VERTIV.

THE INSIDE-OUT APPROACH

Enabling an Open,
Scalable Data Center IoT

The Next Wave of Disruption

With an impact that extends from transportation to healthcare to manufacturing and just about every other industry, the Internet of Things (IoT) is garnering an increasing amount of attention. Goldman Sachs called IoT the "next mega-trend," and wrote that: "The global industrial sector is poised to undergo a fundamental structural change akin to the industrial revolution as we usher in the IoT."

Yet there are questions as to how quickly that can happen. Gartner had IoT at the Peak of Inflated Expectations in its 2015 Emerging Technologies Hype Cycle with a five-to-ten year projection to the Plateau of Productivity.

This is understandable considering the challenges that must be addressed, including enabling legacy devices for connectivity, bridging disparate communication protocols, acquiring network and storage capacity, ensuring security and reliability, and implementing applications that deliver value and tangibly improve operations.

Despite these challenges, a wait-and-see attitude may be more risky than moving forward considering the breadth of applications and potential value of IoT to the business. The key is to move forward intelligently . There is an opportunity today for IoT to deliver a measurable return on investment using the right approach in the right application.

> "The global industrial sector is poised to undergo a fundamental structural change akin to the industrial revolution as we usher in the IoT."
>
> **– GOLDMAN SACHS**

The right approach involves working from the inside of the IoT framework out. The right environment is the data center, which is the most fertile and IoT-ready setting in many organizations.

The Inside-Out Approach

An IoT framework must support three high-level activities in relation to data: create, communicate and consume. Different organizations slice these tasks slightly differently in their IoT frameworks, delineating anywhere from five to seven layers. Vertiv™ uses the six-layer model shown in Figure 1.

While much of the discussion around the challenges associated with IoT has been focused on the bottom layer (where data is created) and the top layer (typically a cloud-based management platform), the middle or "inside" of the IoT framework is where success will be forged. These inside layers provide the scalability required to manage the volume of data being generated and the responsiveness to act on that data in real time.

This realization may be more important in the data center than in other IoT applications. While some IoT applications will require significant investments to implement devices that generate the necessary data, the devices in the data center are already creating a robust data set through sensors embedded in servers, switches, storage devices and infrastructure systems. The challenge is accessing and consolidating that data.

Likewise, many potential IoT applications lack software platforms capable of using device data in ways that deliver value to the business. The data center is maturing quickly at the top of the IoT framework with management suites such as data center infrastructure management (DCIM), application performance monitoring and IT service management (ITSM) offering significant productivity, availability and efficiency benefits when they have real-time visibility into relevant operating data.

