LEARNING MADE EASY

NIyte Special Edition

Integrated Data Center Management

for dummies®
A Wiley Brand

Improve capacity management

Reduce costs and energy utilization

Maximize uptime and availability

Brought to you by

NIyte® Software

Lawrence Miller

About Nlyte

Nlyte products help organizations digitally transform more efficiently and quickly by automating how they manage their workload infrastructure. Born out of the data center, Nlyte provides IT, facilities, business groups, and customers with monitoring, analytics, and management capabilities from the data center, to colocation, edge, and IoT infrastructures. Nlyte address several critical business needs:

- Data center critical infrastructure management
- Asset management
- Commercial and regulatory compliance
- Risk mitigation
- Improved automation, efficiency, and optimization of physical, virtual, and digital assets

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Table of Contents

Introduction

When it comes to smart buildings, data centers are arguably near the top of the collective "food chain." As buildings, data centers are unique in that they're already instrumented to provide vast amounts of data about the health and operational status of the facility's ecosystem. However, with thousands of intelligent devices constantly communicating telemetry data, all this instrumentation quickly becomes "noise" providing an incomplete and confusing picture of the data center's overall health.

A complete, actionable picture requires a software layer that can aggregate the entire computing fabric, turning those thousands of data points into meaningful information. Integrated data center management (IDCM) delivers that software solution to improve data center operations.

About This Book

Integrated Data Center Management For Dummies consists of five chapters that explore the following:

- The basics of IDCM and why it's needed (Chapter 1)
- The building blocks of IDCM (Chapter 2)
- Key use cases for IDCM (Chapter 3)
- How to get the most out of your IDCM solution (Chapter 4)
- The business benefits of IDCM (Chapter 5)

Each chapter is written to stand on its own, so if you see a topic that piques your interest, feel free to jump ahead to that chapter. You can read this book in any order that suits you (though we don't recommend upside down or backward).

Foolish Assumptions

It's been said that most assumptions have outlived their uselessness, but we assume a few things nonetheless.

Mainly, we assume that you're an IT or facilities executive, director, or manager involved in data center operations. As such, we assume you understand and have experience working with building management systems (BMSs) and/or data center infrastructure management (DCIM).

If any of these assumptions describes you, then this is the book for you! If none of these assumptions describes you, keep reading anyway — it's a great book, and after reading it, you'll know how IDCM can help you improve capacity management and energy utilization, reduce costs, and increase uptime for your organization's critical data center operations.

Icons Used in This Book

Throughout this book, we occasionally use special icons to call attention to important information. Here's what to expect:


REMEMBER

The Remember icon points out important information you should commit to your nonvolatile memory, your gray matter, or your noggin — along with anniversaries and birthdays!


TECHNICAL STUFF

If you seek to attain the seventh level of NERD-vana, perk up! The Technical Stuff icon explains the jargon beneath the jargon and is the stuff legends — well, legendary nerds — are made of.


TIP

Tips are appreciated, but never expected, and we sure hope you'll appreciate these useful nuggets of information.


WARNING

These alerts point out the stuff your mother warned you about — well, probably not, but they do offer practical advice to help you avoid potentially costly or frustrating mistakes.

Beyond the Book

There's only so much we can cover in this short book, so if you want to learn more check out `https://nlyte.com`.

IN THIS CHAPTER

- Bringing data centers to the forefront of business operations
- Addressing efficiency, resiliency, and flexibility mandates
- Discovering integrated data center management

Chapter 1
What Is Integrated Data Center Management and Why Do You Need It?

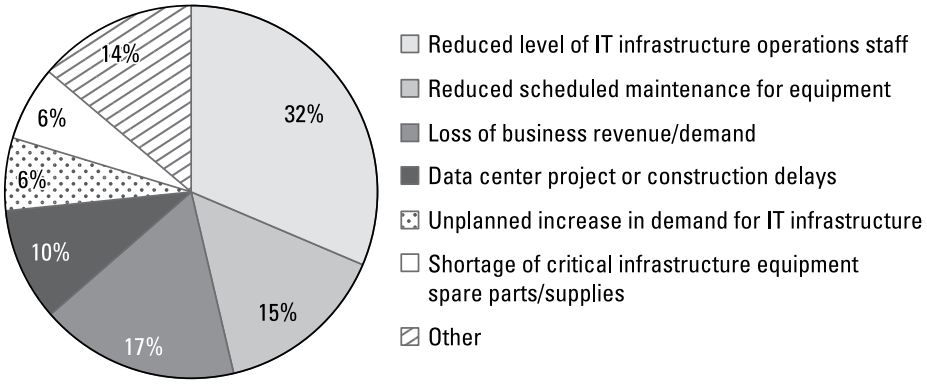
In this chapter, you see how data centers have become the nerve center of business operations in our modern digital economy. You discover the three key challenges of data center management for data center operators and facilities managers, and how an integrated data center management (IDCM) solution brings together different facilities and IT disciplines to deliver better outcomes.

Recognizing the Business-Critical Role of the Data Center

In today's digital economy, data centers are more critical than ever to business operations. Evolving data center requirements, such as supporting virtualized workloads and hybrid/multi-cloud

integration, adds complexity and underscores the need for efficiency, resiliency, and flexibility.

Even the recent global pandemic has had a significant impact on data center operations due to fewer on-site IT and facilities personnel, deferred equipment maintenance and upgrades, and increased IT infrastructure load from remote employees, among others (see Figure 1-1).



Source: Uptime Institute Survey: COVID-19 Impact on Data Centers, April 2020

FIGURE 1-1: The impact of COVID-19 on data center operations.

For years, IT and facilities teams have sought a solution to the challenge of achieving and maintaining end-to-end visibility in their data centers. The "holy grail" for these teams is a single pane of glass that provides a consolidated view of every aspect of facilities and IT data center operations, with contextual information that is relevant to a broad range of audiences. Unfortunately, this single-pane-of-glass panacea has proven more elusive than anyone may have imagined. Different skill sets, job functions, and daily needs, among other challenges, has made the development and maintenance of a single tool that addresses all issues for everyone a veritable impossibility.

Instead, vendors have developed discrete systems for monitoring critical infrastructure or IT equipment and applications with distinct feature sets. These systems include building management systems (BMSs), data center infrastructure management (DCIM), network performance monitors, workflow engines, and so on. This specialized focus has created excellent solutions to address unique challenges for specific audiences, but not for all.

Rather than a single pane of glass, perhaps what's needed is a single frame with interchangeable lenses to suit a variety of

purposes: a pair of Victorian steampunk goggles, if you will (see Figure 1-2). The frame is common to all operators, regardless of focus. The frame comprises components like the underlying system architecture, data ingestion, data storage, and analytics capabilities. The lenses are interchangeable interfaces that provide the desired view or expected result for different operators. For example, an intelligent chiller provides information to any system (such as a BMS and a DCIM) that can ingest the data it sends out (the "frame"). However, the operators of these systems have different needs for how they view and use the data (the "lenses"). Collectively, the frame and different lenses offer a single integrated view of the entire environment for a variety of audiences and purposes.

