POINT OF VIEW: IOT AND ANALYTICS

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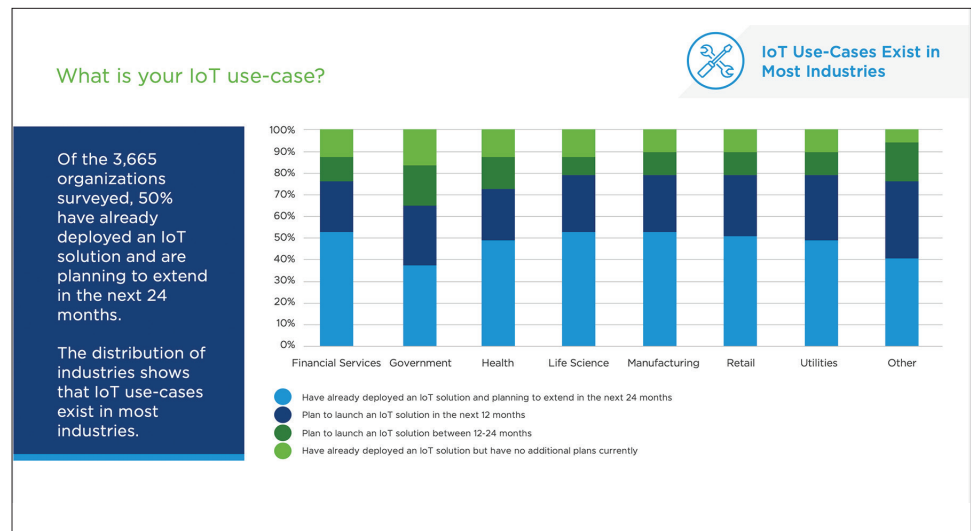
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As Staff Consulting Architect, Professional Services Engineering at VMware, Neeraj leads the development of service offerings for IoT, Edge Computing and NFV. Previously, Neeraj was part of VMware Professional Services field organization delivering integrations to Fortune 500 companies using VMware and non-VMware products. Industry experience includes gaming, utilities, healthcare, communication, finance, manufacturing, education and government sectors. Neeraj has published research papers in the areas of Search Engines, Standards Compliance, and use of Computer Science in Medicine.

Point of View: IoT and Analytics

Most analysts agree that the number of connected devices will soon outnumber the world's population, if it hasn't already. Concurrent with the explosion in the number of devices, there's been a tremendous growth in the amount of data generated. Whereas this data is being used by some businesses to better serve their customers, a large number of today's businesses are largely unaware of their opportunities, challenges, and solutions to tap this vast resource.

Herein we provide a high-level discussion on the categories of use-cases businesses might consider to solve using connected devices and data collected by these devices, key decisions they must consider making early on, related technologies that we recommend they investigate, and how we at VMware can assist them in the process.

IoT Proliferation

What is your IoT use-case?

IoT Use-Cases Exist in Most Industries

Of the 3,665 organizations surveyed, 50% have already deployed an IoT solution and are planning to extend in the next 24 months.

The distribution of industries shows that IoT use-cases exist in most industries.

Financial Services, Government, Health, Life Science, Manufacturing, Retail, Utilities, Other

- Have already deployed an IoT solution and planning to extend in the next 24 months
- Plan to launch an IoT solution in the next 12 months
- Plan to launch an IoT solution between 12-24 months
- Have already deployed an IoT solution but have no additional plans currently

In looking at this bar chart constructed from a survey of more than 3,600 organizations with active and deployed IoT solutions, conducted by MacGillivray et al. (2017), we can observe that **IoT use-cases exist in most industries**.

They may not be obvious since they often cross departmental and technological lines in a business. However, data shows that businesses in most industries have implemented IoT solutions and therefore such use-cases must exist.