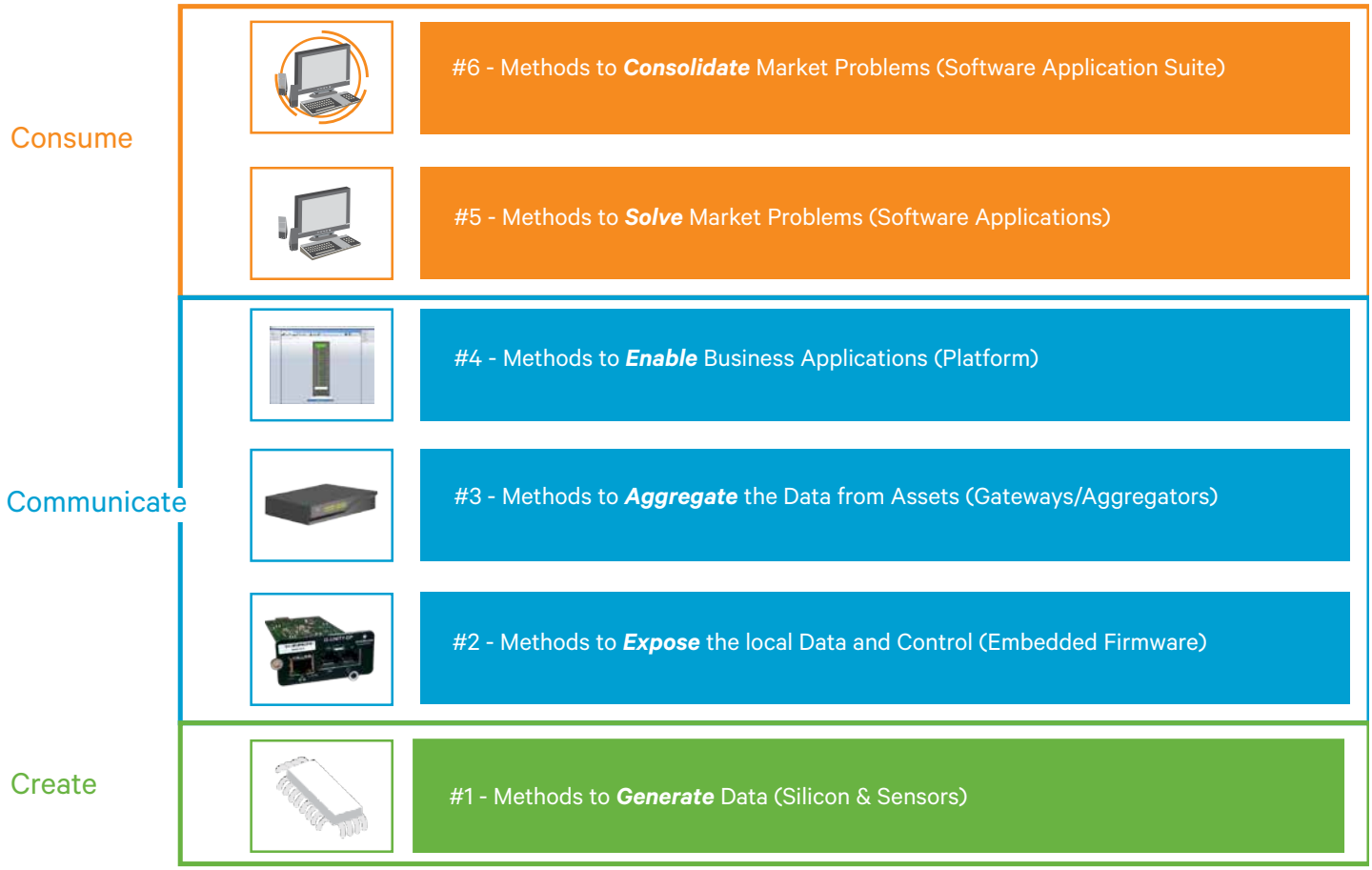

Figure 1: *A six-layer framework for supporting IoT data creation, communication and consumption.*

These inside "communicate" layers provide the scalability required to manage the volume of data being generated and the responsiveness to act on that data in real time.

The challenge—and opportunity—in the data center, then, exists primarily in the middle three layers where data is collected, aggregated and enriched in ways that enable more effective device control and top-level management.

The inside-out approach addresses this challenge using open specifications and application program interfaces (APIs) in concert with mid-level collection engines and gateways to enable machine-to-machine communications while providing secure, relevant data for management. Building out these layers is the key to unlocking the value of the data in one of the most data-rich IoT environments imaginable.

That requires navigating both the volume of data being generated and the variety of protocols in use. Due to their sensitivity and need to be always-on, IT devices in the data center are inherently dependent on the infrastructure support systems in the buildings in which they operate.

These various types of IT devices coexist with multiple facility systems that use completely different communication protocols. The result is a "Tower of Babel" is which data that could be used to drive operational improvement, if it is even collected, is not translated into a form or put into context in a way that allows it to be used.

"The value of DCIM depends on its ability to aggregate large amounts of real-time data from all areas of the data center. APIs that enable the interoperation of functions between many different sources of data and management solutions are essential to a successful DCIM implementation."

– JENNIFER KOPPY

Activating the Data Center IoT

Figure 2 shows the Vertiv™ data center management framework, which addresses layers two through six of the IoT framework. The success of any management framework is as dependent on how information is moved between each layer as it is on what happens within the layers. The data center is no exception.

The **device communications framework** and **data collection engine** layers work together to access and consolidate data locked within data center devices. These layers are enabled by Redfish, a new open specification for device communication.

The intelligent platform management interface (IPMI) protocol historically used by service processors to communicate server operating data has proven inadequate to support effective device communication in the modern data center. As a result, two leading developers of service processor firmware, Vertiv and HP, led an industry-wide effort to develop a new specification. This initiative, which included Dell, IBM and Intel, created the Redfish specification, a true open standard to enable out-of-band device communication. Now under the management of the independent Distributed Management Task Force, Redfish is being embedded in the current generation of servers and is being adopted by switch, storage and infrastructure manufacturers.

