Accelerate IoT Insights at the Intelligent Edge

Mark Barnum, Hewlett Packard Enterprise

ABSTRACT

The Internet of Things (IoT) unlocks efficiencies and innovation from connected sensors, assets, and devices. Organizations now have access to both immediacy and depth of analysis by using edge analytics. See how Hewlett Packard Enterprise and enables instantaneous, secure access to analytics for real-time decision-making, immediate action, and greater device control.

INTRODUCTION

Get ready for further adoption of technology that changes our everyday lives, whether at home, work, or play.

We live in a world where everything computes – thanks to constant connectivity, easy access to massive computational power, exponential increases in data, and even human-machine interaction. These capabilities are pervasive and are upending industries and creating new possibilities around the world – at a pace we've never seen before. We see this disruption and continuous innovation as the new normal (Source: HPE Oxford Economics Research).

We see compute embedded everywhere – in cars, in stadiums, on train tracks, in ordinary, everyday objects – with billions of connected devices. And by 'compute' we mean a bigger idea – a convergence of technology; apps, data, WiFi, 5G, sensors, point to an even faster, more connected world, where decisions are made analytics everywhere between devices/sensors, the cloud and the datacenter.

Prepare for the connected world where everything computes
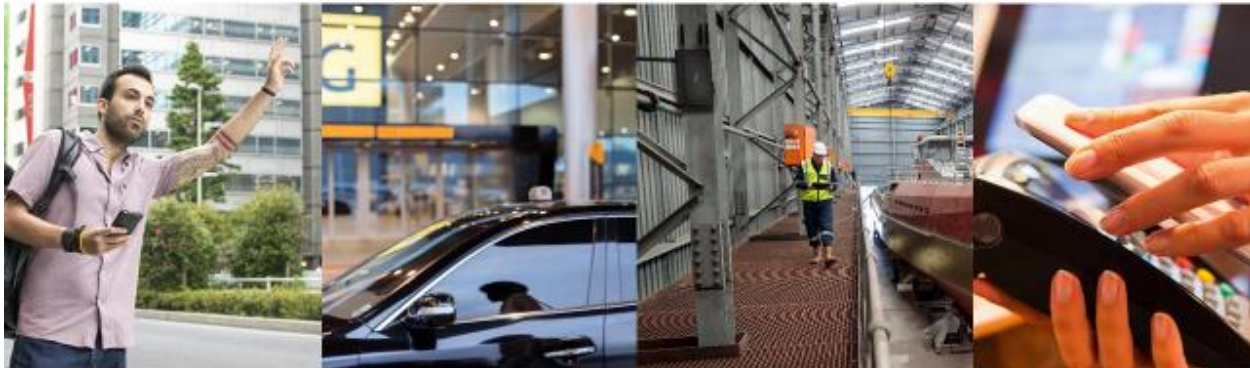
Technology will be embedded everywhere | Everyone & everything will be connected | Everything will be understood

Hewlett Packard Enterprise

Everyone and everything are also increasingly connected and "always-on". And this combination of connected intelligence opens a new data goldmine, with the potential to better understand the world around us, answer our biggest questions, and create new opportunities.

In a world where everything computes, there are rich transformations occuring:

Resource matching: Digitization is changing the transportation industry. Uber, "a transportation network company" uses apps and data to connect riders with drivers.

IoT, sensor-driven services: Nest makes it easy for homeowners to adjust adjust thermostats anytime, anywhere. And Nest uses sensors to automatically adjust temperatures based on data-driven patterns of users – adjusting to preferred temperatures when you're at home (machine learning).

Cardless transactions: Where and how we do our banking is changing. Making payments is getting easier and easier with Near Field Communications (NFC), ApplePay, SamsungPay and more. In China, they are piloting a system where facial recognition is used for payment authorization. You can now make payments from within apps.

Autonomous self-driving cars: Driverless cars are on our roads today, going through extensive testing. These cars are taking in data from all of their surroundings, and must compute this data in real-time to make decisions. This is also an example of the need for data centers with small footprints at the edge, closest to the user and activity – in this case, the edge is the car.

These are a just a few examples that demonstrate that the pace of change continues to accelerate at an unprecedented rate and enterprises face increasing pressure to keep pace and stay ahead of competitors old and new, with many established companies as committed to innovation as any start-up.

ACCELERATE IOT INSIGHTS AT THE INTELLIGENT EDGE

From connected, intelligent devices, we can drive insights to change customer experiences, drive unprecedented efficiencies, and develop new products/business models.

Massive growth has occurred because of the following:

- Mobility- Wireless networking, mobile phones, tablets, and BYOD
- Increase power and decreasing cost of silicon to provide computational and connectivity horsepower
- Rise in open source to manage incredibly large data sets, (Hadoop), economically
- Cloud computing, which is no longer a promise but reality, to give the flexibility to agilely increase capacity without adding hardware
- And software has shifted to apps, that are continually updated, and no longer released only as major updates

What can you do now that you were unable to do before? What will you be able to do in the future?