Ingest, Analyze, Engage

Like most things that IT brings to the table, IoT and analytics are tools that businesses use to improve efficiency, enhance customer engagement, or create a new revenue stream. Our focus thus needs to be on the achievable outcomes. A constant we've observed when evaluating customer expectations from IoT solutions is the pattern **"Ingest, Analyze, Engage."**

An IoT solution **ingests** data from sensors and devices, the analytics component then uses this data to arrive at conclusions (i.e. it **analyzes)**, and the results trigger actions which allow the business to **engage** with infrastructure or their customer.

"Ingest, Analyze, Engage" is therefore being used by businesses to constantly improve their products and services by active or passive feedback. Such feedback could come from myriad sources, such as humans, computers, sensors on trucks, or assembly lines.

It is tempting to associate **analyze** with Machine Learning (ML). However, ML isn't the only means to analyze and interpret data. It is one of the many ways that you may consider, if appropriate, to your dataset and use-case.

Consider, for instance, a very simple use-case of monitoring water levels at cattle watering stations. Experience may have taught cattle farmers that they need at least six inches of water in troughs and that it needs to be maintained at that level between sunrise and sunset. This is easily detectable by taking input from a sensor (**ingest**), comparing this input to set values (**analyze**), and triggering actuators to activate pumps to maintain water levels in the troughs (**engage**). Clearly, in this instance, a farmer's experience has been leveraged to determine the trigger levels and ML is unnecessary. Should ML be required, it could replace our fixed value comparison.

Class your Use-Case

At VMware, we take an IT solutions based approach which implies that we work from our customers' use-cases toward products and services that will assist us in addressing those use-cases. We observed IoT use-cases in the market and divided them into three high-level categories:

• Continuous Customer Engagement — Category of use-cases where the data ingested comes as active or passive input from end users and effects how a business engages with their customer.

• Digital Engagement — Category of use-cases where the data comes from infrastructure components such as machinery, hardware, and software and is used to better detect faults and inefficiencies targeting improvement in business processes.

• New Business Models — Category of use-cases that enable new revenue streams and markets.

Let's go through some of these use-cases:

Treatment Adherence would allow care facilities to monitor if patients are following the treatment plan by *taking medications as prescribed using smart pill boxes* (Silverman, 2017).

Smart Inspections in insurance, *airlines* (Stumpe, 2017), and *structural and civil engineering* (Fuller, 2017) allows inspections using drones and image recognition.

Mining companies, for example, use **Predictive Maintenance** to *schedule preventative maintenance* (Rio, 2015) of heavy infrastructure since it impacts productivity immediately. *Similar methods are used in other industries* (Marr, 2017) to prevent downtime and operate machinery optimally.

Imagine getting a new sports driving mode for your car like you buy an app in Apple Store or Google Play Store. That's what **Software Feature Delivery** can enable in the Automotive space. *Over the air updates for cars* (Sage & Orlofsky, 2017) may be *coming to an ECU near you soon!* (Airbiquity, n.d.)

Driving Risk-Based Pricing for Auto Insurance enables an insurance company to *price insurance per individual driving habits* (Greenough, 2015) as measured by devices tethered to the car's onboard computer or a device the user carries with them.

Automated Checkouts as being trialled by Amazon and WalMart allow *customers to shop without queues*. (Leswing, 2017) Disney is using *IoT and analytics to engineer away friction* (Kuang, 2015) from your holiday experience in a really large store (a la Disneyland).

Smart Cities have been in the news in the recent past. *These enable, among other things, efficient resource consumption, safer roads, and increased longevity of public infrastructure.* (Maddox, 2015)

Ingest, Analyze, Engage — it's evident in every use-case.

IDC surveys (Turner & MacGillivray, 2016, Turner & MacGillivray (2017)) find that the primary motivation for businesses to consider and implement IoT solutions is to improve business productivity and internal efficiency.

We encourage you to think about your IoT and analytics use-case and slot them into one of the following three categories:

• Continuous Customer Engagement
• Digital Engagement
• New Business Models

When considering IoT use-cases, and in light of survey results, we encourage you to focus on quantifiable goals to show improvement in productivity and efficiency, or rather use-cases that you could bucket in the Digital Engagement category.

