

VMWARE PULSE IOT SOLUTIONS

General Overview

Q. Why is VMware entering the IoT market?

A. VMware has been successfully managing our customers' digital transformation by being their trusted platform provider of choice for more than 500,000 customers globally. VMware started its journey by helping customers manage and optimize data centers with its world-class software and solutions. As technology evolved and enterprises changed how they do business, we evolved alongside and helped them optimize, manage and secure the edges of their workforce by providing tools and software to manage mobility. With the advent of the Internet of Things (IoT), we now want to help our customers through the next stage of their evolution. We see IoT as simply "new IT infrastructure" and hence it is a natural next step for us to go out to the edges of your business where this new IT infrastructure resides and help manage, monitor and secure it.

Q. Why can VMware win in this space?

A. We have multiple strengths that can help us become a leader in the market.

- **Established industry leader** – We are the enterprise infrastructure and data center leader and it is a natural evolution for us to extend those capabilities out to the edge to help develop new solutions that solve difficult, IoT "infrastructure-specific" problems.
- **Play to our technology strengths** – Our product's salient features play to our technological strengths of device management, software lifecycle management, infrastructure operational analytics, data orchestration and security.
- **Be relevant to both OT and IT buyers** – Our solution will be designed to cater to the needs of both the IT and OT organizations and the new "edge" development community.
- **Provide an end-to-end solution** – We are positioned to partner with established IoT players and capitalize on their industry vertical expertise to offer an end-to-end IoT solution all the way from the cloud to the edge.
- **Leverage our IT & Enterprise Grade brand** – VMware has strong brand recognition amongst C-level decision makers and since IoT is a strategic conversation, we can leverage our existing reputation to get a foot in the door.

- **Lead with the "Switzerland" approach** – VMware will help customers by enabling and managing whichever IoT infrastructure works for their customers' use cases, whether it is the hardware (things/gateways) at the far edge or the business application and IoT platform.
- **Support flexible deployments** – Most IoT solutions are betting on the cloud, but we know through our experience in the data center that the need for privacy and control, as well as rising costs drive the need for on-premises infrastructure at the edge which our IoT solutions will support.
- **Consistent IT Strategy** – By using VMware IoT solutions, customers can enjoy all the benefits of having the same infrastructure and software strategy from the edge, all the way to their data centers.

IoT Concepts

Q. What is the IoT Insight plane and the Infrastructure plane and the difference between the two?

A. A good way of looking at an IoT-ready architecture, is in terms of an Insight plane and an Infrastructure plane.

The *Insight plane* is where all the insight rich data from connected things is analyzed to drive business decisions, processes and use cases, whereas the *infrastructure plane* refers to the IoT infrastructure itself along with the capabilities to manage, monitor and secure the devices.

Usually, whenever the Internet of Things is discussed in the enterprise context, a lot of focus is given to the data generated from things and how it helps solve a particular use case (e.g., predictive maintenance). However, there is a whole IoT infrastructure layer underneath which does not get much mention but is integral to any IoT implementation. It is the infrastructure layer beneath which enables the insight layer. The infrastructure layer not only includes the IoT infrastructure itself (compute, storage and network needs) but also tools for operational analytics about the things, as well as the ability to manage and secure them.

The VMware Pulse™ family will offer solutions that fall under this category. Our IoT solutions and products help enable IoT infrastructure and make IoT real.

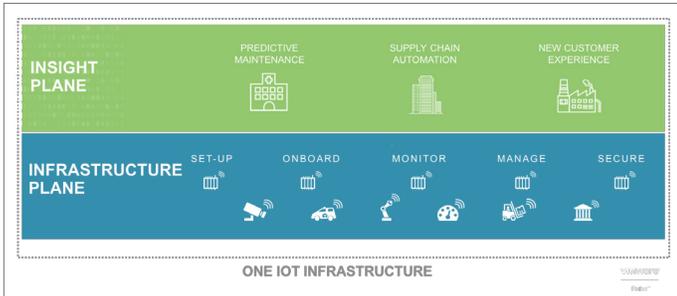


Figure 1

Product

Q. What is VMware Pulse?

A. VMware Pulse is a new family of IoT solutions by VMware which seeks to provide IoT management and infrastructure solutions for enterprises and help them solve the challenges of IoT management, security and scale.

Q. What is VMware Pulse IoT Center?

A. VMware Pulse IoT Center™ is a secure, enterprise grade, IoT infrastructure management solution that helps both IT (Information Technology) and OT (Operational Technology) to onboard, manage, monitor and secure their IoT use cases from the edge to the cloud.