During this period, IT devices have been connected (printers, clients, personal devices, phones, and BYOD), but industrial systems have had limited connections to business systems of record. Manufacturing floors frequently run on separate control networks, building automation often has its own systems, city services have operated in their own data siloes (water/wastewater, cameras, lighting, traffic, safety, etc.) and then there are connected vehicles (and soon autonomous vehicles). The growth to the 44ZB of data across the world, illustrates connecting the rest of things that have not traditionally been connected. The connections are not being made simply to connect to data, but rather to develop the insights from the data to solve problems.

Customers are wondering how they can be converged. They also have serious concerns about what happens when they do merge. The promise of IoT is that the insights we can draw from merging these, previously-unconnected worlds can drive more insights and growth, with faster response, to enhance the life of your customers, citizens, and colleagues.

There are lots of drivers to the growth, but data and devices are central themes that we must manage to get to the insights that can change life for your customers, citizens, and colleagues.

If the process of digitizing was complete, we could simply stop talking about it now. The reality is that IoT is more than a fad, a buzzword, or something to learn about. IoT successes are increasing rapidly. However, challenges remain.

We have been asking both IT and Line of Business (LOB) execs about their plans for implementing IoT. When we first asked IT execs, about 30% said that they had IoT projects underway. When we asked again in January, more than half said they had IoT projects planned or operational. That number is expected to climb to almost to 90% by 2019. But it gets more interesting, as now, organizations are clearly seeing the ROI. When asked, the respondents said that they were averaging 34% ROI for the IoT projects that they had deployed. This ROI number was higher than anticipated, and so was the innovation that occurred with the return.

To overcome the challenges in today's IoT, you need to connect to new and existing devices, protect the devices and their data, and analyse the data to create meaningful insights.

We have already talked about data and device growth.. Once the data have been acquired, they need to be analysed, displayed, and appropriate action taken. Twenty billion devices by 2020 - In reality, the estimates range widely, from as low as 20B (IDC) up to 50B (Ericsson) and all points between.

The data generated from these devices will need to be processed before they hit the cloud or the datacenter, to alleviate cost of transport, bandwidth issues, governance, urgency of response, etc. IDC estimates that 43% of the IoT-created data will be processed at the edge by 2020 to address these concerns. But "compute" does not stop there, you need to think about how to manage and secure all of the data generated.

Routinely, the biggest inhibitor to adopting IoT is security. More data and more devices mean that the attack surface will also be larger. In fact, an HPE/Aruba study from January 2017 found that 84% of all respondents who deployed an IoT project had been impacted by a breach. IoT will change how one needs to think about security.

Connecting encompasses more than simply plugging devices into a network. Yes, the wired or wireless connectivity is still relevant. However, to maximize IoT, numerous additional devices, running hundreds of different protocols also need to be brought together. Data streams also need to be connected, as data are not nearly as useful, if you can't bring them together.

Additionally, when acquiring data, you can build upon the infrastructure to take in additional context. One that is top of mind is location. By knowing where something is, you can more easily route maintenance personnel to broken equipment, patients to the right area in the hospital, trucks to the proper loading area, and customers to the right shelf to find the jacket they would like to buy.

Data monetization should be closely examined, as data may have value to your partners. Additionally, organizations want to ensure that their monetization efforts at least let them break even, when entering into data sharing agreements.

Security is top of mind for all organizations investigating or operating IoT solutions. Devices, whether new or old, need to have rigorous scrutiny. First, access to devices needs to be controlled by user profile and/or location to ensure that the data are used properly. Secondly, once those users' devices are identified, they may need to be verified that they are running the right OS, firmware, or apps, and have policies placed on them to promote the right behavior. Finally, even the right people, using the right devices in the right places may behave in malicious ways. We need to be able to monitor them to ensure that nothing unforeseen can harm the organization, customers, or employees.

Mature IoT deployments are using data to do more than simply monitor and understand what is occurring. Taking action from insights can dramatically improve customer response, remediation of underperforming manufacturing processes, and product development cycles. It is all about using connected systems to automate actions. Getting to quicker action will require the right mix of IT infrastructure- a Hybrid IoT environment that leverages both cloud and on premise deployments- if you will. With the device and data growth, you will need a scalable architecture to acquire growing data streams, analyse the data, manage the new devices, and store/recover data, whether the compute is done at the edge, in the cloud, or in the datacenter. And, managing data growth is more than simply providing additional capacity. Organizations

must develop means to optimize the data that they acquire, determine where the data should live to maximize insights, and be able to merge data streams.