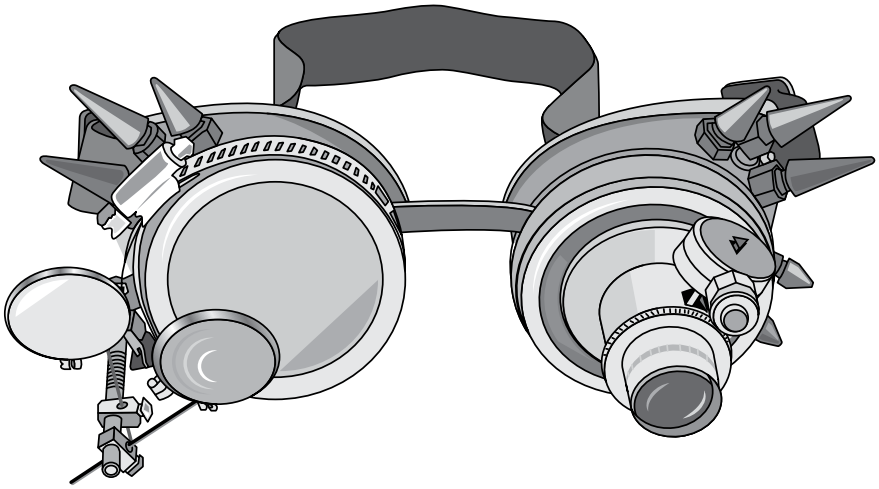


FIGURE 1-2: Victorian steampunk goggles provide many lenses for different purposes in a single frame.

Addressing Data Center Challenges

As businesses increasingly rely on their data centers to deliver critical business applications, data center operators and facilities managers are relentlessly challenged to address three mandates: Find operational efficiencies, increase resiliency, and ensure flexibility.

Efficiency

Finding operational efficiencies in the data center has become more challenging and more important than ever with the advent of the cloud. As organizations adopt cloud-first strategies and

migrate on-premises data center workloads to the cloud to lower costs (both capital and operating), operational efficiencies in the data center resulting from economies of scale are reduced, which, in many cases, increases pressure to migrate additional workloads to the cloud. At the same time, many business-critical workloads still run in on-premises data centers. These workloads may need to remain on-premises or near the edge for security or performance reasons, so finding operational efficiencies in the data center remains a high priority.

To improve capacity management, reduce costs, and increase energy efficiency, data center operators and facilities managers need integrated tools that provide a holistic yet granular view of the symbiotic relationship between data center facilities, critical infrastructure, and individual workloads. With a more complete picture of the data center environment, data center operators gain a better understanding of the impacts of workload migrations and can work together with facilities managers to ensure operational efficiencies are identified and maintained in a dynamic environment.

Resiliency

Ensuring that business-critical workloads are not impacted when critical infrastructure failures occur is vitally important in data centers. Essential applications and their associated workloads can experience outages from physical security issues, poor visibility into the data center's operating state, and various other issues. However, the tools traditionally used to manage data centers and the equipment and workloads in them, although useful, are myopic.

To maximize application availability, the various and disparate systems that comprise the data center management ecosystem must work together in perfect harmony. A single weak element in the ecosystem can create pandemonium and unplanned downtime, costing businesses millions of dollars in just minutes. Understanding the downstream impact of an individual chiller, all the way down to a physical server and the workloads and virtual machines in the data center is essential.

A COOL CASE FOR ARTIFICIAL INTELLIGENCE

A chiller is a critical piece of the cooling chain in a data center, ensuring proper operating temperatures for IT equipment. A chiller provides a beacon, constantly sending out large amounts of data about how it's performing and potential alarm conditions. As with so many intelligent communicating pieces of equipment across the critical infrastructure, much of the data is often ignored because it's considered superfluous to the actual needs of an operator. With all the various communicating devices and the cacophony of data they produce, the output is just noise to human operators and incomprehensible to sort through it in any meaningful way.

This enormous data set, however, is perfect for artificial intelligence (AI) and machine learning (ML) applications. In the AI/ML framework, every data point can be assessed to help predict operating state and failures and even prescribe recommended improvements.

Flexibility

Before the cloud, enterprise data center footprints rarely, if ever, shrank. Inevitably, more systems — including servers, storage, and networking — were added or upgraded every year to support an ever-growing portfolio of applications. Although system upgrades often touted "energy efficiency" benefits, this simply meant that performance-hungry applications and users could have more of everything: more processors and memory, more storage capacity, and more network bandwidth. Thus, data centers continued to grow.

Today, data center footprints can, and often do, shrink and grow throughout the year. As workloads are migrated to the cloud, server and storage equipment is often decommissioned, repurposed, or simply shut down. Cloud workloads are sometimes moved back to an on-premises data center for performance or security reasons, among others. And vacant data center floor space may be reconfigured and repurposed.

WARNING

An often cited "benefit" of migrating workloads to the cloud is lower operating expenses (that is, less power and cooling), but rarely, if ever, is this benefit quantified and validated. Although it may seem intuitive that less equipment means less power and, therefore, less heat generation, this is not always the case. For example, maintaining proper airflow between "hot" aisles and "cool" aisles in a data center is critical to maximizing energy efficiency.

Without the proper data center management tools and clear communication between data center operators and facilities managers, this newfound flexibility in data centers can quickly become a liability.

Defining Integrated Data Center Management

The challenges faced by today's data center operators demonstrate the need for an advanced management solution that provides visibility and control of the data center building infrastructure and the critical elements and systems within the data center — a truly IDCM solution.

At its highest level, an IDCM solution provides deep integration between data-center-critical facilities infrastructure, the resources within the data center (such as servers, storage, network switches, and so on), and the application workloads running on those resources. Simply put, IDCM is a complete suite that brings together the capabilities and features of BMSs, DCIM, and IT operations (see Figure 1-3).

Ultimately, the vision of IDCM is focused on integrating and providing transparency between all the elements, assets, layers, and devices in and around the data center. In this way, components and systems can be managed with awareness and insight into how those elements affect the efficiency and service levels of the application workloads being supported.

Through this more in-depth integration, data center operators and facilities managers can make better decisions about maintenance, operations, and critical events in the data center. IDCM provides complete visibility of where servers are running, and what

devices, systems, and critical infrastructure support those workloads. With this data, organizations can perform better capacity management, increase the efficiency of existing resources, and perform more streamlined workflows and operations across all layers of the IT stack.

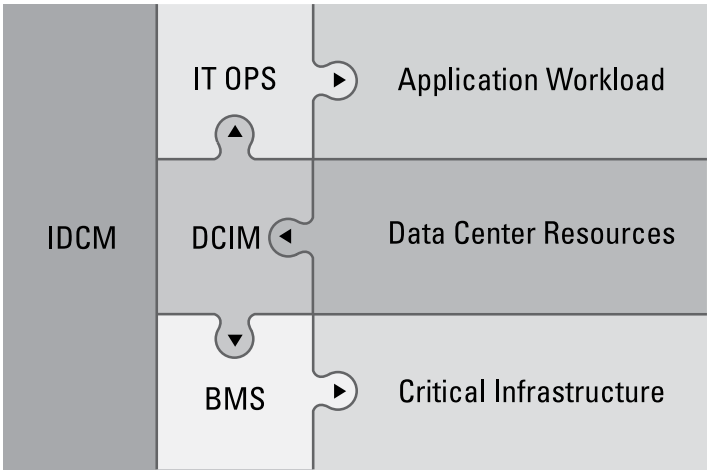


FIGURE 1-3: IDCM brings together the capabilities and features of BMS, DCIM, and IT operations.