Identifying a Gap

Data being produced doesn't necessarily mean that it is being ingested. Data being ingested doesn't necessarily mean it is being analyzed, and data being analyzed doesn't necessarily mean that analyses is being acted upon. We encourage you to follow through the entire chain of data flow (i.e. from **ingestion**), to how it is being **analyzed**, and how the results of that analyses are being used to **engage** to discover your IoT and analytics solution. You'll know that there's space to improve and build when you find a pathway that isn't entirely clear, automated or timely.

We encourage you to assess the solution in place or the gap that you find using Foundational Elements discussed in the next section.

Foundational Elements

Whereas IoT and analytics is exciting, it is equally complex because there are many interdependent components and decisions. The first and foremost of this is hardware, or simply "things" in Internet of Things.
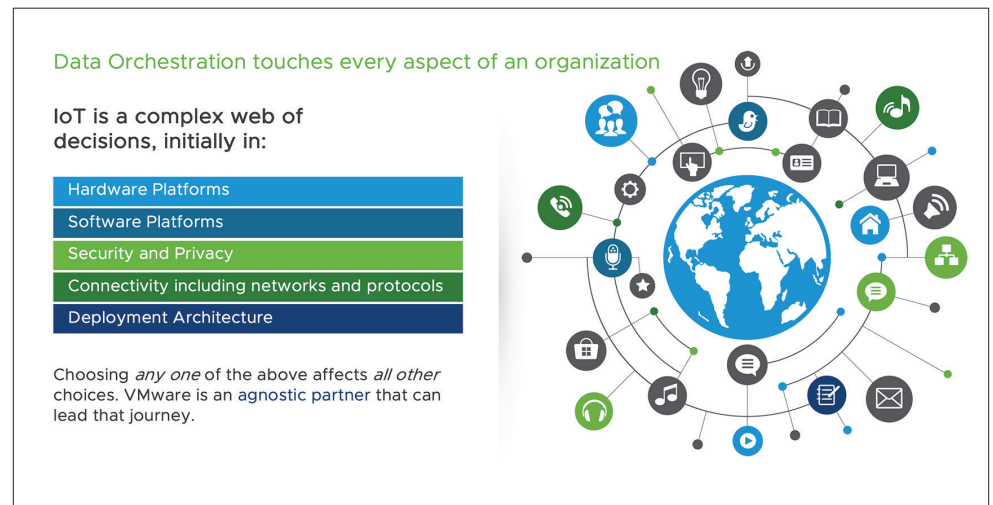
Hardware life-cycles varies significantly by device type. Whereas, mobile phones are replaced every one to two years in the US (Entner, 2015), personal computers replacement cycle has been observed to slow down to six years (Shah, 2016).

Replacement cycles may stretch out further with other types of hardware. Consider, for example, IoT projects to dynamically update Engine Control Units (ECUs) software in a Smart Feature Delivery IoT use-case, or street lighting firmware in a Smart Cities use-case. A usual deployment in this case would be tens of thousands if not hundreds of thousands units spread around a wide geographical area. Replacement schedules could possibly span over a decade.

We believe that hardware used in IoT and analytics solutions will experience a range of replacement schedules. Should the solution depend on consumer devices like mobile phones, businesses can expect to architect their solution based on a short replacement cycle. Whereas, if businesses are dealing with sensors like in the Smart City scenario above, they should consider the possibility of a very long replacement cycle.

Similarly, there are other choices, such as the choice of communication protocol, and delivery method that are crucial in the initial stages since they could be very difficult to change later.