Over the next several technology refresh cycles, Redfish is expected to become the common language in the data center and has the potential to extend to devices outside the data center. In the interim, it serves as a standard that can be used within the middle layers of the IoT framework to resolve protocol conflicts. Standardizing on Redfish within the collection engine allows data to be normalized across devices and moved up the stack for use by the application framework and application suite. This allows data from interdependent devices using different protocols, such as servers, power distribution units, and environmental sensors, to be consolidated, normalized and communicated to the layers above and below the collection engine.

The **application framework** is where collected and aggregated data can begin to be used to drive business value. The use of the Representational State Transfer (REST) and JavaScript Object Notation (JSON) formats to communicate between layers provides a familiar, open architecture that allows applications to take advantage of new technology while leveraging skill sets that already exist within the IT organization. Open architectures provide greater flexibility in how software is tailored to the application and eliminate the risk of getting locked into a proprietary, single-vendor architecture.

This middle layer of management supports the application suite and provides system- or location-based management and control. For example, effective thermal management requires input from multiple sensors across the data center and coordination of room- row- and rack-level thermal management systems. A thermal management application operating beneath the **application suite** layer can consolidate data from all relevant sensors and devices to coordinate the operation of thermal management units to ensure they work together to precisely control environmental conditions and maximize the role of energy-saving technologies such as economizers.

The most pertinent data is delivered through an API to the application suite where it can be viewed in relation to data from other applications and systems.

DCIM has emerged as a solution for organizations seeking to gain enterprise-wide visibility into device location, utilization and performance. However, closed DCIM systems create a limited, proprietary platform within the data center that doesn't support the open, scalable approach required for an effective IoT deployment.

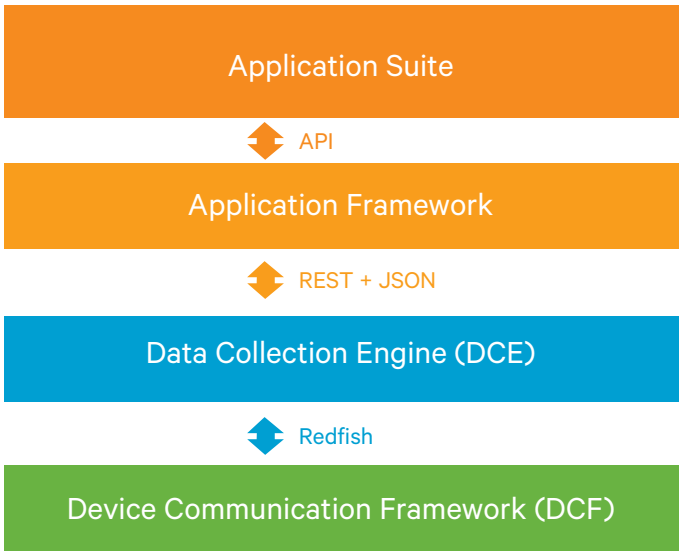

Figure 2: *The management framework that supports the top five layers of the IoT framework*

An open DCIM system, capable of integrating vertically with mid-level applications and horizontally with top level applications, such as IT system management, provides the real-time visibility into resource utilization, available capacity, and costs required for informed decision making and more effective control. According to Jennifer Koppy, research director at IDC, "The value of DCIM depends on its ability to aggregate large amounts of real-time data from all areas of the data center. API's that enable the interoperation of functions between many different sources of data and management solutions are essential to a successful DCIM implementation."

DCIM platforms, such as Vertiv™'s *Trellis*™, are just one example of the management suites that can sit on top of the management stack and leverage the power of the layers beneath. Platforms such as ITSM and Application Performance Monitoring are also enabled by the standardized and filtered real-time operating data provided by the middle layers of the stack.

Thinking Inside the Box

Viewing the challenges of data center management in relation to the IoT framework helps to expose gaps in the management framework and provides a roadmap for moving forward.

In most cases, these gaps are in the middle layers of the IoT framework where data is consolidated and mid-level management is enabled. The IoT approach presented in this paper focuses on these middle layers—and communication across layers—by leveraging open specifications and new data center devices that aggregate and translate device data and provide mid-level management. This allows organizations to finally tap the rich data set trapped inside data center devices to optimize device, system and facility performance without being locked into proprietary protocols.

With an environment that is constantly changing and equipment refresh cycles ranging from 3-15 years, it's important to begin now to put the foundation in place for the data center IoT. The technologies are available today for that to happen. Using an inside-out approach to implementing IoT in the data center today enables more efficient operation and management of IT resources, ensures the foundation is in place as new equipment is introduced, and prepares the organization for enterprise-wide IoT adoption.

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