REMEMBER

With expertise in IT asset management, critical power, and thermal management, as well as how that ecosystem affects application workloads, Nlyte is partnering with several building infrastructure vendors to bring IDCM to market and take data centers to the next level of efficiency, resiliency, and flexibility.

Here are the four primary goals of IDCM:

- Increase efficiency of power, cooling, and space by allowing critical infrastructure to reflect application behavior, such as idle periods or reduced loads.
- Improve effectiveness of facility and IT personnel by pinpointing change or maintenance effects throughout the computing environment.
- Reduce risk of outages or breaches due to poor capacity or asset management processes.
- Improve uptime and efficiency by simulating critical infrastructure in software for planning, operations optimization, and failure scenarios.

IN THIS CHAPTER

- Managing data center infrastructure
- Monitoring and controlling building systems
- Adopting critical infrastructure best practices
- Looking at your physical buildings
- Taking stock of IT assets
- Getting granular with individual workloads

Chapter 2
Exploring Integrated Data Center Management Building Blocks

In this chapter, you learn about the core building blocks of an integrated data center management (IDCM) solution. These include data center infrastructure management (DCIM), building management systems (BMSs), critical infrastructure, buildings, IT systems, and workloads.

Data Center Infrastructure Management

To effectively manage today's data centers, enterprise infrastructure and operations (I&O) teams require a complete suite of tools and solutions that provide the following capabilities across

BMSs (discussed later in this chapter), on-premises data centers, IT service management (ITSM), public and private clouds, and finance systems, among others (see Figure 2-1):

- Asset discovery
- Asset management
- Facilities insight
- Power management
- Machine learning
- Workload insight

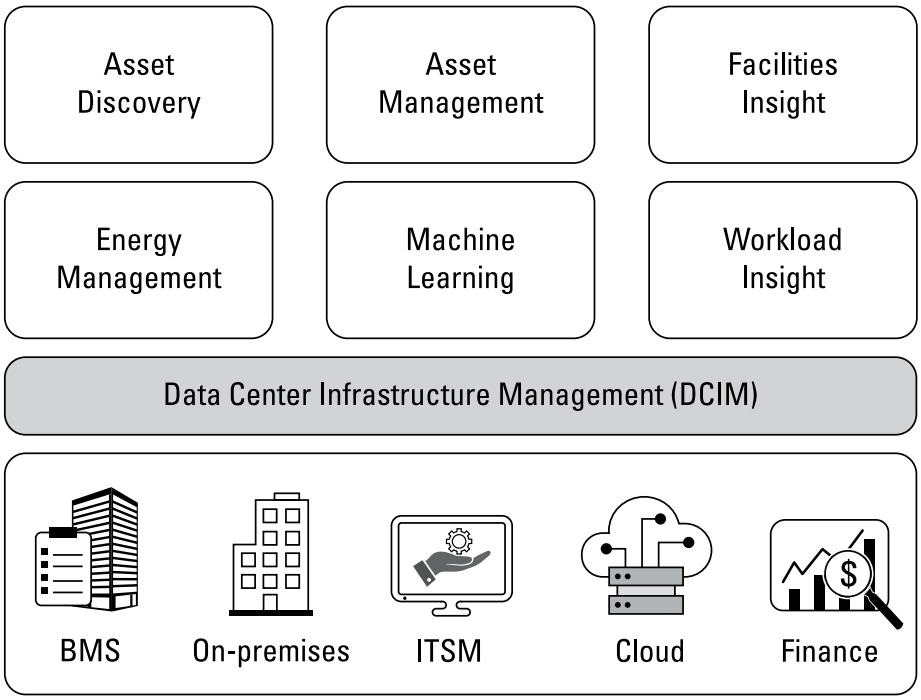


FIGURE 2-1: DCIM provides a complete suite of tools and solutions to manage data center infrastructure across different locations and systems.

Over the course of its evolution, DCIM has become a management extension to a number of other systems, including asset and service management, financial and human resource information systems (HRISs), and other core business systems. A well-designed DCIM solution quantifies the costs associated with moving, adding, or changing workloads on the data center floor or in the cloud to ensure optimal workload placement. It understands the cost and complexity of operation of those assets, and clearly identifies the value that each asset provides over its life span.

Figure 2-2 shows how DCIM stands between IT and facilities and joins them together. The physical assets of the facility, such as floor space, electrical power, environmental control, and cooling, are monitored and controlled by DCIM processes, which then interface with the virtual infrastructure overseen by the IT function. The DCIM suite provides an overview of system health and functioning, and also enables drilling down to any desired level of detail for fine-grained control of operations.

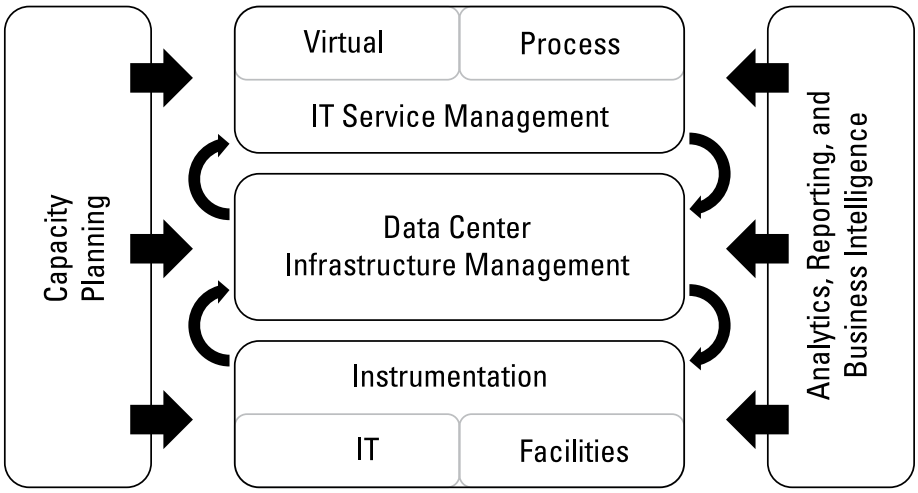


FIGURE 2-2: DCIM works with ITSM and other instrumentation to support capacity planning and analytics, reporting, and business intelligence.

Key capabilities and features of DCIM software include the following:

- **Asset life-cycle management**
  - Get detailed information about your assets and environment.
  - Manage information with robust dashboards and reporting.
  - Increase flexibility to work in any environment.
  - Provide support for receiving, provisioning, changes, tech refresh, and decommissioning of goods.
- **Capacity planning**
  - Visualize space, cooling, power network, connections, storage, and virtualization.

- Enable proactive versus reactive data center management.
- Predict data center life span with accuracy and confidence.

» Real-time data collection

- Track power, cooling, CPU usage, and alarms.
- Integrate real-time analytics leveraging artificial intelligence and machine learning.
- Report on detailed rack, server, and workload power and cooling metrics.
- Avert bottlenecks with global visibility of worldwide operations.

» Automated workflow and change management

- Coordinate activities across independent departmental resources.
- Ensure change management requests are compiled correctly and in a timely manner.
- Eliminate communication gaps between facilities and IT.

» Bidirectional systems integration

- Automate changes to the data center floor for physical install/move/add/change processes.
- Deliver end-to-end visibility of time and costs.
- Automate reconciliation of physical assets to configuration items.
- Enable visibility of physical connectivity dependencies.
- Validate locations.
- Map virtual to physical dependencies.

