

IoT ANALYTICS AT THE EDGE

EDGE ANALYTICS CAN REDUCE LATENCY IN CRITICAL DECISION MAKING

EXECUTIVE SUMMARY

To accelerate business, companies are turning to analytics to help transform data into insight. With so many systems and products now digitally instrumented and providing an endless stream of telemetry, data analytics can help companies glean insight in real-time regarding how their systems are operating. However, to take advantage of these data streams, businesses need to perform analytics close to the edge—near the systems, devices, and users that will benefit the most from the insight. The value of analytics is in the data, and location is critical in driving actionable results.

The Internet of Things (IoT) is delivering new instrumentation of systems and devices that can be tracked, correlated, and reported on, bringing together both operational technology (OT) and information technology (IT). Analytics are reaching outside of the traditional datacenter towards the edge, where the IoT data is generated. IoT helps prevent enterprises from being left behind by releasing trapped data and making it actionable. But to take advantage of this information, companies need technology partners with both the relationships and insights to work across all of the functional domains, as IoT edge analytics crosses both IT and OT.

Hewlett Packard Enterprise (HPE) has products, relationships, and experience to help their customers leverage their IoT data at the edge, accelerating business insight, making sharper decisions, and gaining the competitive edge.

TODAY'S CUSTOMER NEEDS

Throughout the information age, periods of identifiable disruption have changed the course of business. From now through the end of the decade and beyond, businesses need to embrace change as they head into the era of digital transformation. Digital transformation is a business philosophy in which a company embraces its digital assets with the same value and regard as their physical assets, making information just as valuable as an assembly line. The growth and change of these digital assets requires a business to move with speed and efficiency that was simply not enabled by traditional means. As businesses advance, there will be two types of companies: those that embrace and are successful in their digital transformation, and those that fall behind. At the same time, disruptive technologies are creating new and daunting complexities as

both the amount of data and the diversity of its source explodes at a nearly impossible pace. Decision-making times are rapidly scaling back as decisions are no longer driven by the latest results from the quarter, month, week, or even day. Whether it is monitoring a real-time dashboard or creating automation behind the scenes, businesses need actionable data with the lowest latency possible to stay competitive.

Creating a business understanding in this sea of complexity mandates that successful companies be proficient in their ability to understand and make business decisions based on real-time data. Data analytics, perhaps the most important science in all of information technology, has become a catchall phrase for a variety of ideas. However, simply put, data analytics is the ability to extract knowledge and insight from data. To be effective, insights must be not only actionable but contribute positive economic value to the business. Today, especially with the emergence of “big data”, there are many products that attempt, through data examination, to provide business information. These insights tend to be aligned with the “book of records” concepts that have been a cornerstone of the industry. But the rapid rate of industry change will render some existing analytical techniques obsolete, or at best unresponsive to today’s needs.

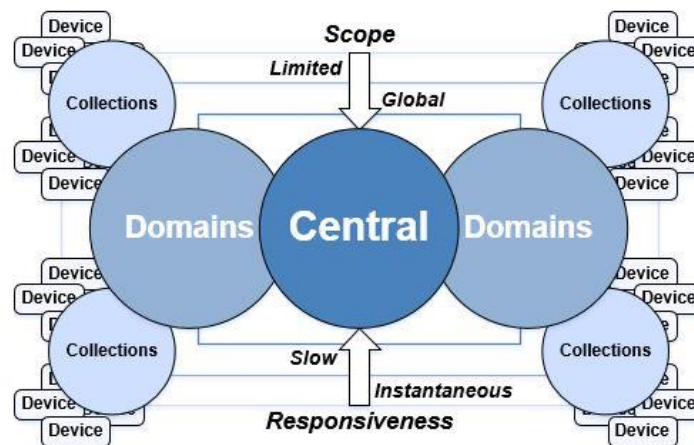
IoT endpoints (the devices and sensors creating the telemetry streams) are the principal source of this emerging new data. Some [predictions](#) see as many as 50 billion devices worldwide by 2020, each contributing to the staggering amount of data and new data types from unique sources. Many of these endpoint devices do not fit cleanly into most existing IT or even OT infrastructure. They vary from very simple, highly prolific devices that do little more than “chirp” sensor data for short distances, to complex devices capable of performing multifaceted functions (and may include a hardened, highly-available communication technique). For all, [careful consideration](#) must be given to connectivity, security and corruption, and cost.