DIGITAL TRANSFORMATION

There are many ways to look at digital transformation, so to organize thoughts, HPE breaks down IoT solutions into three realms.
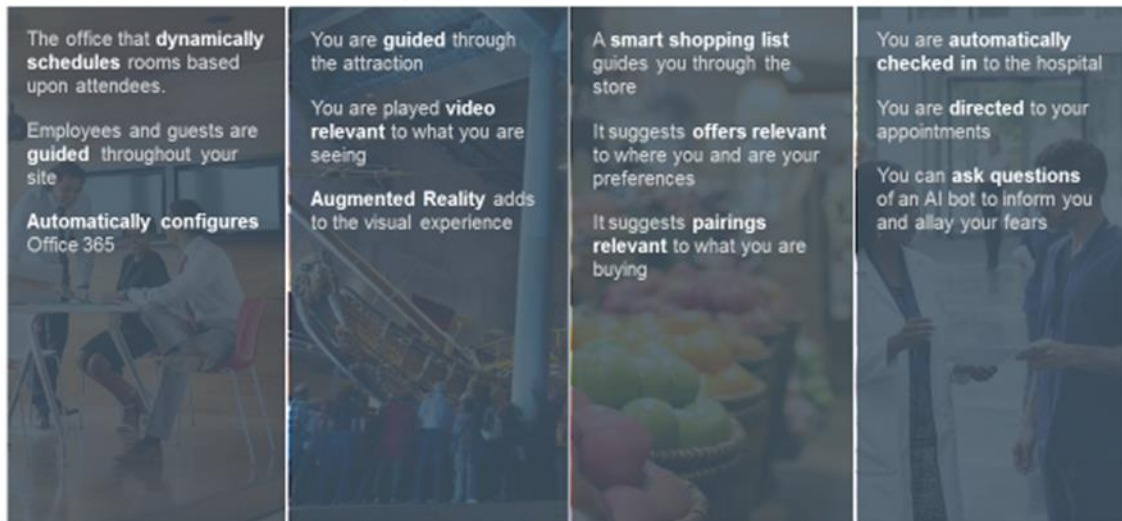
Within buildings- smart conference rooms and office buildings (intelligent spaces), smart venues (stadiums, museums, airports, etc.) and smart building.

Throughout Industry- manufacturing, oil and gas, energy

And across wide areas- smart cities, telcos, agriculture, within vehicles.

You can dramatically enhance and automate customer and employee experiences within buildings and venues. You can help guide people to previously unknown locations to save time, frustration, and ensure schedules are met. You can provide additional context to what people are seeing, whether with simple facts, videos, or narration. You can provide augmented reality so that visitors can use their mobile device to get additional information about what they are seeing to further their knowledge of the attraction or the equipment they have been asked to fix. And, customers visiting your store, can be matched up with sales associates, be guided to the part of the store to find a new pair of jeans, or find special offers, all tailored to them. Or employees can be guided to the right inventory shelf, the right conference room, or schedule a conference room for them.

Create personalized Digital Experiences in buildings and venues

The office that **dynamically schedules** rooms based upon attendees.

Employees and guests are **guided** throughout your site

Automatically configures Office 365

You are **guided** through the attraction

You are played **video relevant** to what you are seeing

Augmented Reality adds to the visual experience

A **smart shopping list** guides you through the store

It suggests **offers relevant** to where you and are your preferences

It suggests **pairings relevant** to what you are buying

You are **automatically checked in** to the hospital

You are **directed** to your appointments

You can **ask questions** of an AI bot to inform you and allay your fears

Hewlett Packard Enterprise

If we look at the second solution realm, "throughout Industry", and talk about industrial operations, a lot of these use cases have actually been around for years in analog. Let's start with predictive maintenance. We have seen predictive maintenance for years in aircraft engines, in heavy machinery, assets like a steam turbine for a nuclear power plant. Predictible uptime has made it worth investing in exotic gear to track the asset performance and to predict failures. What's new about predictive maintenance, with the IOT, is that the cost and the nature of the things that can be predicted has dramatically decreased. Now consumer devices like your car, refrigerator, and sprinklers are now present in industrial settings. We find many high-value assets that were not worth building solutions around for predictive maintenance 10 or 15 years ago, now are. Additionally, analytics have been developed in the past five years that have completely changed the efficacy to accurately assess the condition of, for example a very large rotating machine.

Another genre of use cases is asset tracking. There is an ecosystem out there and it's been out there for some time for tracking assets and HPE has had solutions here for for quite some time and actually it was a very big project that DXC runs with a VA hospital chain to do this. Because of embedded sensors and BLE, the cost of doing this is coming down dramatically. Time not spent for looking for things is time that can be used productively elsewhere.

Pattern recognition is one of those areas that is a big focus area. Video analytics, for example, the ability to detect anomolous people, objects, or behavior from a video without having to build a system of record to track a bunch of identities when, simply, you're looking for events. That type of capability has many, many use cases. We've seen it used for things like ensuring surgical kits have all of the items prescribed on the checklist. It may not be practical to have a passive NFC or RFID tag or barcode on kit components. It's now quite feasible to take a picture of that kit and let software tell you if everything is there and if it's in the right place. This is an area that will see dramatic growth and HPE has developed EdgeLine systems

to host video analytics to allow practical pattern recognition and machine learning outside of datacenters.