» Audit and reporting

- Log all asset changes accurately and completely.
- Verify proper configuration was executed according to request.
- Automate reports to reduce hundreds of man hours for manual processes.
- Identify key performance indicator (KPI) metrics and discrepancies instantly.

Building Management Systems

A BMS is a centralized, networked system of hardware and software that monitors and controls a building's facility systems, including the following:

- Electrical systems
- Fire and flood safety
- Heating, ventilation, and air conditioning (HVAC)
- Lighting systems
- Mechanical systems
- Security and surveillance systems
- Water supply and plumbing

TIP

A BMS by any other name — whether a building automation system (BAS), building energy management system (BEMS), energy management system (EMS), energy management control system (EMCS), or energy power management system (EPMS) — is still, fundamentally, a BMS.

The four core functions of a BMS are to:

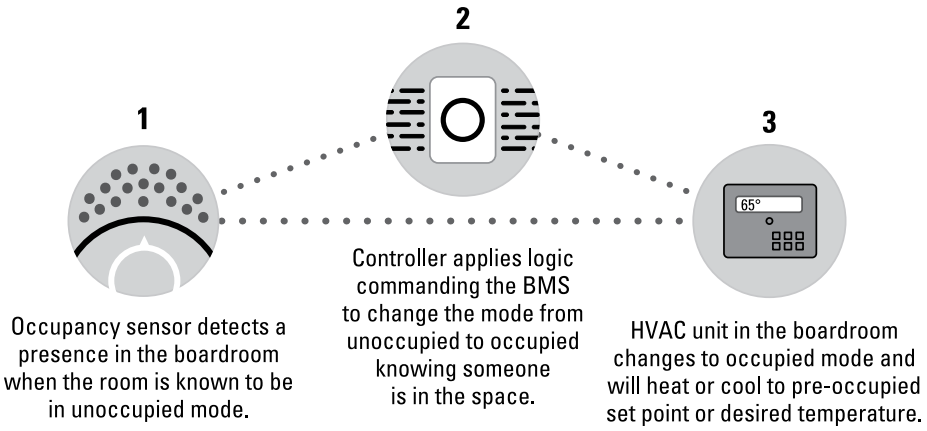
- Control the building's environment
- Operate systems according to occupancy and energy demand
- Monitor and optimize system performance
- Alert or sound alarms when needed

A basic BMS has five essential components:

- **Sensors:** Devices that measure values such as carbon dioxide output, temperature, humidity, daylight, or room occupancy
- **Controllers:** The brains of the systems that take data from sensors and decide how the system will respond
- **Output devices:** Devices, such as relays and actuators, that carry out the commands from the controller

- **Communications protocols:** The language spoken among the components of the BMS
- **Dashboard or user interface:** Screens or interfaces that humans use to interact with the BMS where building data are reported

The controller is the brains of the BMS. The controller receives input data, applies logic to that data, and then sends out commands that regulate the performance of various facilities within the building based on what information was processed. Figure 2-3 illustrates the function of the controller through a basic three-part direct digital control (DDC) loop.



**Note: Actual algorithm is far more complex than depicted in this example.*

FIGURE 2-3: How a DDC loop works.

Today's technology enables a building to learn from itself. A modern BMS monitors facility systems, optimizes for maximum efficiency, remembers who enters which rooms at what times, and adjusts to conserve energy. When facilities are monitored and controlled in a seamless manner, tenants enjoy a more comfortable and productive working environment, and facility management benefits from sustainable practices and reduced energy costs.

TIP

Buildings equipped with a BMS can reduce energy and maintenance costs by up to 30 percent.

Critical Infrastructure

The term *critical infrastructure* is typically used by governments to categorize certain sectors, such as emergency services, energy, telecommunications, banking and finance, and others, which provide vital services to the general public. Industries designated as critical infrastructure are typically subject to regulatory requirements to ensure the resiliency, safety, security, and survivability of the services they provide.

However, any organization that has a critical dependency on its physical (buildings), communications (networks), and digital (compute and intellectual property) infrastructures can adopt the resiliency and business continuity practices required of official critical infrastructure organizations.

TIP

An example of critical infrastructure best-practice guidance that has been widely and voluntarily adopted by organizations is the U.S. National Institute of Standards and Technology (NIST) *Framework for Improving Critical Infrastructure Cybersecurity.*

Buildings

In simple terms, buildings encompass your organization's physical real estate. This includes data centers, headquarters locations, campus buildings, manufacturing facilities, parking structures, and edge compute locations (such as remote offices, micro data centers, and cell tower bunkers), among others.

The physical real estate is typically the exclusive domain of facilities management. However, the lines of responsibility often overlap with respect to data centers and other facilities that house significant IT and operational technology (OT) assets.

IT Systems

IT systems broadly include physical equipment (such as servers, storage, networking, and cabling), software applications, and management applications (such as DCIM, BMS, ITSM, and others).

These systems are typically under the purview of IT management and monitored with hardware and software tools such as DCIM, ITSM, security monitoring, and performance management, among others.

Workloads

The term *workload* used to be reserved primarily to describe virtualized servers and applications. Today, a workload is more broadly defined as any digital component needed to receive a computing request and deliver a response. Many workloads are short-lived or ephemeral, such as containers in a microservices architecture, upon which many modern cloud-native applications are built.

In this book, the term *workload* refers to the collection of applications, databases, web controllers, network routing, and so on, that is required to accept, process, and return a computing query.

IN THIS CHAPTER

- Maximizing space, power, and cooling
- Improving energy efficiency throughout the data center
- Achieving operational excellence

Chapter 3
Defining Integrated Data Center Management Use Cases

In this chapter, you learn about the three main use cases for integrated data center management (IDCM): capacity management, optimization, and improved operations. Whether you're in charge of critical facilities, IT operations, or systems engineering, an IDCM solution can help you address the myriad of challenges you're facing.

Capacity Management

Facilities managers and data center operators have different jobs and responsibilities, each with different tool sets to meet their needs. Unfortunately, these tools often provide a siloed view of the data center environment rather than an end-to-end picture that communicates the interdependent nature of the different elements throughout the data center ecosystem.

NEW SECURE INTEGRATIONS ENABLE ENHANCED MANAGEMENT

IDCM's new secure integration enables data center and facility managers to work together to optimize capacity planning, enhance event management, and identify operational improvement projects. This integrated data delivers an understanding of environmental or workload changes in real time, which is crucial to data center operators. Applications and their associated workloads move dynamically between server or container hosts, racks, and data centers. This dynamic aspect of the data center significantly impacts the power and cooling requirements — at times quite erratically. Integrating data and leveraging artificial intelligence (AI) enables real-time changes to be made automatically and provides predicted changes, which can help in planning and even mitigation of power and thermal issues.

For example, a building management system (BMS) provides no visibility inside the equipment racks in a data center to know where there is available contiguous space, power, or cooling for equipment placement. On the other hand, data center infrastructure management (DCIM) solutions have limited downstream visibility, such as fire detection and suppression, lighting, physical security systems, and other critical building systems. IDCM brings together all the relevant data necessary to provide full visibility into space, power, and thermal capacity management, which helps to ensure that workloads running in the data center are optimally placed.

Today, we live with the challenges of real-time capacity management, but the goal is to avoid scrambling with last-minute adjustments and dealing with the consequences of insufficient capacity. IDCM leverages AI from both DCIM systems and BMSs to analyze historical trends of power, cooling, and computing resources (servers, virtual machines, and so on) to predict future energy and space requirements. IDCM enables you to be proactive and make changes before they become performance issues. Better

yet, AI data helps determine the optimal location and architecture for permanent placement of workloads to eliminate the elastic/dynamic changes that can unexpectedly overwhelm the operations team.


