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Nlyte Software is the leading company helping organizations with their Digital Transformation objectives. Our solutions address your Hybrid Digital Infrastructure Management – from desktops, networks, servers, to IoT devices – across facilities, data centers, colocation, edge, and to the cloud.

With over 30 federal agencies selecting Nlyte as their DCIM vendor, Nlyte was the first vendor to help these organizations to understand and manage compliance requirements with the Data Center Optimization Initiative (DCOI). With the M19-19 updates, we are pleased to sponsor the revision of this book to help our customers meet the new mandate.

Using Nlyte's monitoring, management, inventory, workflow, and analytics capabilities, organizations can automate how they manage their hybrid digital infrastructure. Organizations can reduce costs, improve uptime, and ensure compliance with DCOI, and embrace the Cloud First policy with Nlyte's complete set of solutions:

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Enjoy the book and please feel free to submit comments or questions to **info@nlyte.com**.

We look forward to hearing from you.

The Nlyte Team

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DCOI For Dummies®, Nlyte 2nd Special Edition

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Introduction

Initially mandated for completion by the end of fiscal year 2018, the Data Center Optimization Initiative (DCOI) has been extended to the end of fiscal year 2020 and is now part of a broader government initiative known as Cloud Smart. The updated DCOI mandate, along with the Cloud Smart and Application Rationalization executive orders, form the three pillars of government modernization and optimization.

Data centers throughout the federal government must comply with the optimization mandates set out in the DCOI, which includes the requirement to use data center infrastructure management (DCIM) software in agency data centers. However, not all DCIM software packages are alike. In fact, in many cases, they aren't even close to being comparable. You need to know what to look for in a DCIM package to make sure you get the one that best meets your agency's needs.

About This Book

DCOI For Dummies consists of five chapters that explain the following:

- The current state of the DCOI and what's been achieved so far (Chapter 1)
- The three pillars of agency data centers: the DCOI, Cloud Smart, and Application Rationalization (Chapter 2)
- What the DCOI is looking for in a data center and what data center management needs to do to comply with the requirements that the DCOI lays out (Chapter 3)
- What DCIM software is, how it helps agencies address the requirements of the DCOI, and how to extend its functionality to Cloud Smart and Application Rationalization (Chapter 4)
- Important questions you need to ask when evaluating the offerings of DCIM vendors that want to assist you in meeting the goals set out by the DCOI (Chapter 5)

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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 I don't recommend upside down or backward).

Foolish Assumptions

It has been said that most assumptions have outlived their uselessness, but I assume a few things nonetheless. Mainly, I assume that at least one of the following applies to you:

- You're involved in making decisions about how to comply with the DCOI.
- You're a senior agency manager, responsible for an agency's data centers.
- You're concerned about how the DCOI will affect your agency.

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 when you finish reading it, you'll have a "deep state" of awareness about the DCOI mandate!

Icons Used in This Book

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



REMEMBER

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



TIP

Tips are appreciated, never expected — and I 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.

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Beyond the Book

There's only so much I can cover in 48 pages, so if you find yourself at the end of this book, thinking, "Gosh, this was an amazing book! Where can I learn more?," just go to `www.nlyte.com/federal-government-data-centers`.

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IN THIS CHAPTER

- Getting to know the DCOI
- Defining the goals of the DCOI
- Looking at the key components of the DCOI
- Assessing the DCOI progress to date

Chapter 1
Assessing the Current State of the DCOI

In this chapter, I walk you through the basics of the Data Center Optimization Initiative (DCOI) and its goals and key components. I also provide a brief assessment of the DCOI efforts to date, including outcomes, priorities, and lessons learned.

Covering the Basics of the DCOI

The U.S. federal government owns more computing power than any other country or entity of any kind in the world. Most of this computing power is spread throughout the United States in thousands of data centers ranging in size from a rack tucked away in a closet to a massive collection of servers in a building occupying more than a million square feet of floor space.

Between 1998 and 2009, the number of federal data centers grew from 432 to more than 1,000. By 2014, the number of federal data centers had swelled to more than 10,000! Not only was this rapid expansion of infrastructure expensive, but much of it was underutilized. The procurement bias was to overprovision rather than to find the most efficient or cost-effective solution to a computing requirement.