IoT Challenges

Data Orchestration touches every aspect of an organization

IoT is a complex web of decisions, initially in:

- Hardware Platforms
- Software Platforms
- Security and Privacy
- Connectivity including networks and protocols
- Deployment Architecture

Choosing *any one* of the above affects *all other* choices. VMware is an agnostic partner that can lead that journey.
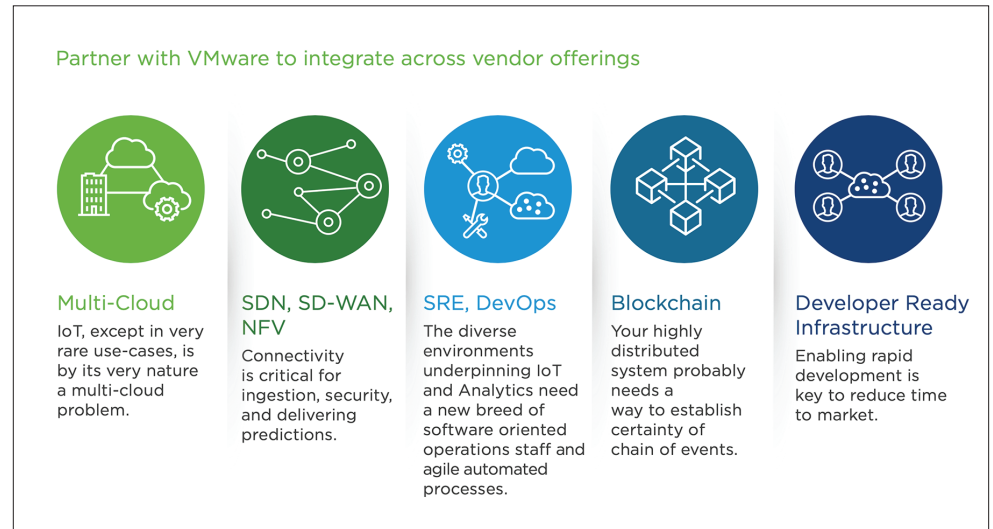
High-Level Decisions

Our research points to a recurrent theme in that there are five key high level decisions to be made in early stages of architecting and implementing an IoT and analytics solution. These are:

• Hardware Platforms

• Software Platforms

• Security and Privacy

• Connectivity, which includes networks and protocols, and

• Deployment Architecture, which includes the decision to have edge or central prediction capabilities, and distributed or centralized training capabilities

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Relevant Solution Domains

When making decisions in the five key areas identified identified in the previous section, businesses must consider the impact the decisions have on each other. Since these are also technical decisions, businesses should evaluate underlying technologies as part of the decision making process.

Partner with VMware to integrate across vendor offerings

Multi-Cloud
IoT, except in very rare use-cases, is by its very nature a multi-cloud problem.

SDN, SD-WAN, NFV
Connectivity is critical for ingestion, security, and delivering predictions.

SRE, DevOps
The diverse environments underpinning IoT and Analytics need a new breed of software oriented operations staff and agile automated processes.

Blockchain
Your highly distributed system probably needs a way to establish certainty of chain of events.

Developer Ready Infrastructure
Enabling rapid development is key to reduce time to market.

We believe that the decision making process can be assisted and will benefit from maturity in other solutions domains. The five solution domains that we think relevant are:

• *Multi-Cloud*
• Software Defined Networking, Software Defined Wide Area Network, and Network Function Virtualization
• *DevOps* and *Site Reliability Engineering*
• Blockchain
• Developer Ready Infrastructure, or what is also sometimes referred to as Developer Cloud

Some of these may not be entirely necessary, such as blockchain, but we'd still encourage an evaluation.

Since IoT and analytics is built on, consumes from and brings together many IT solutions, we believe success of IoT and analytics implementations is directly affected by the strength of foundations that an organization has in DevOps, SRE, Multi-Cloud, Software Defined Networking, and Developer Ready Infrastructure.

