy than any of the unitary methods proposed so far.”

Based on this insight, they then modified the residual connection slightly by converting it to a gate. “This achieved an accuracy that matches the state of the art in LSTMs, GRUs, and so on, but with a model that is two to four times smaller,” explained Varma. Gated RNN that hit speed, achieved accuracy, remained stable and – was tiny. FastGRNN.

To compress this model even further, the researchers then took all the FastGRNN matrices and made them low rank, sparse, and quantized. This reduced the size by a factor of 10.

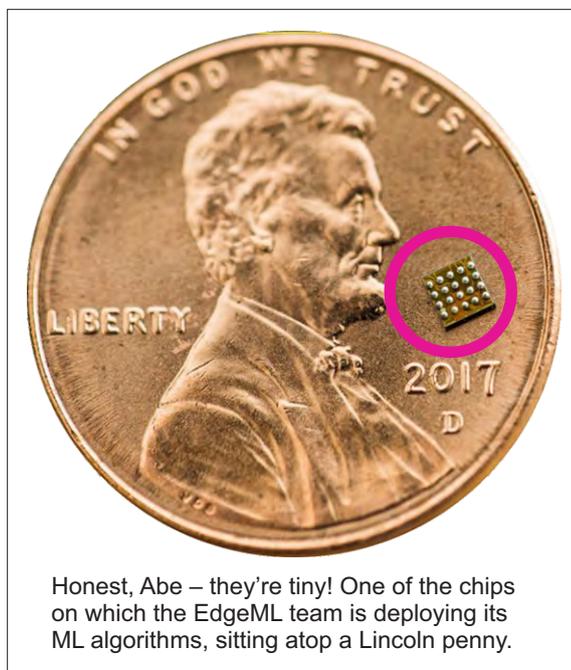
“Based on this, we were able to build a wake-word detector for Cortana using a 1KB model and fit it on the Arduino boards,” said Varma.

The team's code is available online for free on [Github](https://github.com).

Accommodating real world IoT off the cloud

The real-life applications brought into the realm of the possible by FastGRNN are seemingly unlimited, with ideas cropping up across smart health care, precision agriculture, augmenting of abilities for people with special needs, and even space exploration. The EdgeML team is prototyping a smart cane for low-vision people.

... to next page



Honest, Abe – they're tiny! One of the chips on which the EdgeML team is deploying its ML algorithms, sitting atop a Lincoln penny.

Microsoft is breathing life into IoT devices with an innovative algorithmic approach



... from previous page

"We're focusing on getting the machine learning algorithms as compact as possible. Our hope is that if you can fit them onto the tiniest microcontroller, then any other microcontroller can also run them," said Senior Researcher and Edge ML teammate Prateek Jain.

Hence the EdgeML team's smart cane prototype that can interpret gestures and then can interact with the user's phone. A twirl with the cane gets the user's phone to report present location. A double-swipe gets the cane to answer the owner's phone. A fall detector, for example, for the blind or for the elderly could instruct the owner's phone to call for help.

Smart spectacles for people with low-vision represent another example of on-the-spot, real-time training and prediction that could transform lives and one deeply significant to Varma, who is himself low-vision. "It would be enormously helpful to have a camera on my glasses that would tell me what's happening in the world, who I am looking at, and so on, he said. "You can't send the whole video stream to the cloud; it would be too costly and there wouldn't be enough bandwidth." And again, latency is an issue if the spectacles were to be depended upon to warn one of hazards when walking on the street."

Privacy is paramount and a problem that is addressed by miniaturizing deep learning. "You don't want your visual or voice data being streamed to the cloud all the time. That would be creepy, everything you say or see in your home being recorded and sent to the public cloud," said Varma. With the EdgeML team's methodology, voice detection is run locally and not being sent to the cloud at all.



The EdgeML team (left to right) – Aditya Kusupati, Don Dennis, Manik Varma, Harsha Vardhan Simhadri, Shishir Patil, Rahul Sharma, Nagarajan Natarajan, Prateek Jain.

"We spent a lot of time talking to many different Microsoft product groups, startups, scientists, and the government trying to figure out applications," recalled Jain.

An interesting application the team came across was in astronomy and space exploration. Resource scarcity—specifically energy—in spacecraft and machines that are sent into deep space is a huge issue. Another is the fact that satellites and probes collect an enormous amount of data via telescopes, cameras, and other sophisticated sensors; yet astonishingly, only a miniscule fraction of the data that is sensed is ever seen by a human being. If there were energy-efficient, low-latency machine learning available on the sensors themselves, the on-chip algorithms could learn what data is most interesting, and then determine which data would be sent for human analysis.

Varma has been invited as a Visiting Miller Research Professor at UC Berkeley to work on some of these problems. "It's one of the great things about Microsoft Research, the amount of freedom and support you get for blue skies research, to take risks and to collaborate with people inside and outside Microsoft," he smiled. In the case of FastGRNN, we may be looking at the stars.