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HOW THE DCOI DEFINES A DATA CENTER

The way the DCOI defines a data center may be different from the way most people think of data centers. According to the DCOI, a *data center* is any room that contains at least one server, regardless of how the server is being used. Rooms containing only switching and routing gear or security hardware are not considered data centers; only rooms with servers are data centers.

The DCOI recognizes two types of data centers: tiered and nontiered. A tiered data center is one that has separate space for IT infrastructure, an uninterruptable power supply (UPS) system, an independent cooling system, and a backup generator. Any other kind of room with servers is considered a nontiered data center.

To rein in costs, and at the same time provide all the compute services that the government requires, the Office of Management and Budget (OMB) has issued mandates that require improvements in the performance and efficiency of existing compute assets in data centers, as well as redeploying or retiring assets that aren't being used productively.

The OMB launched the initial Federal Data Center Consolidation Initiative (FDCCI) in 2010 with three primary goals:

- To promote the use of green IT by reducing the energy use and real estate footprint of government data centers
- To reduce the cost of data center hardware, software, and operations, while increasing security
- To shift IT investments to more efficient computing platforms and technologies

Several years after the initiation of the FDCCI, it became clear that stronger measures were needed to produce a meaningful reduction in data center costs. OMB Memorandum M-16-19 established the DCOI in 2016 with specific goals, priorities, and required reporting metrics. The original DCOI has now been superseded by OMB Memorandum M-19-19, issued in June 2019, which updated the original goals of the DCOI, incorporating lessons learned over the past three years.

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Understanding the Goals of the DCOI

The main goals of the DCOI are easy to understand but not so easy to achieve.

Closing as many existing data centers as possible

If you want to save money on data centers, closing them completely will probably save more money than anything you could do to make them more efficient. However, the updated DCOI acknowledges that data center closures in many, if not most, cases have now reached the point of diminishing returns. Instead, agencies are directed to evaluate their remaining options for consolidation and closure of existing data centers while ensuring alignment with the broader Cloud Smart strategy. For tiered data centers that remain open, agencies should strive for continuous improvement in their efforts, particularly in the areas of energy and operational efficiency.

One method of reducing the data center footprint is to shut down inefficient and underutilized data centers. Inefficient data centers are costly in more ways than one. In 2006, federal data centers consumed more than 6 billion kilowatt-hours of electricity. When the FDCCI was rolled out in 2010, it was estimated that by 2011 that number would double to 12 billion kilowatt-hours. That's expensive, not only to the taxpayer, but also to the environment if that electricity is generated using fossil fuels. Using less electricity reduces both operating costs and the costs associated with cooling infrastructure.

Small, distributed data centers tend to host redundant copies of software applications that could more efficiently be run from a single, centralized data center. Not only would this approach save money and electric power, but it would also make it easier to provide effective security for one major data center.

When data centers are closed, the applications and workloads that they've been hosting must either be transferred to other data centers or eliminated if they're no longer necessary. One option is to colocate the work in another agency's data center. This may make sense if another agency's data center has unused capacity. Another option to consider, consistent with the Cloud Smart

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initiative (see Chapter 2), is to migrate applications and workloads to the cloud. This option passes on to the cloud service provider the expense and headaches of maintaining infrastructure that would otherwise accrue to the government.


TIP

A big advantage of buying infrastructure as a service (IaaS) from a cloud service provider is that you purchase only as much capacity as you need. As your needs change, you can easily scale up or scale down, without having to make changes to your core infrastructure. Going to a cloud service provider also reduces overall energy consumption and frees up real estate that can be put to other uses or even disposed of.


TIP

The DCOI mandate has the side benefit of requiring agencies to take a close look at all the computing they're doing and determine whether it's still needed to support their mission.

Consolidating data centers

Another goal of the DCOI is to consolidate data centers that can't be closed, when possible. The primary focus of the FDCCI was the consolidation of data centers, so it provides helpful guidance for implementing the data center consolidation goal of the DCOI. For the purposes of the FDCCI, any room that is devoted to data processing servers — whether it's a closet or a million-square-foot building — is considered a data center. The objective was to optimize the utilization of servers, racks, and floor space. The primary method of achieving this optimization was to consolidate the workloads of small, inefficient data centers into larger, more efficient data centers, retiring the small ones in the process.