- **Connectivity:** Solutions must ensure proper connectivity with sufficient bandwidth and appropriate latency for the system to operate as intended. For mission critical (especially life critical) situations, loss of connectivity or extended latencies are unacceptable. Connectivity to a central authority can become problematic, and response must be effected locally to avoid interruption or delay.
- **Data Integrity:** Solutions must guarantee source integrity, authenticity, compliance with governance, and state of the data, protecting from attack or transmission disruption.
- **Economics:** Certainly all solutions must be cost effective and must include the proper tradeoff of size, complexity, and power consumption. Many devices will even be fully battery powered, likely limiting integrated complexity, and function.

Collective data behaviors and responsibilities vary and take place at multiple levels. Some decisions are best made locally near the point of origin (or at the edge). For example, each data point creation could include response, validation, remediation, deduplication, action, or a communication with a central authority. As such, analytics performed at the correct place in a continuum can better serve the needs of business.

Figure 1 depicts a continuum of analytics—growing in **scope** and decreasing in **responsiveness**—from collections through domains to a central core. Analytics can be performed at any level, although endpoint devices themselves may have limited compute capability.

FIGURE 1: CONTINUUM OF ANALYTICS



- Depending on the solution, **collections** represent **devices** grouped due to their contribution to a solution. For simply monitoring a collection of assets, they can operate by a simple gateway, performing device management and data assurance. For assets with extensive value to the operation, more analytics will likely drive a need for heavy-duty compute.
- A **domain** consists of one or more collections and is the seat of edge computing. Analytics at the domain (edge) can perform most types of analysis within a local environment or site. The domain's proximity to the origin of the data makes it the most compelling location, because it will lead to enhanced automation and new services that were not possible with a high latency cloud-based solution.
- Finally, the collection of global information is performed in the **central** core authority (the cloud). Examples are global trend analysis and policy synthesis. This centralized resource can also be the global repository for important data.

Analytics do not have to be completely deterministic at a given level, as long as a deterministic result is ultimately concluded. The best place to perform analytics is the location with the best balance of cost-effectiveness, purpose, and timeliness that maximizes operational utility.

THE BENEFITS OF EDGE COMPUTING FOR IOT

IoT is transforming how businesses work by enabling better real-time insight into operations. This trend blurs the lines between Operational Technology and Information Technology, as OT's systems (like manufacturing and facilities) are integrated into IT's analytics engines. IoT helps release insight from a sea of data to create hard, actionable conclusions that drive clear business results. Some view the endless stream of IoT data as a valuable asset, but the insight derived has a much greater value than the data stream itself. **How** companies use this data—including **when** and **where** they use it—will determine the amount of value that they can bring to the business.

One common analytics model uses a central repository where all data is kept and broad analysis is performed. Borrowing from the idea of a central “book of records”, this model can be expensive and limiting. Cloud is a popular alternative to conventional IT, but its exclusive use will not constitute the best solutions in the future (due to latency, cost, and data transport). In our increasingly competitive world, businesses must use analytics at maximum effectiveness, reducing time-to-decision as well as cost, also considering location. Doing so requires thorough comprehension of five aspects of IoT data.

TABLE 1: IOT DATA ASPECTS

Aspect	Description
Source Information	The deterministic identity of the device supplying data, the data type, & validity (or credentials) enabling it to supply this data
Temporal Nature	The duration of data validity, requirements for anticipated response, & the necessary bandwidth to properly service the data source
Interrelationships	The relationship (if any) to other data sources (including redundant or duplicate), discernable ownership, & management methods
Compliance	Any regulatory requirement that must be enforced (usage, privacy, data residency laws, <i>etc.</i>)
Operational Model	The relationship of data to the global business (optimizing operations, tracking asset or process, <i>etc.</i>) & the creation of new opportunities emerging as a result of data that was previously not available

By driving IoT analytics to the edge—where data lives—businesses can reduce latency while increasing the immediacy and value of insights. Previously only “light” compute was happening at the edge. Now, with shifts in the value of this information and the benefit of acting rapidly, we are beginning to see more “deep” compute at the edge.