Automating Innovation and Efficiency in the Industrial IoT

Performance dictates maintenance, not schedules

Know equipment well enough to offer as a service

Conditions **dictate spares inventory** levels

Time cycles are for innovating, not finding things

The extensible network **navigates you** to locations

Route materials when almost need, not when out

Identify traffic patterns, eliminate bottlenecks

In emergencies, **workers are guided** to muster points

Correlate video analytics to perimeter and crowds

Analyze data where devices live for **fast insight**

Integrate systems of record and device to **take control**

Balance analytics cost, speed, and performance, from **device to cloud**

Connect the intelligent to the intelligence in the data center and cloud

Hewlett Packard Enterprise

Generally speaking, edge processing is is a significant factor in the advent of many of these use cases. Simply put, if you need to copy a file that's 50 megabytes today, in many cases we won't even email that to each other. The network, especially a wide area network, is not able to handle that type of bandwidth and capacity. We will frequently put it on a USB stick or worse yet, a disk drive. The point being, is that trade-off between storage, networking, processing, and the time required, are causing edge processing to be much more important.

In the third solution realm, across wide areas, the big difference is that we will talk about communication across cities, plants, regions, to both stationary and moving objects.

Because of the distances travelled, deployments will have different needs for communicating, and will follow different protocols. The key is not how many protocols you can use, but rather how to get the data mashed together to solve problems and support customers, whether phones, devices that only respond once a day, or devices within a plant or campus.. You need to support the data for all of these needs.

You can augment the telco coverage by providing additional data coverage, that will be forthcoming in technologies like 5G.

Regardless of source, the data need to be visualized for quick assessment, alerts need to be pushed, and data need to be analyzed, whether you have a million meters, thousands of cars, or many thousands of trash bins.

To accommodate all of these devices and the people using them, you need to be able to scale to billions of devices, especially when you may have millions of meters, and millions of citizens.

There are a set of use cases that are generating a lot of interest, first and foremost is smart cities. Some examples of use cases within smart cities are, for example, the smart trashcan. For this use case there's no power, but we want to know the can's location and whether it's empty or full. We don't want to roll trucks to dump trash if the can is empty and if we have to roll trucks to replace batteries that's an even bigger problem than picking up empty cans, so this is where some of these low-power wide-area technologies come in. Another area that we've had a lot of project action in is in connected vehicles and there's a lot of hype around self-driving cars and around automated traffic systems but there's still a lot of value we see being invested in just connecting vehicles and providing new services monetizing data on behalf of drivers and fleet owners. Finally, smart connected agriculture is both the topic for wide area

connectivity, for example, we have a project using LoRAWAN, but there're also projects we've done that are using Wi-Fi technology and we've also done projects using a hybrid of WiFi wide area and on-premise networking within agricultural fields.

IOT SOLUTIONS ARCHITECTURE

What are the parts of an IoT solution? To recap, an IoT solution is only as good as the insights that can be generated from things, and the control that can be provided to those things. We look at these elements, when co-developing an IoT solution:

- Connecitivity- Must be ubiquitous, instant-on, and able to handle multiple protocols

- An Intelligent Edge that can handle streaming data, process events, assist with location, and be context aware, via edge analytics

- Data must be aggregated from multiple device types, analyzed, and presented to users so that you enable and manage the IoT value chain

- Solutions should integrate with existing infrastructure, and should be distributed, deep/scalable, and cover the edge through to the cloud

- To get to best of breed solutions, an open, extensive and partner-driven ecosystem must be available and integrated within the ecosystem

- To augment your capabilities, Services can help advise & transform, integrate your projects, and support you through your project's lifecycle

- And, finally, Security. Security is top of mind for IoT deployments. It needs to included the right access to devices/data and be able to monitor device/people behavior.

Connectivity includes Bluetooth Low Energy (BLE), Sensors, Beacons, Low power WAN, LAN, and OT connectivity via PXI (extensible PCI)

The Intelligent Edge relies upon extensible networking (hooks to location and security), gateways to ingest data, edge compute to real-time analytics at devices, and multi-access Edge computing to augment telco offerings

IoT platforms can connect, secure, provide location information, analyze data, and connect the various data streams from a myriad of protocols

The hybrid IT infrastructure is your typical IT fare, including infrastructure for cloud, compute, converged systems, networking, and storage (online and nearline)

The ecosystem includes consulting services, service providers, solution partners, and technology partners

Services include consulting services, support, and financing of things like Edge as a Service.

Security is really about getting the right access for devices/sensors and people, remediate if necessary, and monitor their behavior.