VMware offers products and services in these areas and for the most part customers aren't restricted to consuming products and services from VMware. We'll work with you to implement an architecture that is best suited to your needs, agnostic of vendors.
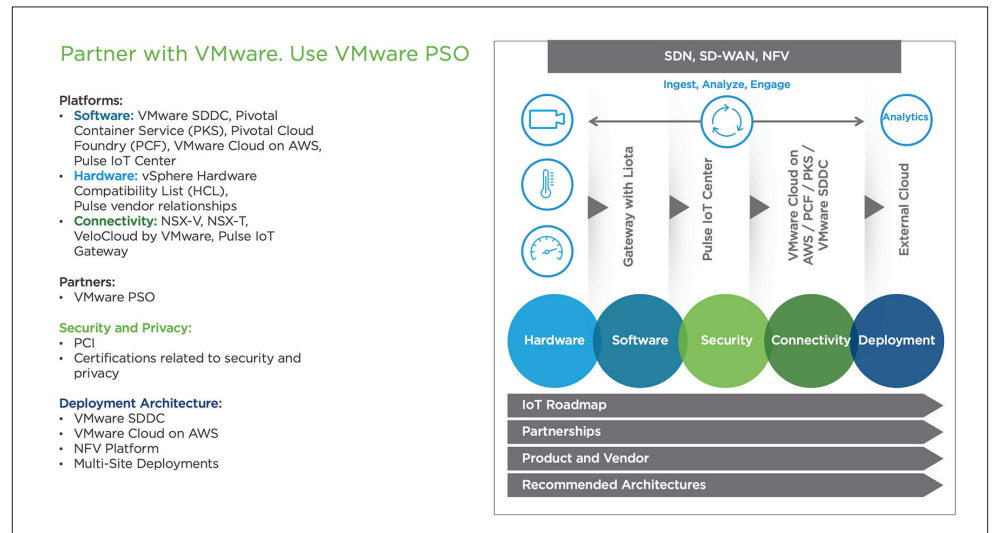
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Underpinning Foundations

High-level decisions take us one step closer to IoT solution architectures. Each high-level decision, whether that be a choice of platform, product or standard needs to be underpinned by four key things. These are:

• Product roadmaps

• Product and vendor selections

• Industry partnerships

• Recommended architectures

Surveys by IDC have found that many organizations choose a professional services partner to assist with understanding and implementing IoT and analytics solutions. Surveys also find that customers prefer using professional services partners that are also product vendors.

Partner with VMware for IoT

At VMware we'd like customers to choose our products and us as a professional services partner to implement their IoT and analytics solution.

We bring:

• IoT roadmap for VMware products

• Compatible, supported and verified vendors and products

• Industry partnerships

• Reference architectures, recommended architectures and solution architectures for customer specific use-cases

These support and underpin the five high-level decisions enabling solutions and implementations.

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Call to Action

Since IoT and analytics is at an early stage of adoption, we recommend the following:

- **Engage** with your account team in IoT conversations. They'll get the right people involved to help you think through use-cases relevant to your business.
- **Partner** with Professional Services Emerging Technologies to identify opportunities, technologies and challenges associated with implementing an IoT solution. IoT is supported by at least five key decisions that are inter-dependent.
- **Focus** on use-cases where ROI is easily quantifiable. Today, this is around cost saving and increasing efficiency internally.
- **Establish** a constant line of communication with your account team and Professional Services Emerging Technologies. Work with us on Proof of Concepts relevant to your organization.
- **Re-Engage** with us after consuming our blog posts, white-papers, high-level architecture, and product expertise. Introduce your technologists to architects working with DevOps, Multi-Cloud, SDN/SD-WAN/NFV, SRE, Developer Cloud (or Developer Ready Infrastructure), and Blockchain.