The FDCCI provided a rationale for closing data centers whose work had been transferred to other facilities, but it didn't constrain the procurement of new data centers. As a result, the total number of data centers continued to grow, and the economic savings attributable to the FDCCI were modest.

Optimizing existing data centers

A number of things can be done to optimize a data center, but before you can do any of them, you must have a good understanding of the current state of the data center. How much floor space is it taking up? How much electricity is it using? How large is its operations and support staff? How fully is its capacity being used? These questions are an important prerequisite to deciding where optimizations are possible and what they may be.

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TIP

Software tools to help you record and visualize the answers to these questions can ease the burden of finding the optimizations required by the DCOI. Data center infrastructure management (DCIM) software is the appropriate tool for this job. Additionally, it's a critical path to apply for Modernizing Government Technology (MGT) funds for information technology systems modernization.



WARNING

Prior to the issuance of the DCOI, federal data centers could use DCIM software, but they didn't have to. After the DCOI took effect, that was no longer the case. It's essentially impossible to satisfy the goals of the DCOI without DCIM software. All data centers must have DCIM software in place by the end of 2020. Any new data centers will have to include DCIM software from the outset.

Lowering costs of existing data centers and avoiding new costs

Data centers are expensive to procure and provision, and after they're procured, they're expensive to operate. One goal of the DCOI is to reduce the operating expenses of existing data centers and avoid the costs of expanding those data centers or procuring new ones. This goal is consistent with the goal of optimizing data centers, because optimization should result in lower costs in addition to more efficient operation.

Reviewing the Key Components of a DCOI Implementation

Although there are many ways to optimize a data center, the DCOI is very specific in the optimizations that it mandates. First, and foremost, the DCOI mandates that agencies implement automated infrastructure management tools (specifically, data center infrastructure management [DCIM] software) to provide monitoring, inventory, and management of agency data center assets. The updated DCOI mandate also includes four key performance metrics for tiered data centers:

- **Virtualization:** The total number of servers and mainframes in agency data centers that are hosting virtualized or containerized systems

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- **Advanced energy metering:** The total number of agency data centers over 100 kilowatts (kW) that have advanced energy metering and submetering capabilities installed in a majority of the space, sufficient to estimate power usage effectiveness (PUE)
- **Server utilization:** The number of underutilized production servers in agency data centers, minimally considering central processing unit (CPU) usage and storage space, but otherwise defined at the individual agency's discretion based on mission-specific, hardware-specific, and application-specific requirements
- **Availability:** The planned hours of availability for each data center and any unplanned outages (measured in hours) during the reporting period

I cover each of these components in greater detail in Chapter 3.

Evaluating the DCOI Track Record: A Scorecard

Right out of the gate, the original DCOI ordered all new federal data center construction to cease. This rather draconian measure was meant to stem the seemingly inevitable growth in the number of federal data centers. In 2014, for example, the government spent $5.4 billion on physical data centers. The DCOI's goal was to reduce spending by $270 million in 2016, $460 million in 2017, and $630 million in 2018, for a total savings of $1.36 billion.

According to IT Dashboard (`https://itdashboard.gov`), DCOI has helped agencies achieve nearly $2 billion in savings and cost avoidance since 2016, and has resulted in the closure of 210 tiered data centers and 3,005 nontiered data centers.

Since the original DCOI was issued, OMB has determined that although data center closures and consolidations (including migrating workloads to the cloud) should continue wherever possible, a renewed focus on data center optimization and IT modernization is necessary to drive further cost reductions.

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Another important lesson was that the performance metrics defined in the original DCOI were confusing, often impossible to practically achieve, and not particularly useful. The use of averages in metrics obscured inefficiencies and many opportunities for improvement. So, a key change in the updated DCOI is that it no longer defines averages and target performance metrics (and their associated complex calculations) for agencies to achieve. Instead, the performance metrics now focus on continuous improvement as the goal for agencies to achieve.