Q. What are the key features of VMware Pulse IoT Center?

A. VMware Pulse IoT Center is an end-to-end IoT infrastructure management solution that enables OT and IT organizations to *onboard, manage, monitor and secure* IoT implementations.

Onboard

- **Highly scalable** – Supports hundreds of thousands of diverse edge systems and IoT connected devices such as sensors and actuators
- **On-premises support** – Offered as an on-premises solution for deployment flexibility and security; future versions will also be offered as cloud-hosted
- **Enterprise integrations** – Quick and easy integration with existing server-side monitoring and alerting capability through REST APIs along with flexible client-side integration through Python-based SDK

Manage

- **Edge device management** – Ability to support heterogeneous things and gateways with different

hardware, operating systems, and communication protocols

- **Single point console** – A single point of monitoring and management for the IoT infrastructure (across private networks composed of edge systems and connected devices) for both IT and OT users

Monitor

- **Infrastructure analytics** – Ability to identify anomalies with real-time monitoring and perform infrastructure analytics
- **Visualize relationships between things and gateways** – Provides pictorial representation of the topology of the IoT infrastructure—2-tier or 3-tier—in a parent-child relationship diagram

Secure

- **OTA updates** – Ability to provide over-the-air updates to connected edge systems and things
- **Security at all levels** – Secure onboarding, authentication and ongoing authorization
- **Contain Threats** – Ability to enterprise wipe the managed object

Q. What are the different components of VMware Pulse IoT Center and where do they sit?

A. Pulse IoT Center is comprised of two primary components:

A management console (server-side)

The Admin Console component sits in the datacenter or private/public cloud and includes the following set of services:

- Admin Console for dashboard and setting alerts and notifications
- APIs for enterprise integrations and extensibility
- Infrastructure Monitoring module for alerts and symptom configuration
- OTA software lifecycle management, onboarding and configuration
- eMQTT Broker for collecting telemetry from various gateways and other edge systems

An agent (client-side agent, Liota is the open source project)

The client-side component includes:

- An open-source SDK that can be customized to interface

with and ingest telemetry from any edge systems or connected things

- An agent that delivers data samples from devices to the server and receives packages, such as configuration changes and software updates

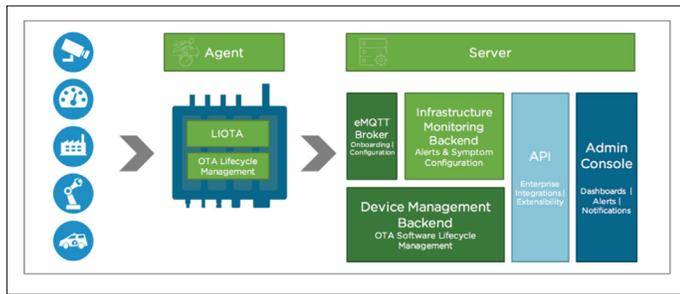


Figure 2

Q. What is Project Liota and how does Liota relate to VMware Pulse IoT Center?

A. Liota (Little IoT Agent) is a vendor-neutral, open source SDK for building IoT gateway applications for managing, monitoring and orchestrating data between things, gateways and the cloud/data center. Liota is the client side module for VMware Pulse IoT Center which resides on edge gateways or embedded “things” and transmits data to the VMware Pulse IoT Center console back in the cloud/data center.

Q. How scalable is Pulse IoT Center?

A. The solution will scale to hundreds of thousands of edge systems, gateways and IoT connected devices such as sensors and actuators. This capability will be expanded to millions and up in future product releases.

Q. How do we offer IoT Center—SaaS, On Prem?

A. This solution is initially available only for on-premises deployments. If customers show interest in SaaS, we plan to work with partners to deliver it as a SaaS offering.

Q. What types of connected devices or “things” are supported? What types of edge systems or gateways are supported?

A. The Pulse agent is installed on edge systems, gateways or IoT devices that have operating systems. Simple devices, such as sensors, that do not have an operating system would typically not have the agent installed. However, sensors are managed “by proxy” since these

simple devices are connected to a gateway or edge system. Due to the open-source Liota component, most edge systems with a Python interpreter are supported.

Q. What are VMware Pulse IoT Center’s security features?

A. VMware Pulse IoT Center has the following built in security features:

Secure Onboarding (asset discovery, profiling and tracking)

- A unique username/password is used to enroll each gateway.
- A preassigned passphrase is used to decrypt enrollment staging package.