IoT data and data streams differ significantly from data traditionally seen in IT. HPE not only recognizes their difference but is contributing significantly to the state of IoT. HPE is developing a purpose-built product line optimized for the increasingly important role of IoT. These IoT-focused products are defined by what HPE calls the [seven principles](#).

1. **Big Analog Data:** As a primary source of big data, IoT streams are usually analog. Many endpoints are transitional devices that convert the natural analog information to digital, enabling it to be usable by computing. Data’s binary nature reduces information density but explodes with the number of streams that must deliver the analog equivalent in a digital manner.
2. **Perpetual Connectivity:** IoT endpoints provide constant telemetry data for industrial applications as well as product or user behavior for more conventional applications. Their permanent connection enables instantaneous parametric adjustment, device management, or modification.
3. **Real-time:** Real-time or “as it actually happens” data is both the most valuable and most challenging. Real-time data enables an entirely new class of solutions that had previously been implausible.
4. **Complete Spectrum of Insights:** IoT must be comprehended in each of the five phases of data: real-time, in motion, early life, at rest, and archival.
5. **Immediacy vs. Depth:** Traditional solutions tradeoff speed or depth. In the past, they have delivered immediate “time-to-insight” or delayed “depth-of-insight”. As compute capabilities move closer to the data’s origin, both must be enabled.
6. **Shift Left:** IoT mandates a systematic “shift left”. Capabilities previously found only in sophisticated compute and data analytics (typically reserved for the cloud or datacenters) now need to be enabled at the “left” of the data source.
7. **The Next V:** Big data is commonly characterized by the infamous “V(s)”: Volume, Velocity, Variety, and Value. IoT enables a fifth “V”: Visibility. As data is collected, data scientists around the world can see and analyze it, as needed. Visibility exposes data to remote people or locations without moving the source data.

EDGE COMPUTING FOR IOT IN ACTION

HPE already has extensive experience working with industrial customers. As IoT becomes more prevalent, HPE is able to put its experience into action, delivering clear IoT benefits to their industrial customers.

Flowserve is a 225+ year old company that manufactures advanced heavy equipment like pumps, valves, and mechanical seals. They faced a challenge in helping their end customers in the petroleum refining industry reduce the opportunity cost of unplanned downtime, something that is projected to be as high as \$20B/year in the US refining market alone. Flowserve has over 3 million pumps in the field and is now beginning to equip them to provide digital telemetry data. This data allows companies to pick optimal service windows, reducing downtime. With equipment and systems being offline up to 24 hours for service, revenue is being lost because refineries are very operational—they only make money when the equipment is running.

Because HPE was the first to industrialize a commercial piece of IT equipment for a refinery floor, they were a natural partner as Flowserve integrated IoT into their service processes. Flowserve required a high level of computation at the edge with local control, right on the plant floor, for better latency and real-time response, something they could never get with cloud-based analytics.

HPE enabled analytics at the pumps via Edgeline EL1000 intelligent gateways, avoiding cloud latency and delays. The EL 1000s collect and process pump sensor data via NI VXI sensor interface cards and PTC's ThingWorx IoT machine learning and user interface software. The user interface features augmented reality, allowing a tablet to overlay equipment status onto live video of the pump, for a simpler, more intuitive view of the pump. Analytics insights are securely relayed via Aruba Wi-Fi access points which also interface with Aruba BLE Beacons on the Flowserve pumps to provide location-based services (for example, tracking service personnel or even recalling service records when an engineer approaches a machine).

The EL 1000s provide Flowserve a significant level of compute power, even in a cost challenging plant environment. The gateways' ability to operate in elevated temperatures at low power consumption enables them to function virtually anywhere the pumps are deployed. Faster time to insight helps reduce the typical maintenance window by up to 75%. The result is that the Flowserve pumps, and the processes they serve, can run continuously for longer periods, and that when maintenance is required it substantially reduces downtime compared with competing solutions.

HPE'S PORTFOLIO OF IOT EDGE COMPONENTS

HPE addresses the IoT market with a combination of products including the purpose-built Edgeline compute products, high security networking infrastructure, location-based services, analytics software solutions, as well as HPE IoT services and financial services. These products are supplemented by an ecosystem of technology and reseller partners who understand how to leverage IoT to transform business operations.