HPE IoT solutions
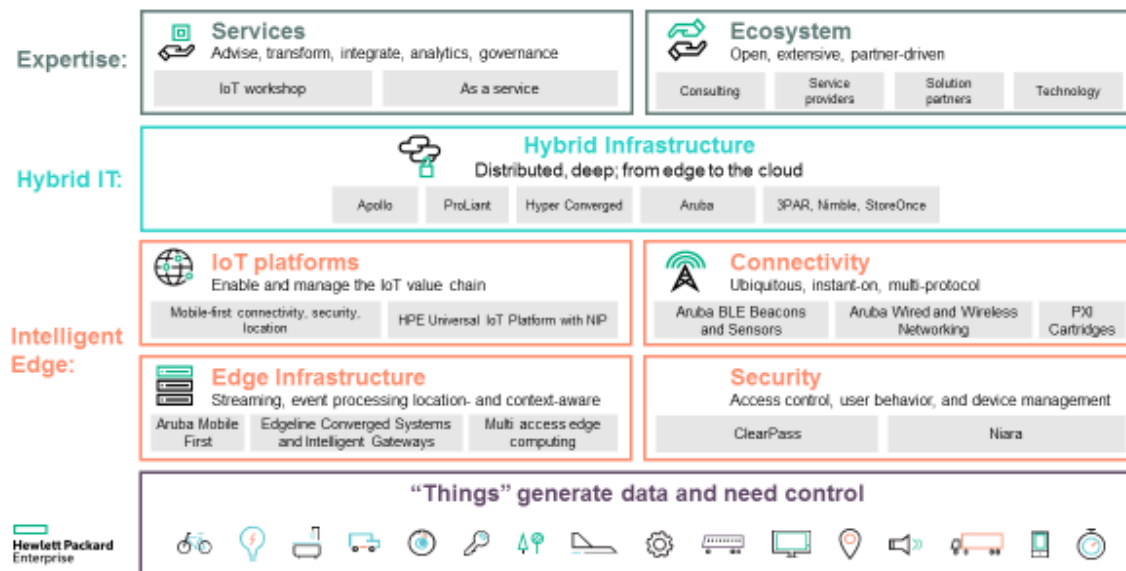
HPE breaks down IoT solutions into four stages. Stage one are the sensors and actuators on the things that create data. With many different data sources, there will be some nuances that will need to be dealt with in terms of different formats, types, and vendors.   Many of these things may not interoperate because they use different protocols or data structures.

In stage two, data acquisition occurs on devices like gateways. Sensors can pull the data but that data from the sensors needs to be packaged and sent out to be analyzed.   There will be things that need to be considered:

- What is the media being used?

- Is it Wired or is it Wireless?

- What are the protocols that are being used?

- Is it secure?

Many, if not most, of these things were built before interconnection was a goal. As such, security was not a consideration. Another consideration is that there are a lot of different standards across the things and different standards across the industries of things that will need to be brought together to make these things work. At HPE we are working with OneM2M. OneM2M is working very diligently to try to pull these things together and HPE has a representative working with OneM2M, keeping HPE involved in these discussions so that we can be relevant, compliant and build solutions that match the standard.

IoT On-Ramps
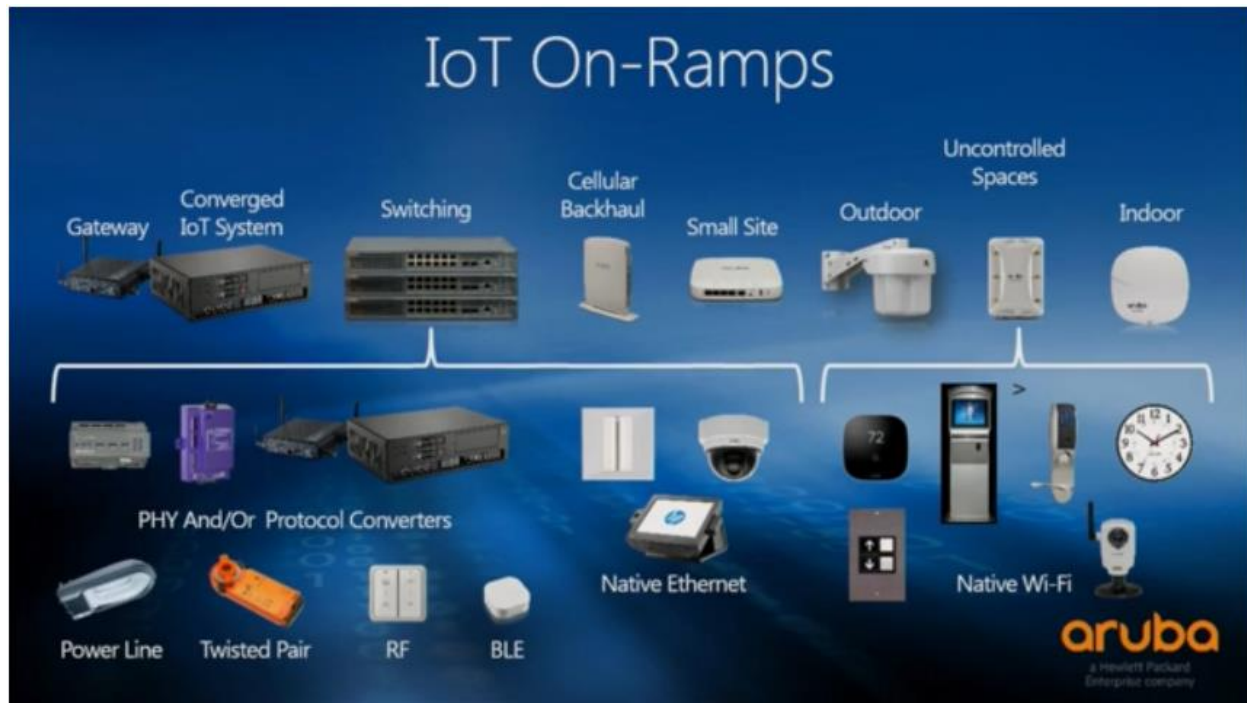
HPE Aruba has a number of devices, technologies, components, and products that help provide solutions in this space. Aruba has products that understand the different data types, understand the different protocols, understand the different control sequences across the different types of things that we find, especially in the industrial internet and they can pull these things together in secure solutions. Aruba secure solutions focus on the three A's:

1. Access: Can I access the device with the data?

2. Authentication: Am I who I say I am?

3. Authorization, if I am who I say I am, then what am I able to look at?

Aruba products and solutions can pull all these things into secure packages and build them into the solutions that we need for the IoT solutions. In addition, the network can be augmented to discern location from BLE devices and beacons, provide access control to users and devices, and monitor to determine anomalous behavior.

Stage three begins merging data acquisition with the datacenter- the edge. This is where intelligence comes to the edge. This is where compute resources are brought closer to our things so that the analysis can be done on-site.
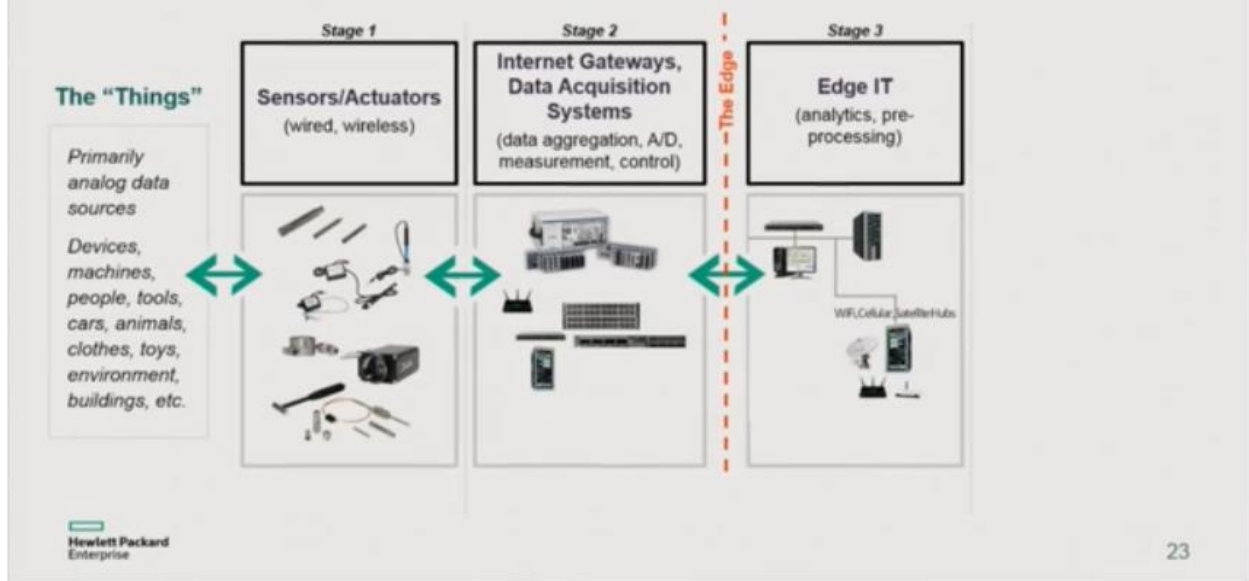
Hewlett Packard Enterprise has developed the Edgeline Converged Edge Systems to bring unprecedented compute, control systems, data acquisition, and device management (HPE iLo) in a converged, single enclosure that is hardened for IoT edge environments.

The Edgeline Converged Edge Systems provide the capability to gather data and with powerful compute resources. Analytics can be run against the data as it is collected where it can house applications that can respond or have the analyzed data sent upstream for further aggregation or processing.

For simple apps and data analysis, The HPE GL10 IoT Gateway is an entry-level ruggedized compute solution designed to operate in industrial environments such as manufacturing, smart cities, or oil and gas. This gateway comes optimally configured with CPU, memory, connectivity and an expansive I/O selection addressing a host of Internet of Things (IoT) needs.

The HPE GL20 IoT Gateway is a mid-level ruggedized compute solution also designed to operate in industrial environments. This performance gateway comes optimally configured with CPU, memory, connectivity and an expansive I/O selection including four-port Power-over-Ethernet (PoE) plus 1 x 8 bit digital input/output (DIO) addressing a host of Internet of Things (IoT) needs.