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IN THIS CHAPTER

- Aligning the DCOI, Application Rationalization, and Cloud Smart
- Addressing the three pillars of government modernization and optimization with a unified strategy

Chapter 2
Extending the Scope of the DCOI

In this chapter, you learn how the Data Center Optimization Initiative (DCOI), Application Rationalization, and Cloud Smart are all interrelated and form the three pillars of the Modernizing Government Technology (MGT) Act.

Exploring the Three Pillars of Government Data Centers

Previous efforts to modernize the federal IT infrastructure put a burden on agencies to improve and stay in budget. The introduction of the MGT Act allows agencies to use unspent budget on improving their IT infrastructure. It allows them to invest in technologies, like data center infrastructure management (DCIM), which further reduce overhead and accelerate the adoption of the Cloud Smart, DCOI, and Application Rationalization mandates.

The DCOI

The updated DCOI provides greater alignment to the Application Rationalization and Cloud Smart initiatives by recognizing the

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importance of considering applications running in agency data centers rather than focusing on the infrastructure alone.

The DCOI now provides greater purview to individual agencies for application and workload placement decisions and encourages greater adoption of virtualization, containerization, and cloud computing consistent with the Application Rationalization and Cloud Smart mandates.

The DCOI now requires the implementation of a DCIM solution. DCIM is critical to understanding the cost of the facility, as well as to extrapolate the cost of each workload within the facility. (A workload references an application and all of its associated technology components such as hypervisors, processors, memory, storage, databases, web servers, and so on.) With this understanding, informed decisions can be made about optimally placing or ultimately continuing the use of a given application.


TIP

The key performance metrics in the DCOI (see Chapter 3) have been simplified and updated to better align with Application Rationalization and Cloud Smart and ensure that agencies aren't "penalized" for adopting virtualization, containerization, and cloud computing. For example, agencies may optionally include their cloud workloads to more accurately reflect their complete virtualization footprint under the updated virtualization metric.

Application Rationalization

The goals of the Application Rationalization initiative include the following:

- To help federal agencies mature their IT portfolio management capabilities
- To empower leaders to make informed decisions
- To improve the delivery of key mission and business services

The Application Rationalization Playbook, developed by the Chief Information Officer (CIO) Council and the Cloud and Infrastructure Community of Practice, lays out a structured, six-step iterative approach to application rationalization, as follows:

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1. **Identify needs and set governance.**
   - Determine scope.
   - Establish governance.
   - Identify requirements.
   - Develop a questionnaire template.
2. **Take an inventory of your applications.**
   - Send the questionnaire.
   - Validate the responses.
   - Create a new application process.
   - Publish a service catalog.
3. **Assess the business value and technical fit of the applications in your portfolio.**
   - Review the business value and technical fit for each individual application workload.
   - Determine dependencies.
   - Identify duplication.
4. **Assess the total cost of ownership (TCO).**
   - Confirm the current-state TCO.
   - Identify cost outliers and compare the TCO.
5. **Score applications.**
   - Develop a scoring methodology and score applications.
   - Review application scores.
6. **Determine application placement.**
   - Group applications based on score.
   - Assess future state.
   - Analyze hosting alternatives.
   - Develop migration strategy.

A critical piece of technology needed to enable Application Rationalization, in addition to the cost of a workload derived from DCIM, is a tool for discovery and inventory of applications and workloads. Such a tool physically scans the environment to identify all applications connected to the network and provide visibility into how many application instances exist, their frequency of use, and who is using them, as well as the ability to reconcile

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applications against licenses and entitlements. This capability allows the agency to build a case for keeping an application or retiring it.


TIP

You can download the complete Application Rationalization Playbook at `www.cio.gov/assets/files/Application-Rationalization-Playbook.pdf`.

Cloud Smart

Cloud Smart, issued by the Office of Management and Budget (OMB) in June 2019, is an update to the Cloud First Federal Cloud Computing Strategy.

Cloud Smart adopts the cloud computing deployment models defined by the National Institute of Standards and Technology (NIST), as follows:

- **Infrastructure as a service (IaaS):** The cloud service provider or vendor provides "processing, storage, networks, and other fundamental computing resources" (that is, the infrastructure and hardware) to be managed by the consumer.
- **Platform as a service (PaaS):** The cloud service provider or vendor manages the underlying cloud infrastructure, including "programming languages, libraries, services, and tools" (that is, a managed environment for a customer's applications).
- **Software as a service (SaaS):** The cloud service provider or vendor provides an application and manages the underlying cloud infrastructure, including "network, servers, operating systems, [and] storage" (that is, a fully managed application).