HPE EDGELINE EL10 / EL20 INTELLIGENT GATEWAYS

The HPE Intelligent Gateways enable organizations to capture and handle data streams at the edge in challenging environments, including oil and gas, manufacturing, and smart cities. Their non-traditional form factors are designed specifically for these new deployment scenarios. With low wattage DC power, the entry level [Edgeline EL10](#) (based on Intel Atom processors) and the more capable [Edgeline EL20](#) (based on Intel i5 processors) are designed to be mounted and operated at the edge, as close as possible to data collection. Used with a suitable Ex enclosure, both the EL10 and EL20 can be used in hazardous industrial applications.

HPE EDGELINE EL1000 / EL4000 CONVERGED IOT SYSTEMS

The HPE [Edgeline EL1000 and EL4000](#) systems are the industry's first "Converged IoT Systems". They integrate high performance Intel Xeon x86 compute, industry standard PXIe data capture and control, and enterprise-class systems and device management. Converging PXIe and datacenter-class compute is a first, enabling HPE to address a multitude of IoT connectivity use cases. Environmentally hardened to be deployed at the edge, or far from the traditional datacenter, these systems use HPE server processing and Integrated Lights Out (iLO) management, so the server management and security technologies in practice in the most demanding datacenters are available at the edge. High capacity storage and standard PCIe capabilities are integrated into the Edgeline chassis. This complete converged solution features small footprints, low energy, fewer cables, and embedded control, which are key benefits at the edge.

ARUBA SECURE MOBILITY

Aruba Wi-Fi solutions wirelessly connect devices (even in areas requiring Class 1 Division 1 certification), wired Aruba switches service Ethernet enabled devices, and Aruba remote access solutions connect remote sites over cellular or WAN. Meridian location-based services offer wayfinding and geofencing for site navigation, safety, and compliance applications. Aruba ClearPass IoT Profiler fingerprints new IoT devices to

determine whether they can be trusted to access the network and manages access rights once they are connected.

VERTICA ANALYTICS SOFTWARE

To handle the actual analytics load at the edge, [HPE Vertica Analytics Platform](#) can run on Edgeline EL4000 systems. This gives businesses a unique and practical solution for handling massive amounts of data in remote locations along the edge. This in-database machine learning can be applied to a wide range of analytics use cases, with the flexibility to interact with broader-level analytics solutions built on Hadoop, whether running on premise or in the cloud. Vertica can execute at the edge for instant insight while also driving those interim, non-concluding data points further up the stack to integrate with traditional analytics engines.

IoT SERVICES & IoT INNOVATION LABS

As a company that has led its own IT transformation, HPE is in a good position to both understand a company's infrastructure and challenges as it moves into the world of IoT. With services [designed around key components](#) of an IoT solution (including business process, infrastructure and applications, along with vertical knowledge and expertise), HPE can help customers work through their unique IoT challenges. HPE has created [IoT Innovation Labs](#) to help customers visualize real-world examples of IoT in a lab environment that encourages collaboration. As a way to help companies using IoT to drive more efficiency and insight, the HPE IoT Innovation Labs bring together the IoT ecosystem with HPE products, including strategy, roadmap, and deployment discussions. HPE customers can then use the labs either physically or remotely to prove out a specific solution and reduce time to implementation.

HPE UNIVERSAL IoT PLATFORM - DATA ENABLEMENT PLATFORM

This platform enables the connection of any device over any network, with a standards-based data model, creating micro services and IoT applications that drive data to monetization, quickly and at scale.

THE IoT SENSOR & CONTROL ECOSYSTEM

The [IoT ecosystem](#) is robust in industries like energy, healthcare, manufacturing, smart cities, and transportation. IoT solutions have created a sea of endpoint sensors that collect information and generate streams of data. Endpoints range from simple probes to complex kinetic devices that can perform functions on command. Sensors monitor temperature, pressure, presence of gas or liquid, consumption, process status, location,

and more. As the industry evolves, solutions will enable business integration, creating a fully optimized and instrumented enterprise. Edgeline's inclusion of the PXIe industry standard enabled a converged approach to data acquisition and analysis directly from sensors. HPE's participation in industry standards helps avoid vendor lock-in.