References

Airbiquity. (n.d.). Multi-ECU Over-the-Air Software Updates for Connected Vehicles. Airbiquity. Retrieved from *https://www.airbiquity.com/application/files/3914/ 8961/0533/Airbiquity-ST_SDM_Solution_Collateral.pdf*

Entner, R. (2015). 2014 US mobile phone sales fall by 15% and handset replacement cycle lengthens to historic high. Recon Analytics. Retrieved from *http://reconanalytics. com/2015/02/2014-us-mobile-phone-sales-fall-by-15-and-handset-replacement-cycle- lengthens-to-historic-high/*

Fuller, S. L. (2017, September 7). Honeywell Starts Drone Inspection Service Using Intel System. Avionics. Retrieved from *http://www.aviationtoday.com/2017/09/07/ honeywell-starts-drone-inspection-service-using-intel-system/*

Greenough, J. (2015, August 5). Auto insurers are using the Internet of Things to monitor drivers and cut costs. Business Insider Australia. Retrieved from *https://www.businessinsider.com.au/iot-is-changing-the-auto-insurance-industry- 2015-8?r=US&IR=T*

Kuang, C. (2015, March 10). Disney's $1 Billion Bet on a Magical Wristband. Wired. Retrieved from *https://www.wired.com/2015/03/disney-magicband/*

Leswing, K. (2017, June 16). Amazon is buying Whole Foods — here's Amazon's vision for the grocery store of the future. Business Insider. Retrieved from *http://www.businessinsider.com/amazon-go-grocery-store-future-photos-video-2017-6*

MacGillivray, C., Torchia, M., Siviero, A., Wallis, N., Kalal, M., Turner, V., … Bisht, A. (2017). Worldwide Internet of Things Forecast, 2017–2021. International Data Corporation. Retrieved from *https://www.idc.com/getdoc.jsp?containerId=US43087717*

Maddox, T. (2015, November). The world's smartest cities: What IoT and smart governments will mean for you. Tech Republic. Retrieved from *https://www.techrepublic.com/article/smart-cities/*

Marr, B. (2017, February 7). IoT And Big Data At Caterpillar: How Predictive Maintenance Saves Millions Of Dollars. Forbes. Retrieved from *https://www.forbes. com/sites/bernardmarr/2017/02/07/iot-and-big-data-at-caterpillar-how-predictive- maintenance-saves-millions-of-dollars/#513e14617240*

Rio, R. (2015, November 12). Industrial IoT Helps Prevent Costly Unplanned Downtime at BHP Billiton. ARC Advisory Group. Retrieved from *https://www.arcweb.com/blog/ industrial-iot-helps-prevent-costly-unplanned-downtime-bhp-billiton*

Sage, A., & Orlofsky, S. (2017, May 19). Ford using first over-the-air software updates to its 2016 cars. Reuters. Retrieved from *https://www.reuters.com/article/us-ford-motor- software/ford-using-first-over-the-air-software-updates-to-its-2016-cars- idUSKCN18F2BJ*

Shah, A. (2016, June 1). The PC upgrade cycle slows to every five to six years, Intel's CEO says. IDG News Service. Retrieved from *https://www.pcworld.com/article/ 3078010/hardware/the-pc-upgrade-cycle-slows-to-every-five-to-six-years-intels- ceo-says.html*

Silverman, L. (2017, August 22). "Smart" Pill Bottles Aren't Always Enough To Help The Medicine Go Down. National Public Radio. Retrieved from *https://www.npr.org/ sections/health-shots/2017/08/22/538153337/smart-pill-bottles-arent-enough-to- help-the-medicine-go-down*

Stumpe, J. (2017, November). Drones to the rescue. Aerospace America. Retrieved from *https://aerospaceamerica.aiaa.org/features/drones-to-the-rescue/*

Turner, V., & MacGillivray, C. (2016). IoT Talks IDCs 2016 Global IoT Decision-Maker Survey Launch. International Data Corporation. Retrieved from *https://www.idc.com/ getdoc.jsp?containerId=WC20160922*

Turner, V., & MacGillivray, C. (2017). IoT Talks IDCs 2017 Global IoT Decision-Maker Survey Launch. International Data Corporation. Retrieved from *https://www.idc.com/ getdoc.jsp?containerId=WC20170928*

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