TIP

Read Chapter 2 to learn about BMS and DCIM solutions.


TIP

An IDCM solution provides workload visibility across IT and facilities with auto-allocation of assets based on available space, power and cooling, IT operational guidelines, and security policies. Look for the following capabilities and features in an IDCM solution's capacity management module:

- **Power and cooling monitoring:** Enables micro-level control of facility power and cooling based on rack, server, and workload changes and demands.
- **Rack power management:** Controls power switching to local and remote (edge) computing facilities to save power and eliminate the need for on-site hands-on support.
- **Cooling chain mapping and management:** Historical trends provide insight into future thermal demands, allowing for proactive changes as well as optimal workload placement.
- **Security policy compliance:** Automated workflows can ensure access is controlled at all times based on service tickets and authorized personnel.
- **Space management (rack, rack units, and floor space):** Leveraging DCIM asset libraries and power and thermal mapping, equipment and corresponding workloads can be placed in optimal locations.
- **Dashboards and reports:** Unique and individual data is served up for a user's or team's specific need and can be easily shared.
- **Workflow integration:** Automating workflow processes across multiple teams and systems ensures accurate, timely, and consistent completion of repetitive and one-off service requests.

REAL-WORLD BENEFITS OF INTEGRATED DATA CENTER MANAGEMENT

IDCM allows organizations to create a single pane of glass to see from facilities to the workload and manage beyond the mechanics to deliver optimal business availability. From this single pane of glass, power and thermals can be optimized down to a virtual workload. This consolidated view delivers improved efficiencies across IT operations by improving power, space, and CPU utilization. Maintenance cycles and schedules are improved with dependency mapping, predictive analysis, and collaborative workflows across groups. Here are a few efficiencies that organizations are realizing with IDCM:

- Tying chiller performance to impacted workloads delivers efficiency mapping and a foundation for predictive maintenance.
- Visibility to the data center's power, cooling, and space capacity provides more accurate analytics and better facility-wide power state and usage capacity management.
- Machine learning provides analytics for predictive failures, alerting organizations of potential problems before they become disruptions to the business.
- Tying in data from BMS and DCIM systems, power and cooling anomalies are better understood and trigger workflows that result in faster, more accurate remediations.
- Combined BMS and DCIM data provide more informative reporting and enhanced workflows for standard and customized user situations.
- Reduced unplanned downtime of chillers and uninterruptible power supplies (UPSs).
- Mitigated impact of unplanned downtime on tenants in colocation facilities that improve service-level agreements (SLAs).

Optimization

Data centers are among the largest consumers of electricity in an organization with requirements for robust 24/7/365 power and cooling capabilities. Consequently, data centers are frequently a

prime candidate for targeted cost recovery and improved energy utilization. However, it's no simple task to change temperature setpoints without end-to-end visibility into how a temperature change will affect the equipment that is processing critical workloads. To safely change thermal equipment's energy consumption, an operator must have a granular level of transparency into how any proposed change in temperature will affect the environment and the applications being run within it.

IDCM provides operators the information required to optimize the energy usage of the data center's thermal equipment. This solution processes vast amounts of data points from critical infrastructure and IT equipment to proactively provide information necessary to make data-informed time-sensitive changes to the operating parameters of thermal equipment.

IDCM goes beyond just energy optimization. It enables better power and cooling management and optimizes space and maintenance cycles. With DCIM's ability to monitor CPU utilization and track virtual machines (VMs) to physical servers, it provides vital data to improve server density and reduce rack and floor-space consumption. A byproduct of this capability ties back into the energy efficiency by further understanding the characteristics of individual workloads. By correlating the power and cooling demand cycles, individual workloads can be moved around to better balance the data center's thermal and energy distribution. The addition of AI in both DCIM and BMS systems can balance maintenance cycles to more optimal times to reduce downtime of critical applications. Additionally, the predictive capabilities enable maintenance of a device to be scheduled before an unplanned outage occurs.

TIP

An IDCM solution provides cooling based on the needs of affected assets and end-to-end energy prediction and optimization. Look for the following capabilities and features in an IDCM solution's energy optimization/efficiency module:

- **Power monitoring:** Real-time power monitoring enables facility power systems to react in a timely manner to throttle up or down as demand changes.
- **Cooling monitoring:** Real-time visualization down to the server and workload ensures room-level data is not masking over- or under-cooling supply.

- **Energy optimization (workload alignment):** Historical analysis makes it easy to place workloads in the most optimal location or run applications at optimal times.
- **Cooling prediction/optimization (rack white space level):** Provides thermal details inside racks to augment and fine-tune floor and ceiling sensors and enhance time-based temperature mapping.
- **Power usage effectiveness (PUE) prediction/calculation:** Simplifies the PUE calculations while adding additional layers of sensor and workload data.
- **Dashboards and reports:** See historical trends and predictive analysis in real time to determine optimal placement of workloads and application processing both immediately and in the future.

TECHNICAL STUFF

PUE is a measure of what proportion of a data center's electric power usage is going into powering the IT infrastructure:

$$PUE = \frac{\text{Total Facility Power}}{\text{IT Equipment Power}}$$

For example, Table 3-1 shows that a PUE of 1.2 is indicative of a very efficient data center with 83 percent data center infrastructure efficiency (DCiE).

TABLE 3-1 PUE Ratings Based on Level of Efficiency and DCiE

PUE	Level of Efficiency	DCiE
3.0	Very inefficient	33%
2.5	Inefficient	40%
2.0	Average	50%
1.5	Efficient	67%
1.2	Very efficient	83%

Improved Operations

Many areas of data center operations can be targeted for improvement, but perhaps none has a more profound impact on the bottom line than maximizing uptime.

Data center operators can improve uptime in many ways. It starts with having the ability to simulate critical infrastructure in software for scenario planning purposes and to optimize operations. Scenario planning allows operators to plan for failures at critical points in the data center and plan for maintenance, workload migrations, and equipment replacement. Another way to improve uptime is to map and understand the dependencies of a workload downstream to the power ingress.

AI benefits data center and facilities operators by giving them an understanding of the predictability and timing of maintenance cycles for components and devices. With this knowledge, spare parts can be managed in a just-in-time manner and stored at the appropriate location to avoid overprovisioning of spares. This reduces costs and improves the mean time to repair (MTTR).


TIP

An IDCM solution helps improve data center operations with power anomaly workflows to minimize customer outages, security issue workflows to automate risk mitigation, automatic identification of specific events to direct available cooling capacity, and rich analytics to enable proactive issue resolution. Look for the following capabilities and features in an IDCM solution's end-to-end operations management module:

- **Power monitoring/event management:** Server-level readings provide granular statistics and readings for IT ops and facility teams to better control and predict power demand.
- **Cooling (health and status):** Server-level cooling data helps prevent overheating and improves uptime for individual workloads while controlling excessive energy usage for cooling.
- **Predictive maintenance, fault detection and diagnostics (FDD):** AI built into both BMS and DCIM drive the analytics needed for understanding potential failures and driving maintenance before a failure event.