Cloud Smart also extends the definition of *cloud* to solutions that demonstrate the five essential characteristics of cloud computing defined by NIST:

- On-demand service
- Broad network access
- Resource pooling
- Rapid elasticity
- Measured service

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Cloud Smart gives agencies broad authority to evaluate their cloud computing options based on their individual service and mission needs, unique technical requirements, and any existing policy limitations. Cloud Smart promotes a culture of continuous improvement and learning by embracing modernization as a constant state of change rather than a periodic refresh activity, and a leadership focus on staff training and education, migration planning, and striking a balance between solution sustainability and implementation of new capabilities.

Cloud Smart mandates a risk-based approach to security for cloud environments utilizing a defense-in-depth strategy. It addresses the need to evolve the Trusted Internet Connection (TIC) reference architecture with newer, less rigid approaches to Internet access for agencies, reaffirms the importance of continuous data protection and awareness, and acknowledges the need for greater reciprocity across agencies in adopting Federal Risk and Authorization Management Program (FedRAMP) authorizations to reduce duplication of effort.

Finally, Cloud Smart addresses procurement requirements, including the following:

- **Category management:** The federal government is undertaking strategic business practices to buy smarter and more like a private enterprise, by simplifying the process of doing business with the government — for example, by reducing duplicate contracts and decreasing the costs associated with competitive bids, proposals, and contract management.
- **Service-level agreements (SLAs):** Contract clauses and quality assurance contractual provisions must define the expected level of performance from a service provider, how performance will be measured, and what remedies will be used to ensure SLA compliance.
- **Security requirements:** Contracts impacting high-value assets (HVAs) must include a requirement to provide the agency with continuous visibility of its HVAs to enable agencies to proactively assess the security and privacy posture of those assets.

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The success of the Cloud Smart initiative builds on the implementation of DCOI and Application Rationalization. Only after understanding the cost and usage of an application and the supporting infrastructure can you apply artificial intelligence (AI) derived from machine learning technology. This AI data identifies risks and opportunities for optimization of an application and its associated workload. This data will help you determine if an application is best suited for the cloud or should remain on traditional data center infrastructure.

Tackling the Three Pillars as a Unified Initiative

When developing a compliance strategy, agencies should try to address the DCOI, Application Rationalization, and Cloud Smart mandates as a single, unified initiative. This approach is similar to that taken by many private-sector enterprises that must comply with multiple compliance mandates, such as Sarbanes–Oxley (SOX), the Health Insurance Portability and Accountability Act (HIPAA), and the Payment Card Industry Data Security Standard (PCI DSS). However, unlike SOX, HIPAA, PCI DSS, and others, the DCOI, Application Rationalization, and Cloud Smart were jointly developed and/or updated to ensure alignment between the three mandates. This alignment will help agencies implement a comprehensive strategy to address all three mandates and identify natural synergies between them.

The government views Cloud Smart as the leading initiative, but it cannot be effectively achieved without having the DCOI and Application Rationalization initiatives in place. First, you need to understand infrastructure costs and corresponding application workload costs. Next, you need to rationalize the use and proliferation of all your applications. Finally, you need to determine where best to place an application based on reliability, performance, and cost requirements. DCOI, discovery and inventory, and AI from machine learning are the essential technologies supporting the DCOI, Application Rationalization, and Cloud First mandates.

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IN THIS CHAPTER

- Looking at data center consolidations, closures, and optimization
- Eliminating time-intensive, manual processes
- Establishing performance metrics for continuous improvement

Chapter 3
Understanding the Key Components of the DCOI

Congratulations! Since 2010, federal agencies like yours have achieved significant cost savings and numerous operational efficiencies by working aggressively to consolidate and close data centers as mandated by the Data Center Optimization Initiative (DCOI). Your hard work has paid off, and the federal government has now reached the point of diminishing returns on data center closures. Although data center consolidations and closures will continue where possible, it's now time to take your efforts to the next level and focus on the *O* part of DCOI: Optimization.