HPE Edgeline Systems Portfolio

Compute at the edge, accelerate insight™
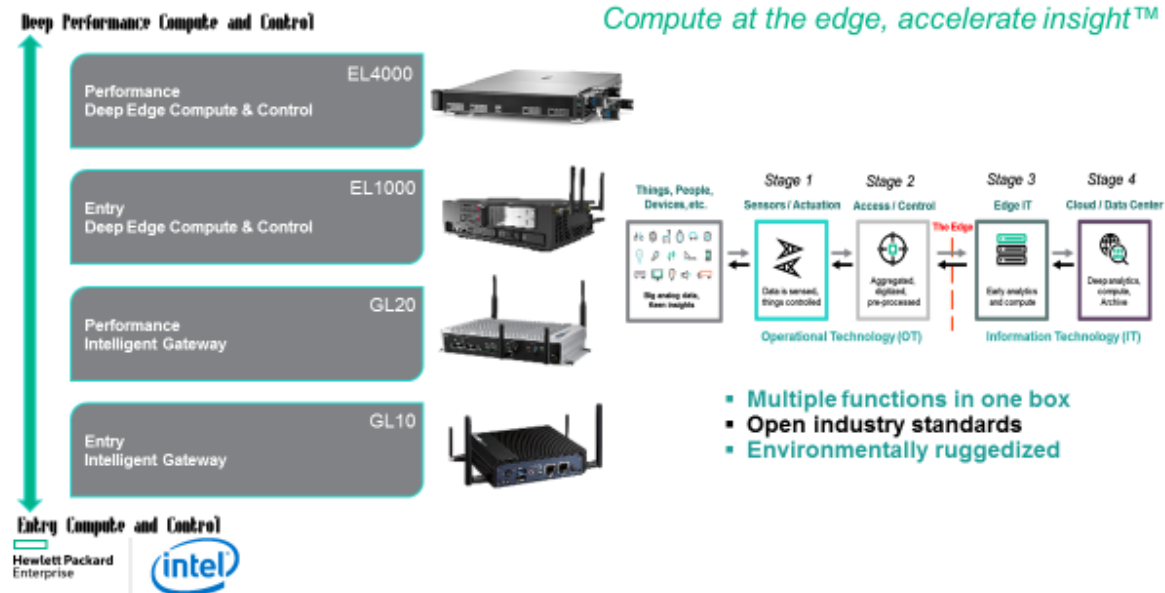
The HPE Edgeline EL1000 Converged Edge System integrates unprecedented levels of edge compute, precision data capture and control, data center-class security, device and systems management, as well as large and blazingly fast storage capabilities – in one converged box. This ruggedized, compact system is designed to perform in harsher edge environments with higher shock, vibration and temperature levels than those found in a datacenter. It is perfect for expanding your IoT infrastructure beyond traditional data center confines and can also help break cloud vendor lock-in to enable true edge computing.

The HPE Edgeline EL4000 is a compact, ruggedized system that is designed to withstand increased shock and vibration, and can tolerate high ambient operating temperatures up to 55°C (131°F) – well beyond what traditional servers can typically endure. The EL4000 can acquire data, analyze it on an industry-standard x86 deep compute platform, drive high-performance displays for operators, and initiate control actions in real-time, at the edge, removing transfer issues to result in faster insights and business agility. It also runs unmodified enterprise-class analytics software such as SAS Event Stream Processing (ESP) and SAS Visual Data Mining and Machine Learning (VDMML), and each server is engineered to deliver high performance. The slim, 1U form factor can be configured with a combination of one to four HPE ProLiant m510 (Intel® Xeon® D – 8 or 16 core) or HPE ProLiant m710x (Intel® Xeon® E3 – 4 core with workstation-class GPU) compute nodes. Solid State Drive (SSD) options in the M.2 form factor with different interface types (SATA or NVMe), can also be selected to help deliver the perfect balance between cost efficiency and extreme storage performance.