- **Thermal monitoring/event management:** With the IDCM system, macro- and micro-time slices of thermal data can be normalized to avoid erratic responses based on room- and rack-level thermal sensors.
- **Security management (centralized monitoring):** Tying facility security systems together with DCIM automated workflows provides approved room- and rack-level access to authorized personnel and provides an audit trail of events.
- **Dashboards and reports:** Personalized views of power, cooling, thermal, and energy data provide specific management data for each organization's unique needs.
- **Workflow integration:** Process templates ensure a consistent response to service tickets while tracking progress across teams and providing an audit trail.

IN THIS CHAPTER

- Identifying and prioritizing projects
- Getting your organization aligned
- Ensuring the right skill sets
- Chalking up early successes

Chapter 4
Getting the Most Value from Integrated Data Center Management

In this chapter, you explore the potential projects, organizational requirements, requisite skills, and quick wins that will help you get the most value out of your integrated data center management solution.

Types of Projects

The types of projects that you choose to undertake as part of an integrated data center management (IDCM) solution implementation will vary across the organization depending on the priorities and challenges of the different stakeholders throughout the organization.

Some key needs and common pain points typically include the following:

- Workload and chiller efficiency mapping with prediction
- Capacity management with analytics for power state and usage

- Analytics for predictive failure
- Automated response and action based on sudden temperature anomalies
- Tailored reports and workflows for specific situations and customers
- Reducing unplanned downtime of chillers and uninterruptible power supplies (UPSs)
- Mitigating the impact of unplanned downtime on colocation tenants and service-level agreement (SLA) implications

To help you identify and prioritize different projects to get started with, consider asking your various stakeholders some of the following questions:

- **Facilities director(s):**
  - How accurately are you able to determine the cost of powering and cooling in your data center today? Can you measure the cost by application? By business group?
  - How do you currently calculate the cost per IT workload running in your data center?
  - How do you and your team calculate the real-time and historical power and cooling loads of individual racks in your data center?
  - How do changes to the way servers are being used affect your power and cooling load?
  - How much time do you spend performing manual inspections and calculations to determine the impact of IT usage on your critical infrastructure and costs?
  - Do you know which applications are affected by upcoming maintenance?
- **IT/data center operations manager(s):**
  - What are your SLA requirements for notifying your customers of a loss of redundancy when you have an unplanned outage of critical facilities (such as a chiller or a UPS)?
  - How easily can you generate reports tailored to your customers' specific requirements or needs?

- What mechanisms do you currently have in place to notify you of impending equipment failures?
- If you're notified of an impending equipment failure, how confident are you in the data you receive?
- Is upcoming maintenance seamlessly tied into your data center and IT service management (ITSM) workflows?

» **Systems engineer(s):**

- How up to date are your physical security logs?
- Are those logs captured in an automated or manual fashion?
- How quickly are you able to satisfy your security audit requirements at present?
- How many systems do you currently need to reference to find information about power anomalies and security breaches?
- When you identify a power anomaly or a security breach, how quickly can you minimize the impact of those events on your IT systems?
- How do you currently determine which power and cooling assets are directly supporting your data center racks, cages, and/or rooms?

In most organizations, it's unlikely that a facilities director, data center operations manager, or systems engineer will be able to answer many of these questions without consulting their counterparts in different parts of the organization. For example, to answer the question "Do you know which applications are affected by upcoming maintenance?" a facilities manager will likely need to ask a systems engineer or the IT operations manager. Likewise, a systems engineer will likely need help from the facilities director or data center manager to answer the question: "How up to date are your physical security logs?"

These questions illustrate the point that you also need to consider your current organizational structure to get the most value out of an IDCM solution.

Organization

In our modern working environment, where "team communication and collaboration" is considered key to success in practically every endeavor, it's ironic that two critical functions that provide the workspaces, equipment, and tools for teams to communicate and collaborate are themselves often siloed. These two functions are, of course, facilities and IT operations.

Most IT operations and facilities personnel have at least one horror story in their past about a generator that the facilities folks "unexpectedly" tested, which caused critical systems to crash, or a new rack of servers that the IT folks decided to just "plug them in and see what happens." As the Captain in *Cool Hand Luke* said, "What we've got here is failure to communicate."

IDCM provides the tools to help organizations break down communications barriers between facilities, data center, and IT operations teams. These groups have a tremendous amount of interdependence, but they seldom have transparency between them to know how their actions impact each other. This transparency is particularly crucial for proper capacity management and planning. For example, with IDCM a facilities engineer can have visibility into the business-critical workloads being run in the data center, thus providing a better understanding of how the building systems and critical infrastructure affect those workloads and applications.

To help you achieve organizational alignment for your IDCM projects, consider the following best-practice recommendations:

- Get buy-in across all groups.
- Run baseline measurements.
- Start collecting data for historical analysis.
- Implement machine learning.
- Integrate workflow management.
- Leverage historical data and artificial intelligence (AI) to improve energy and thermal management.
- Leverage AI to optimize the placement of workloads.

Skills

Digging deeper into the organizational structure, you need to ensure your data center, IT operations, and facilities staff has the right skill sets.

The good news is that there aren't necessarily any new skills that your IT operations, data center, and facilities teams collectively need to learn. By leveraging data center infrastructure management (DCIM) and building management systems (BMSs), as well as ITSM, an IDCM solution allows your different teams to quickly work together using the new solution. The integrated systems keep the expertise and skills where they're applied, but share the operating data needed by the other groups to operate efficiently and reduce misunderstandings (risk mitigation). The right task gets performed at the right time in the appropriate manner to avoid user disruption, and unexpected disruptions are handled quickly because the system automates the workflow instructions to all teams.

TIP

Turn to Chapter 5 to learn how IDCM helps break down silos across teams.

As with any advanced management and monitoring tool, the operators quickly become familiar with the functions of the operation that were not originally part of their core tasks. For example, in the data center, a technician responsible for replacing servers will simply remove and install servers, connecting power and networking cables as instructed. However, with the introduction of DCIM, they become more aware of the power and network management aspects that go into turning on that server. With DCIM, they're exposed to cooling management and capacity planning for power and space. DCIM users experience a broader understanding of the various aspects of the data center from power to workload.

The same holds true for the BMS side of the equation. The facilities team can now understand how their power cables and chiller units directly affect the performance of an application — and the efficiency and success of the entire organization.

Bottom-line decisions are constantly being made around keeping the lights on, energy, power consumption, and future investments by data center and facility managers, as well as by executives in the C-suite. DCIM systems and BMSs provide the analytics to

make predictive and prescriptive decisions regarding resiliency and sustainability.

The advent of meaningful AI is ushering in a change in the workforce in and around the data center. In the past, you had facilities networks, facilities systems, and facilities network and systems personnel running the data center. These roles have traditionally been completely separate, but as technology changes and the proliferation of the Internet of Things (IoT) influences and controls multiple aspects of the data center, the distinction between these roles is blurring. In the past, someone had to physically be in the data center to make changes to the heating, ventilation, and air conditioning (HVAC) system. Now, changes can be done on a smartphone from practically anywhere. Although there will always be a need for someone in the data center (for example, security and janitorial personnel), much of what needs to be done can be done remotely, and with AI technology, who does it begins to matter less. As things become more connected, integrated, and complex, quickly moving an application workload to a new environment will require AI in DCIM and BMS to react to those changes.

TIP

Although machine learning and analytics aren't new or unique to data center and facilities management, they're far more integral to an IDCM solution. Again, no new skills are necessarily needed because most of this technology is automated and the rich data is served up in the form of intuitive dashboards and familiar reports for the right audiences.