Contain Threats

- Use enterprise wipe to protect data from a compromised gateway/edge system.
- In a future release, Pulse will provide the ability to quarantine a gateway/IoT device for further investigation without impacting the operation of other connected things.

Authentication and authorization for ongoing communication

- Each gateway uses authorized Access Control Lists for communicating with the server to reduce spoofing.
- Utilizes HMAC Token for device session authentication for continued communication with the server.

Network Security

- SSL certificate encryption (TLS) - TLS encryption for server to server and client to server network communication
- Future versions will incorporate micro-segmentation support with VMware NSX® integration.
- Active, real-time threat detection in partnership with 3rd party solutions.

Automated monitoring, detection and response

- Secure content delivery - IoT apps, firmware or software patches/updates
- Over the Air updates on secure channels

Q. What other products are upcoming in the Pulse family?

A. Gartner predicts by 2022, 75% of enterprise generated data will be created and processed outside the data center or cloud, up from just 10% today. For this to

happen, edge devices must have compute and storage capabilities to power edge analytics, which the majority of things and sensors, such as smart cameras, smart lights, smart meters etc., do not have. This is where hyper-convergence at the IoT Edge can come in and be a game changer.

Our second upcoming offering from the VMware Pulse family takes the highly successful concept of virtualization in the datacenter and brings it to the edge in the form of Project Fire.

Project Fire is a pre-packaged, pre-validated turnkey solution to help you get started with your edge computing. It brings together all the benefits of hyper-convergence to the edge in one neat package along with the capabilities to do analytics (infrastructure and insights) on the hardware of your choice that suits your use case and environment. Project Fire is purpose built to provide you an efficient and secure IoT infrastructure which is easy to manage, scale and update so that you can get started with your IoT initiatives quickly and realize ROI faster.

Project Fire consists of the following components:

- **VMware Pulse IoT Center** to manage, monitor and secure all your heterogeneous edge systems and connected devices, identify and act on anomalies as they occur and provide complete software lifecycle management.
- **Third-party Business Analytics starter kit** (in partnership with industry leaders) to help you with your content analytics and help drive business decisions with valuable and timely insights. You can also opt to use your existing content platform based on your unique use case.
- **VMware Cloud Foundation**- Any kind of computing capability requires storage, network and compute power. VMware Cloud Foundation™ brings together VMware's enterprise grade compute, storage, and network virtualization through VMware vSphere®, vSAN™, NSX and SDDC Manager™ (lifecycle management) into a natively integrated stack.
- **Gateway/Server of your choice** - Again based on your use case, environment and desired ruggedness, you have the flexibility to choose what hardware runs VMware IoT Edge™.

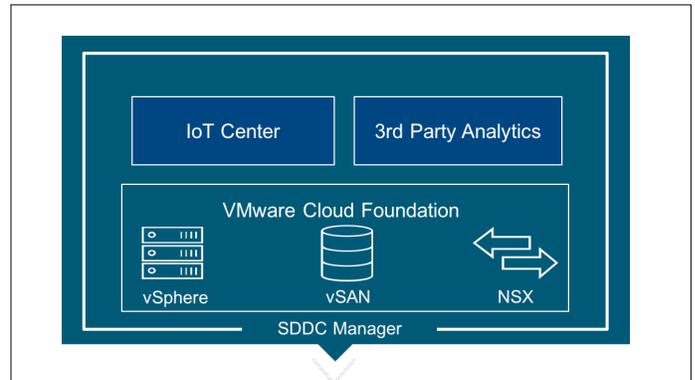


Figure 3

Field Sales

Q. How is Pulse different from AirWatch?

- A. As we got deeper into the enterprise IoT challenges, we realized very quickly that Enterprise Mobility Management products as-is do not meet requirements for many IoT use cases. VMware saw the need to have a truly dedicated IoT management product which catered to the unique challenges of an IoT infrastructure.
- **Support for 3-tier architecture** - We believe that the 3-tier architecture (simple device > gateway > data center) will be prominent in IoT use cases - which means the edge systems or gateways need to be managed along with the connected devices. This child/parent relationship (simple device > gateway) is something current EMM solutions typically cannot address.
 - **Heterogeneity of gateways and things** - VMware has found that an enterprise typically will not have the same types of gateways for different use cases. So over time an enterprise might have three dozen or more gateway types- typically Linux based, and hundreds of different connected IoT devices. For this reason, it is essential to have an open-source, customizable agent to collect telemetry from various sensors, cameras, robots and other devices.
 - **IoT Scale** - Typical EMM use cases may reach tens of thousands of devices - or maybe hundreds of thousands of devices for a few of the largest organizations. However, as enterprises add gateways and IoT use cases, the number of devices increases exponentially—easily reaching millions to hundreds of millions of devices. The device management system must scale to hundreds of millions of devices, which is what VMware is working on now.