On June 25, 2019, the Office of Management and Budget (OMB) issued Memorandum M-19-19, which updates, extends, and supersedes the previous DCOI (M-16-19). In this chapter, I walk you through the key changes in the new DCOI mandate.

Making the Most of New and Existing Data Centers

In case you've missed the trend over the past decade, the federal government is making a concerted effort to get out of the business of data center management, as evidenced by the many closures,

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consolidations, and data center optimizations that have already happened under the original DCOI and continue to be pushed in the updated DCOI. New development of data center facilities and significant expansion of existing agency-owned data centers are frozen, and requests for exceptions to this policy are generally frowned upon in favor of alternatives such as cloud hosting, shared services, and third-party colocation.



REMEMBER

The development freeze does not apply to critical agency facilities and carves out exceptions that are permitted under the "Key Mission Facilities for Data Management" section of the updated DCOI.

Agencies are expected to continue data center closures, consolidations, and optimization by reducing their application, system, and database footprints through the use of virtualization and containerization technologies (discussed later in this chapter), which enable compute, storage, and network resources to be pooled and dynamically allocated, on-demand, for scalability and elasticity.

Agencies are also encouraged to consider investments that improve energy efficiency and reduce operational costs in existing data centers, for example, by doing the following:

- Replacing legacy, end-of-life systems to avoid high support costs
- Upgrading physical servers to ENERGY STAR Certified servers with environmental operating ranges rated as American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Class A2 or higher
- Using performance contracting to finance cost-effective energy improvements

Automating Infrastructure Management

Agencies are expected to continue their efforts to implement automated monitoring, inventory, and management tools (such as data center infrastructure management [DCIM] software) in

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their data centers with the goal of eliminating manual processes necessary to collect and report data center operational data, including systems, software, and hardware inventories.

Any significant data center projects that received Development, Modernization, and Enhancement (DM&E) funds in fiscal year 2017 or later are required to implement automated monitoring and management tools. Implementation of such tools is considered a best practice and should be implemented wherever possible, particularly in agency data centers larger than 100 kilowatts (kW).


TIP

The Technology Modernization Fund (TMF), authorized by the Modernizing Government Technology Act of 2017, enables federal agencies to accelerate the DCOI, Application Rationalization, and Cloud Smart initiatives by automating the collection and reporting of all their key data center and application metrics. The solution and corresponding services provide technology to meet an agency's goals. This effort is based on a proven technology and will enable an agency to focus on the following:

- Deploying cost-saving strategies
- Leveraging new or existing investments in DCIM implementation
- Reducing workloads
- Automating manual processes
- Providing greater visibility
- Enabling better decision-making for the following:
  - Further cost savings
  - Security and risk management compliance
  - Complete asset life-cycle management
  - Real-time monitoring for data centers
  - Artificial intelligence (AI) and machine learning (ML) for data centers
  - Automated discovery of hardware and applications

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Tracking Performance Metrics

The new DCOI mandate acknowledges several problems with the performance metric averages used in the original DCOI mandate, including the following:

- Calculations that obscured specific successes and failures within an agency's inventory
- Outliers (for example, a few low-performing data centers) significantly skewing an agency's overall average efficiency
- Establishing metrics that were, in some cases, practically impossible for an agency to achieve
- Limited success criteria (either you met the target average or you didn't)
- Lack of transparency into operational effectiveness and efficiency, as well as ongoing improvement efforts

As a result, performance metrics in the new DCOI avoid the use of target averages, where possible. Instead, metrics are identified that enable agencies to demonstrate continuous improvement with guidelines for reasonable performance based on actual performance baselines.

The new DCOI removes two performance metrics established in the original DCOI (energy efficiency and facility utilization), updates three performance metrics (virtualization, advanced energy metering, and server utilization), and establishes one new metric (availability).


TIP

These measurements are only required for agency-owned, tiered facilities, but they can be used for smaller, nontiered facilities (such as server closets), at the individual agency's discretion, if it's cost-effective and aligned to the agency's mission.

Virtualization

Federal agencies run many applications that often require different operating system versions and application releases. Maintaining a physical server for each of these is costly and doesn't provide application portability, scalability, or elasticity. Virtualization and containerization technologies provide a flexible and lower-cost alternative to hosting applications on dedicated

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physical servers. Multiple virtual workloads or containerized applications can be consolidated on a single physical host server, providing operational efficiencies and reducing capital expenditures and operating costs.