Quick Wins

Nothing helps a project gain momentum like a few quick wins to get everyone excited about the opportunities.

In data center environments with an already well-instrumented environment, these early success opportunities will be readily available with IDCM. After all, you already have the data — it's just a matter of surfacing it in a contextually relevant manner to all your various stakeholders, which is what IDCM does for you.

Organizations that are already utilizing DCIM and BMS or BAS solutions are monitoring and collecting large amounts of telemetry data from sensors (such as temperature, humidity, and so

on). IDCM provides the necessary end-to-end visibility that these organizations need to drive maximum efficiency and optimization in their data center environments.

Here are some examples to quickly demonstrate that your IDCM implementation is working for your organization:

- **Build out some workflow templates that incorporate data center, IT operations, and facility response teams.** Run the scenario and track the progress. Were tasks completed faster? More efficiently? Does the audit trail reflect the reality of the event?
- **Build a unified thermal model from BMS and DCIM data points to identify meaningful trigger points for temperature alarms.** Did facilities increase or decrease cooling in time to avoid failure? Were you able to increase overall ambient temperature of the data center, thus saving money? Did you reduce power cycling for server fans?
- **Run DCIM's auto discovery and build a real-time end-to-end map of a workload's network, power, and cooling dependencies.** Run failure scenarios on each point in the chain and see the corresponding waterfall effect across the data center and all associated application workloads. Adjust workflow templates in BMS, ITSM, and DCIM to reflect the corresponding dependencies. Are unplanned outages reduced? Are maintenance windows adjusted to reduce planned outages of critical systems? Are maintenance surprises reduced?
- **Engage the AI and machine learning engines in your DCIM systems and BMSs to run predictive maintenance on a select group of systems, devices, and components.** Identify critical application workloads and run maintenance and part failure calculations against them. Review and adjust your maintenance schedule to reduce user downtime. Evaluate spare parts inventory and supply chain. Are users experiencing less downtime for critical applications? Are you able to reduce on-hand inventories of parts? Are parts readily accessible for rapid replacement?

As you begin to answer yes to each of these questions, share your results and celebrate! If not, rinse and repeat.

IN THIS CHAPTER

- Improving teamwork and delivering real-world efficiency gains
- Managing hybrid cloud assets
- Mapping cooling and power chains to local events
- Detecting anomalies in the data center
- Driving energy efficiency and reducing costs
- Leveraging artificial intelligence and machine learning for deep insights

Chapter 5
Ten Benefits and Capabilities of Integrated Data Center Management

Data centers have ever increasing demands for efficiency, resiliency, and flexibility, which are best addressed by tightly integrating the critical infrastructure. This critical infrastructure consists of power, cooling, monitoring, security, and the building itself, along with IT equipment and workloads. Here are ten key benefits and capabilities that make the implementation of an integrated data center management (IDCM) solution in your organization a valuable undertaking.

Working Together Better

IDCM enables silos in organizations, such as between facility and data center operations team, to be broken down. The benefit in an IDCM implementation is that it allows data to be shared and workflows to be coordinated without encroaching on other teams' sandboxes or areas of responsibility. Part of the reason these silos have developed over time is the need or desire of these respective groups to maintain their own practices, processes, and vernacular. In the past, when management has attempted to replace seemingly redundant systems with a common platform and single-pane-of-glass tool, the individual teams have revolted. No group wants to take on the attributes of another team's processes, and no one wants to give up their way of doing things. IDCM simply allows the relevant data to flow between each team's respective management systems without imposing their own way of doing things on the other teams.

Real-World Efficiency Gains

IDCM allows organizations to create a single-pane-of-glass view from facilities to the workload so you can manage beyond the mechanics of the data center and deliver optimal business availability. From this single-pane-of-glass view, power and thermals can be optimized down to a virtual workload. The consolidated view allows for improved efficiencies across IT operations by improving power, space, and CPU utilization. Maintenance cycles and schedules are improved with dependency mapping, predictive analysis, and collaborative workflows across groups. Here are some of the efficiency gains that real-world organizations have realized with IDCM:

- By tying chiller performance to impacted workloads, IDCM provides efficiency mapping and the foundation for predictive maintenance.
- With visibility to the data center's power, cooling, and space capacity, more accurate analytics provide more accurate facility-wide power state and usage capacity management.
- Machine learning provides deep analytics and insights for predictive failures, alerting the organization of potential problems before they become business disruptions.

- Tying in data from building management systems (BMSs) and data center infrastructure management (DCIM) systems, power and cooling anomalies are better understood and trigger workflows that result in faster, more accurate remediations.
- Combined BMS and DCIM data provides more informative reporting and enhanced workflows for standard and customized user situations.
- Unplanned downtime of chillers and uninterruptible power supplies (UPSs) is significantly reduced.
- The impact of unplanned downtime on tenants in colocation facilities is mitigated, thereby improving service-level agreements (SLAs).

Hybrid Cloud Workload Visibility

By seeing the entire digital compute infrastructure (hybrid cloud — data center, colocation facility, edge site, and public cloud) at a glance, planned disruptions can be globally orchestrated and workloads optimized against a given infrastructure's performance. IDCM dashboards offer a variety of selection criteria (such as location, date, customers, business groups, and so on) and provide valuable information including:

- Count of selected hybrid locations
- Count of physical servers under management that run virtual workloads
- Count of virtual workloads under management
- Ratio of virtual workloads to physical servers
- Count of running workloads over time, by hybrid location
- Forecast of monthly running workloads, by hybrid location
- Forecast of monthly costs of running workloads, by hybrid location, to support on-premises and cloud cost comparisons
- Count of running workloads, by vendor operating system, over time

REMEMBER

The benefit of hybrid cloud workload visibility is the ability to understand workload dependencies on the infrastructure and the cause and effect of planned and unplanned disruptions.

Hybrid Cloud Asset Management

IDCM shares infrastructure services (downstream) with the data center, allowing operators to optimize asset placement to maximize workload uptime and performance.

IDCM asset management delivers details about power and cooling demands at the rack and server level. Organizations run applications on both physical and virtual servers, so IDCM identifies workload characteristics and performance values from a logical perspective. This logical view allows an organization to manage workloads across hybrid cloud environments, including public clouds such as Amazon Web Services (AWS), Microsoft Azure, and Google Cloud Platform (GCP).

Implementing DCIM is the first step in addressing the challenges and issues in the data center. It's the tool to manage all the assets, know where they're located, and understand what resources they consume. It provides the means to monitor everything in the data center, where they're physically located, and how they move in and out of the data center.

Hybrid data center infrastructure management (HDIM) is the natural evolution of DCIM (see Figure 5-1); it isn't separate from DCIM but extends DCIM and adds tools to address the needs of a disaggregated (that is, hybrid) computing infrastructure. Even though cloud, edge, and data center are essentially just different names for computing environments, there are unique needs for each and a need for orchestration to utilize them together in harmony as a hybrid cloud. When the orchestration functionality is in place and you can operate the hybrid cloud as a single computing infrastructure, you can start to move application workloads around the different architectures to achieve maximum optimization. HDIM provides answers to questions such as:

- Based on cost, performance, and risk factors, where is the best location for a given workload?