- **Remote and continuous management** - Most IoT devices are unmanned and require real-time monitoring to determine if they are working properly. For example: sensors in oil wells, on facility ceilings, inside machines, on cranes, in jet engines, etc. Just as VMware monitors the data center, we will now monitor all devices as part of our new VMware Pulse IoT Center product.
- **OTA software lifecycle management** - Finally, there must be a reliable method to maintain the software lifecycle on all IoT devices - whether those devices have operating systems or not (like "simple" sensors). This is a key requirement to maintain the security of the systems. There must be a method to apply security patches to various components, add new functions or features, add new devices, or add new software or apps to gateways - all over the air so that Operations is not required to visit each physical device. Most importantly, the device management system must have awareness of which gateways proxy the management of which connected devices.

Partners

Q. Who are the partners and why are they important?

A. Implementing an IoT solution today is a huge challenge for enterprises, as they often need to cobble together offerings from various vendors with few standards and little guidance. VMware and its rich partner ecosystem take the guesswork out of IoT implementation decisions to help customers address complex IoT use cases across multiple industries. For this purpose, VMware is forging IoT-related alliances with the following kinds of partners to bridge the gap between the IT and OT worlds and deploy an end-to-end IoT solution from the device to the data center.

Our partners represent different components of the IoT ecosystem and can be broadly classified as the following:

THING/OEM MANUFACTURERS

Hardware considerations are critical to the success of an IoT deployment. It is important to consider which sensors fit your use case and if you will need on-prem aspects to the deployment - either at the location of the IoT use cases or in a private data center. Some use cases will require solar powered edge systems or hardware specifically made for more rugged, outdoor or refrigerated environments since most of the things will reside in remote, unmanned areas. Our partner manufacturers of embedded systems will offer VMware IoT

software as part of their industry-specific solution bundles. VMware has partnered with a range of global market leaders to ensure solutions are available for a wide range of industry-specific applications.

Examples: Dell, ABB, Zebra, V5 Systems

GATEWAY/EDGE SYSTEM MANUFACTURER

With the advent of the 3-tier architecture (thing→gateway→edge system→cloud), gateways and other edge systems have become a major component of any IoT ready architecture. These gateways do a lot of the heavy lifting for the things connected to them like storage and edge analytics, integrate protocols for networking, and facilitating data orchestration securely between edge devices and the cloud.

VMware has selected gateway manufacturers that cater to specific use cases as well as broad offerings to provide a great selection for our customers.

Examples: Dell, ADLink, Eurotech, Harman, Samsung

SYSTEMS INTEGRATORS

Global leaders in systems integration will have a critical role in the design and implementation of many IoT projects. These projects will require expertise across a wide range of information and communications technologies and the ability to execute at scale and, in many cases, across multiple locations. VMware has partnered with a select group of market leaders who will embed VMware's IoT solutions into their recommended architectures.

Examples: Deloitte, Tech Mahindra, Wipro, ATOS, Fujitsu, Harman Connected Services

BUSINESS APPLICATIONS & ANALYTICS

Tools for analyzing and extracting value from the data generated by connected things will be essential to maximizing the benefits of any IoT implementation. VMware has partnered with leading global players whose expertise spans the gamut of industry sectors.

Examples: VizExplorer, SAP, IBM

IoT PLATFORM VENDORS

Sitting at the heart of IoT infrastructure, IoT platforms play a crucial role ensuring seamless integration of

different IoT hardware devices and IoT applications that support analysis, data visualization, etc. VMware has partnered with global companies whose IoT platforms are market leading across key industry verticals. Together we will offer IoT starter kits that are industry and use case specific and on-prem solutions delivered directly to the factory floor, hospital, oil rig or power plant and significantly reduce the time it takes for customers to deploy IoT. These packaged solutions will include VMware IoT solutions to manage, monitor and secure a variety of IoT edge systems and connected devices as an integrated component of the IoT Platform. These packages will also include VMware's hyper- converged infrastructure software to save time, effort and cost to deploy IoT.

Examples: PTC ThingWorx, Fujitsu, SAP, IBM

Additional Information

Where can I learn more?

- [IoT Blog](#)
- [Website](#)