TIP

Running applications in a virtual environment enables IT personnel to deploy services more rapidly. Administrators can provision new applications quickly to meet emerging requirements and respond to shifts in application demand, without dealing with lengthy procurement cycles and having to install physical hardware.


TIP

To ensure alignment with Cloud Smart (see Chapter 2), any new agency applications should use virtualization or containerization technologies whenever possible and appropriate.


TIP

The virtualization ratio mandated in the original DCOI (greater than or equal to four by the end of fiscal year 2020) has been eliminated. Instead, agencies now need to report the number of servers and mainframes in their agency-managed data centers that are being used as hosts for virtualized or containerized systems. The requirement to report cloud investments as part of data center inventories has also been eliminated, but agencies may optionally report these investments as part of their virtualized portfolios to provide a more accurate total count of their virtualized and containerized systems.

Advanced energy metering

The advanced energy metering metric recognizes the value of DCIM software (see Chapter 4) in helping agencies to do the following:

- Identify specific energy-efficiency opportunities and best practices within agency data centers.
- Find *stranded capacity* (underutilized server loads that are limited by the design or configuration of the data center, such as hot spots in an equipment rack that cause servers to overheat when running at full capacity).
- Optimize operational parameters, such as environmental conditions (that is, temperature and humidity) within agency data centers.
- Improve resiliency and reliability in agency data centers with advanced monitoring systems that provide early warning of potential issues, fault detection, and alarms and identify predictive maintenance and energy and demand savings opportunities.

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TIP

The updated advanced energy metering metric eliminates the previous DCOI requirement to calculate the ratio of gross floor area (GFA) of an agency's energy metered data centers to the GFA of *all* the agency's data centers, both metered and nonmetered.



TIP

To learn more about DCIM software, download a free copy of *DCIM For Dummies* at `www.nlyte.com/resource/dcim-for-dummies`.

The new DCOI advanced energy metering metric is simply the total number of facilities that have advanced metering capabilities installed within a majority of the space. Agencies are required to have sufficient advanced energy metering and submetering capabilities to accurately estimate power usage effectiveness (PUE; see the sidebar) for agency data centers over 100 kW that are not planned for closure.



TIP

Although the energy-efficiency metric and associated PUE targets have been eliminated from the DCOI, OMB still uses PUE for statistical purposes and encourages agencies to report energy-related cost savings and avoidance achieved in their data centers.

Server utilization

The Federal Information Technology Acquisition Reform Act (FITARA) requires OMB to track server efficiency, among other data center efficiencies. The updated DCOI server utilization metric acknowledges the difficulty in correlating server utilization to server efficiency (that is, equating high server utilization to high server efficiency). Challenges with server utilization measurements under the original DCOI mandate include the following:

- Lack of context about expected usage, such as citizen-facing systems and agency mission
- Failure to account for normal operating (or peak) hours
- Mission-critical, redundant systems configured for active–passive failover or unexpected load
- Servers used for system and data backups
- Hardware refresh cycles that improve efficiency but reduce utilization with newer, more advanced server equipment that delivers more processing power and storage

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POWER USAGE EFFECTIVENESS

PUE is the ratio of the total data center energy used to the total IT equipment energy used. To calculate PUE, you need to have the ability to monitor and track the data center's energy consumption by both of the following:

- **The IT equipment:** The denominator of the PUE ratio is the average energy used by the IT equipment in the data center. This is the energy going into the server racks that are doing actual productive computation, as well as the energy used by ancillary equipment.
- **All the other things that use electricity in the data center:** Any energy consumed in the data center that does not go directly to IT equipment (such as lighting, heating, cooling, air circulation, security, and so on) is added to the energy used by the IT equipment to form the total average data center energy usage.

Software tools designed to make such measurements and associated metering hardware are essential to meeting this goal.

There are two ways to decrease the value of a ratio:

- Decrease the value of the numerator.
- Increase the value of the denominator.