- Why should we run a given workload in a private data center versus edge, colocation, or public cloud?
- Based on privacy and risks calculation, which is the most secure environment to run a given workload?
- Based on critical needs or performance demands, what is the best location for a given workload?

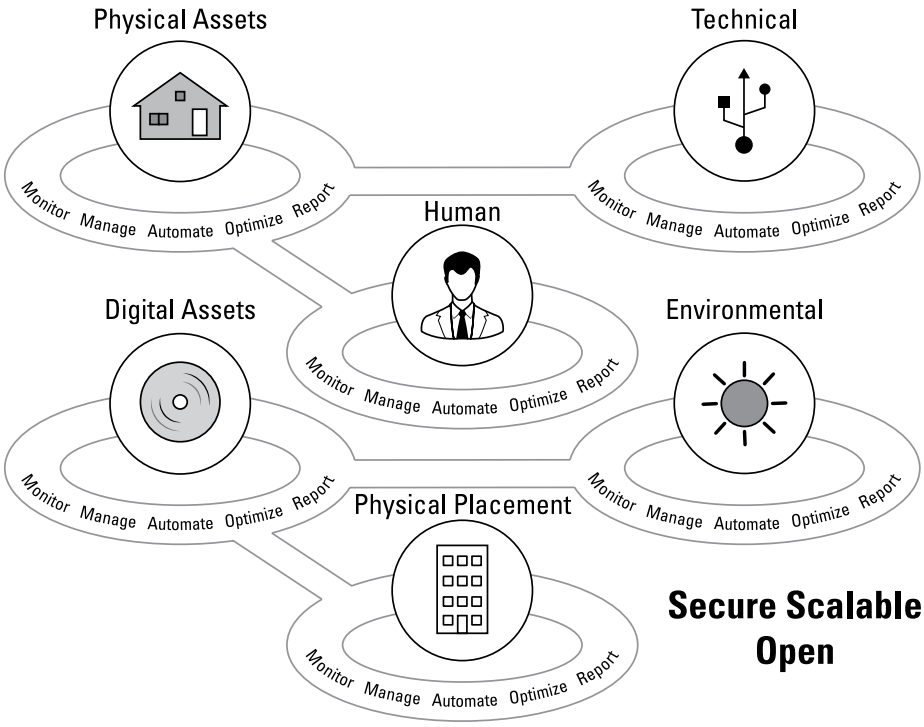


FIGURE 5-1: HDIM is the next step in the evolution of DCIM.

REMEMBER

The benefit of hybrid cloud asset management is the ability to share upstream data with facilities, enabling them to understand the detailed requirements and the effect data center assets (and workloads) have upon the power, cooling, and other services supplied.

Map Cooling Chain to Local Events

A physical change (planned or unplanned) to an asset in the data center can be reported back into the BMS by the IDCM. With both DCIM and IDCM aware of the alert, a workflow can be initiated with specific details about anything from a virtual workload to a

chiller. In either case, the benefit is quick mitigation and avoidance of an extended unfavorable condition.

Integrating DCIM systems and BMSs together provides the ability to model the relationship of an increase at a server level (based on an increase in workload activity) to the thermal effects on the rack, row, and room in the data center. DCIM monitors the environment in very short intervals, whereas a BMS monitors the environment in longer intervals. Modeling cooler responses solely off of one system or the other would be inefficient. However, understanding the characteristics of the thermal output at the server level and the response time of the cooling system, optimal temperature management can be achieved. This reduces energy expense and potential device failure.

REMEMBER

The benefit of a cooling chain map is that it provides a trace, down to the workload in the data center, of the effect of a change in the cooling system.

Map Power Chain to Local Events

Given the various components of the power chain (utilities, generators, batteries, breakers, power strips, and more), an event may have an immediate effect on only one set of assets, but an extended disruption may involve many other assets. IDCM provides views of both currently affected and potentially affected assets and corresponding workloads.

An integrated system of DCIM and BMS allows for the modeling and predictability of energy needs. With a predictable understanding of power requirements in advance, power contracts can be modified to pay for only what's actually needed rather than bulk power that will go unconsumed. Adjusting computing times to take advantage of energy pricing, such as lower rates from utilities at night or renewable sources such as solar during the day, improves your power usage effectiveness (PUE) and data center infrastructure efficiency (DCiE) performance.

REMEMBER

The benefit of a power chain map, like that of the cooling chain map, is that it allows for events to be monitored both upstream and downstream.

Anomaly Workflows

Power, cooling, and security alarms are the most common events responded to by facilities and data center staff. Historically, end-to-end details were nonexistent because of siloed and disaggregated systems, causing delays, errors, and redundant remediation activities. IDCM's aggregated data set ensures that workflows are coordinated between multiple groups, but also provides an appropriate mapping to ensure any mitigation activity causes minimal disruption.


REMEMBER

The benefit of enabling anomaly workflows across groups is that an alarm anywhere in the system will trigger a workflow simultaneously to all personnel required to resolve the problem.

Enhanced Colocation Cooling Capacity Management

Historically, colocation providers have not had direct visibility of their tenants' equipment types or workload demands, which limited efficient management of cooling needs. Integrating DCIM floor maps and capacity management with the facilities' BMS data about the cooling chain, colocation providers can tie committed thermal SLAs to real-time demand.


REMEMBER

The benefit of IDCM for colocation providers is that it gives insight into a tenant's workflow demand so they can improve the predictability of the facility's cooling demand.

Full Stack Energy Prediction and Optimization

Machine learning can take the data from BMS and DCIM to provide predictive analytics, helping organizations avoid inadequate power supply and identify the optimal placement of workloads based on energy needs.

REMEMBER

The benefit of end-to-end energy prediction is that it enables you to understand energy supply and demand from the power plant down to a single workload.

Analytics and Multivariant Use Cases

DCIM and BMS integrated machine learning provides a multivariate analytics framework to impact data such as detecting anomalies in overall power draw for cabinets in zones and forecasting individual device telemetry. Historically, the volume of this data has been overwhelming and it has been discarded as noise. Now, with artificial intelligence (AI), it can be processed to improve overall efficiency and reliability of data centers and the application workloads running in them.

REMEMBER

The benefit of multivariant analytics is that it correlates equipment behavior and anomalies to the impact on workloads.

Attention Facilities and Data Center Managers!

The time has come to break the silos between you and start sharing data and workflow management. Your critical digital infrastructure depends on it!

Nlyte IDCM is the leading solution that integrates the key management systems for buildings to servers to applications.

- Tighten the integration between Cooling/power systems and servers/workloads that run within your data centers.
- Manage your infrastructure for energy savings, reduced costs, and improved uptime of data center operations.
- Unify your infrastructure ecosystem that runs your business with Nlyte IDCM!

Nlyte® Software

Learn more at
Nlyte.com/solutions/integrated-data-center-management/

Gain next-level insight into and control of your data center

Data centers are critical to businesses, so they need to be more efficient, resilient, and flexible. These goals are best achieved by tightly integrating the critical infrastructure (power, cooling, monitoring, and the building itself) with IT equipment and applications. Data centers are unlike other buildings because they're significantly and dynamically influenced by the systems running within them. Integrated data center management (IDCM) brings together these different systems — from buildings to virtualized workloads — to provide greater efficiency, streamlined management, and better insights.

Inside...

- Reduce power and cooling costs
- Align facilities and IT staff
- Improve communication and productivity
- Improve resiliency with planning scenarios
- Automate risk mitigation
- Enable visibility across facilities and IT

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