The 4 Stage IoT Solutions Architecture
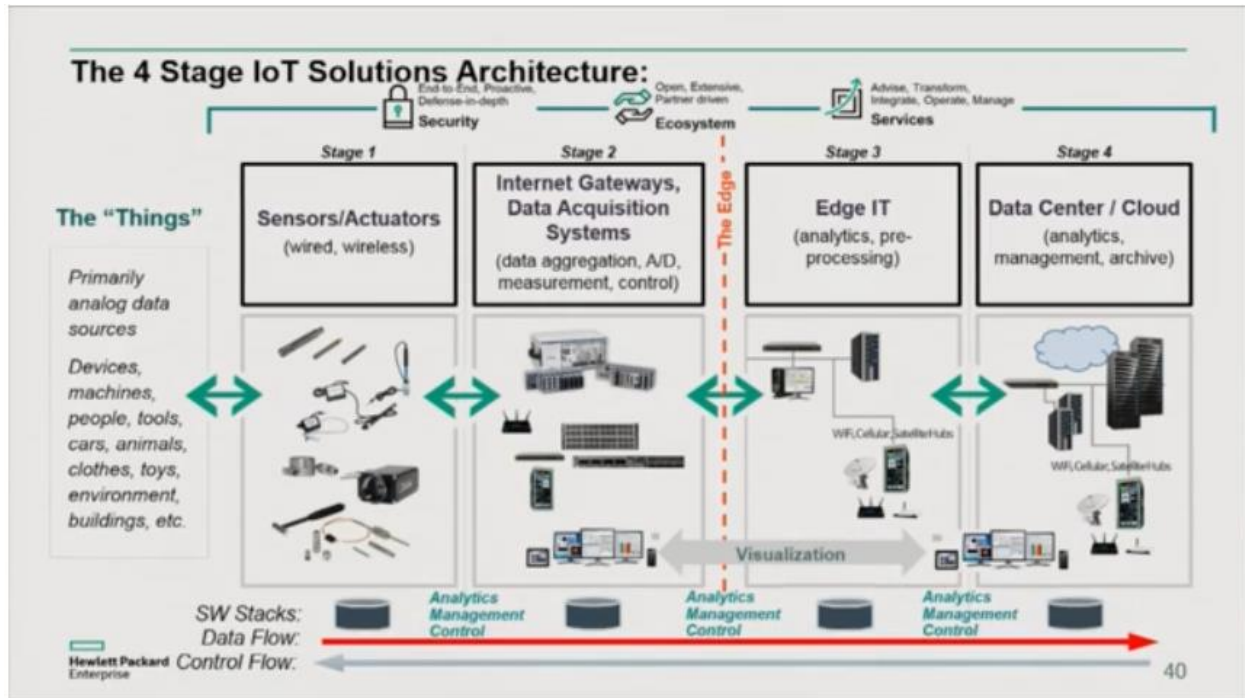
Stage 4 is the Data Center or Cloud where Hewlett Packard Enterprise has decades of experience and products to meet all of the Hybrid IT solution requirements. Enterprise IT organizations need to deploy the right hybrid infrastructure to power their IT services. HPE has a broad portfolio of products and services that offer the fastest path to a hybrid infrastructure with optimized performance, security, and cost—including support for third-party hardware—and a complete portfolio of managed services if you want to avoid the hassle of managing the environment yourself.

CONCLUSION

HPE can help accelerate the IoT Transformation Journey. Today, delivering business outcomes quickly and securely, requires intelligence to enable real-time decisions at the edge. Moving computing power, data acquisition and data management to the edge of an organization's network, outside of the traditional data center, allows faster decisions from relevant data, requires less bandwidth to transport useless data, and ultimately accelerates the time to insight for organizations.

Hewlett Packard Enterprise delivers one of the most comprehensive portfolios of IoT compute, data analytics, security, and connectivity solutions and services, as well as a robust ecosystem of top-tier partners. They include:

- Compute: HPE optimizes the value of IoT analytics through proven compute platforms from the edge to the cloud – enabling data ingest, compute and analytics. HPE offerings at the edge include HPE Moonshot, ProLiant Servers and HPE Edgeline IoT Systems.

- Connectivity: HPE solutions unify access, management, and configuration of devices – enabling secure connectivity in any operating environment from the edge to the cloud. Offerings include Aruba and HPN networking equipment.

- Security: HPE Security enables organizations to proactively mitigate and respond to the inherent risks that IoT devices present, including increased connectivity and a broader attack surface. Offerings include Aruba ClearPass and Aruba Secure Core, which provide network access control and data encryption.

- Data Analytics: With its broad portfolio of solutions including software, hardware and services, HPE can leverage devices and sensors as new sources of data, to create historical and predictive insights and unlock business outcomes. HPE solutions for IoT data analytics include infrastructure optimized for big data (hardware), Aruba Meridian Service and Analytics & Location Engine (location and contextual data).

- Services: HPE offers a comprehensive suite of services to bring together and support connectivity, security, data and compute solutions to accelerate time to value for clients with IoT initiatives.

- Ecosystem: HPE has a thriving, global ecosystem of top-tier partners including industry solution providers, ISVs, SIs and IoT technology providers. For example, as a member of Microsoft Azure Certified for Internet of Things (IoT), HPE will help ensure businesses get IoT solutions up and running quickly with an ecosystem of devices and platforms.

In summary, HPE is focused upon 3 things and this focus encompasses the areas that can help you be successful with IoT

1. Making hybrid IT simple – Hybrid IT is not simple. Software-defined investments and new architectures like hyperconverged and Composable Infrastructure, Traditional Data Center, Software-defined Infrastructure and Private Cloud, Multi-cloud Partnerships

2. Powering the Intelligent Edge – to create the next gen of digital experiences and services, like enterprise/intelligent workplaces/building, throughout Industry, and across wide areas.

3. Providing the expertise to make it happen –   Addresing the "How" question every customer has. How should I think about digital transformation?   New services alignment and Financial services and IT consumption models that HPE can enable

REFERENCES

Nease, Lin and Narasimhan, Partha. June 9, 2017. "Accelerate IoT insights from the Intelligent Edge" HPE Discover

Patterson Jr., Robert C June 20, 2017 "Powering the Intelligent Edge HPE's Strategy and Direction for IoT" DataWorks Summit

CONTACT INFORMATION

Your comments and questions are valued and encouraged. Contact the author at:

Mark Barnum
Hewlett Packard Enterprise
Mark.Barnum@HPE.com

SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc. in the USA and other countries. ® indicates USA registration.

Other brand and product names are trademarks of their respective companies.