HPE ECOSYSTEM PARTNERSHIPS

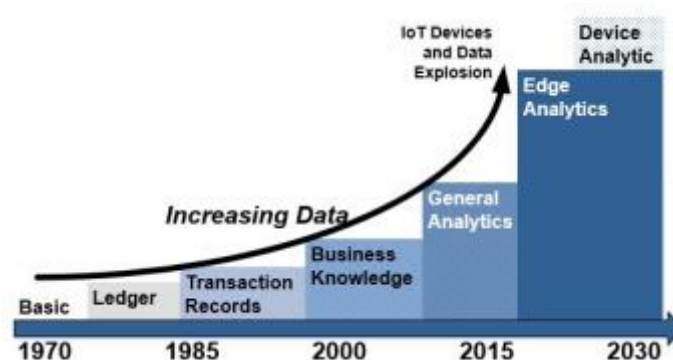
In addition to the products optimized for the future, HPE understand this market disruption goes beyond a single company. To be successful, this opportunity mandates best of breed partnerships. As such, HPE has established several key partnerships. According to HPE, various other partnerships will be disclosed as they mature.

- **Intel Corporation:** HPE and Intel partner to enable delivery of open standards-based IoT solutions that will enable creation of value from the growing amount of data collected from devices and sensors. Both companies are committed to best of breed solutions combining device and sensor technology with products that will collect and process data even in the harsh edge environment.
- **Microsoft Azure:** HPE Edgeline systems come in ruggedized, mobile, and rack-mounted versions and are aimed at a variety of industry sectors, with HPE specifically naming the logistics, transport, health, government, and retail sectors all certified to work with Microsoft's Azure IoT Suite.
- **GE (Predix):** HPE is the preferred provider for GE's Predix cloud-based Platform-as-a-Service technology built exclusively for the industrial internet. This partnership will enable businesses to integrate once-isolated control systems and leverage next-generation sensors, enable insights, and automate industrial environments. The companies plan to support the aerospace, oil and gas, manufacturing, automotive, and energy industries.
- **National Instruments (NI):** HPE and NI plan the availability of pre-tested Big Analog Data solutions based on NI DataFinder Server Edition software and HPE platforms. This partnership enables an IoT big data solution that is fundamentally different from traditional big data. This pre-tested solution reduces integration risks by providing complete, pre-validated, tested solutions that manage and analyze the complexities of file-based sensor data.
- **PTC:** Among the capabilities available from PTC is edge computing support as part of its IoT technology platform. PTC's control system provides aggregation and seamless integration of both primary and secondary sensor data into ThingWorx Analytics. Additionally, ThingWorx provides automation for machine learning, real-time anomaly detection, and failure prediction in rapidly deployed role and user experience based web and mobile applications.

HOW EDGE IOT IS EVOLVING

Since the beginning of the information technology era, the principal value has been “data” and the ability to obtain insight from it. There have been many technological advancements, ranging from the early mainframe to today’s interconnected devices. While few advancements equal the impact of the internet or the repeated reinvention of more capable / lower cost building blocks, the general theme remains: scale-out from centralized to highly distributed. Information processing follows the data and naturally flows to the most optimum point, continuously rebalancing speed, efficiency, and cost.

FIGURE 2: DATA GROWTH



The explosion of IoT and the data it creates coupled with the needed speed of business, mandates analytics be performed at the edge—fastest access to data, ability to put data in context, and most reliable operations—all enabled by increasingly capable, cost-effective endpoints. As capability increases, device analytics (integrated into the device itself) will be added, further empowering rapid, data-enabled business direction.

CALL TO ACTION

The opportunity to reduce latency, accelerate action, and amplify results will come only when analytics can happen closer to the edge, where all of this IoT data is being created. To change their business trajectory and leverage IoT, enterprises should give serious thought to not only **what** is being analyzed but **where** it is being analyzed.

Long known for their IT products, HPE is helping reduce latency and accelerate real-time answers by bringing IT and OT together. HPE has both the specialized equipment and the ecosystem partnerships to build a complete solution, all wrapped up in the IoT services and expertise that come from an industry leader. Companies who are actively investigating edge analytics for the sea of IoT data they are creating should consider HPE for edge analytics solutions.

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