The simplest way to drive down the PUE ratio is to reduce the amount of energy consumed by anything that is *not* IT equipment. This reduces the numerator without reducing the denominator, thus reducing the PUE. One such intervention may be to reduce the amount of lighting in the data center. If in the normal course of operation, there is little need for humans to be present, there is little need for artificial lighting.

Newer large data centers are largely run autonomously, so they're already dimly lit, which means you have to look elsewhere for an easy PUE reduction.

Another possible intervention would be to increase the energy efficiency of any assets in the data center that are not classified as IT equipment.

DCIM software can provide real-time monitoring of energy usage and cooling effectiveness. This information gives management insight into where to look for interventions that could reduce the data center's PUE.

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WARNING

Servers running at the target utilization levels established in the original DCOI requirement may actually be at greater risk of failure or poor performance due to overutilization.



REMEMBER

The goal of the server utilization metric is to help agencies identify and reduce underutilized servers. When you can accurately identify servers that are not being used productively, it's easier to determine which ones are ripe for decommissioning. Sending unproductive servers out to pasture reduces electricity usage and the physical footprint in the data center floor.

An operating system running applications on a server knows when it's busy and when it's idle. In a virtualized environment, the underlying native operating system knows when it's busy and when it's idle based on the activity (or inactivity) of the virtual workloads that it's hosting. That knowledge of busy time versus idle time must be surfaced to an application that monitors activity for DCOI purposes. Often, such applications are under the purview of an agency's application management team, rather than a facilities team.



TIP

The Cloud Smart initiative (see Chapter 2) helps to drive alignment among agency software engineering, facilities, and security teams. DCIM software can help these teams coordinate their efforts to achieve the goals set forth in the DCOI, Application Rationalization, and Cloud Smart mandates (all discussed in Chapter 2).

Availability

Data center availability (not server uptime or application availability) is a new metric introduced in the DCOI update. Although it does not set required availability thresholds, it mandates that agencies should, at a minimum, establish service availability guarantees that are comparable to those established in commercial infrastructure provider facility service-level agreements (SLAs).

Agencies are required to report the planned availability and any unplanned outages that affect a majority of the facility, both measured in hours, for each of their data centers. Unplanned outages may be due to the following:

- Disaster
- Systems failure

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- Cybersecurity incidents
- Other events that cause a facility to be unavailable when it would have otherwise been planned as available

When establishing priorities, agencies should put their mission goals first, and then prioritize the DCOI requirements as follows:

- Data center consolidation and closure
- Data center optimization in the following order:
  - Virtualization
  - Availability
  - Advanced energy metering
  - Server utilization

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IN THIS CHAPTER

- Knowing what you need to do to comply with the DCOI
- Looking at DCIM software components and aligning them to the DCOI
- Leveraging DCIM software to address the modernization and optimization pillars

Chapter 4
Addressing the DCOI Requirements with DCIM Software

The Data Center Optimization Initiative (DCOI) is complicated, but you don't have to go it alone. Data center infrastructure management (DCIM) software can help you comply with the DCOI and take a lot of the stress out of the whole process. In this chapter, I show you what you need to know in order to comply with the DCOI, introduce you to DCIM software, and explain how DCIM software can help.

Complying with the DCOI Mandates

You can do many things to move your agency toward the goals set forth by the DCOI. For example, many applications running on a dedicated physical server can be virtualized and consolidated on shared servers. Other applications may be candidates for containerization or migration to the cloud. Virtualizing, containerizing,

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and moving applications to the cloud will help with the data center optimization goal of the DCOI. As a bonus, the original server can then be retired, thereby reducing ongoing support and maintenance costs.

Another change, which just involves the placement of physical assets, is to eliminate anything from the data center that does not need to be there, along with the square footage of real estate occupied. Shrinking the data center down to the immediate vicinity of the server racks potentially enables further data center consolidation and optimization.

The DCOI also requires automated infrastructure management, advanced energy metering, data center availability reporting, and other monitoring and reporting. In most cases, this is best performed by software specifically designed to perform those tasks — DCIM software.



REMEMBER

The DCOI specifically mandates that DCIM software be installed in all agency data centers that are subject to the DCOI.

Defining DCIM Software

DCIM software is a suite of software tools that provides a structured approach to managing a data center. It bridges the facilities aspects and the IT aspects of the data center. In the specific case of an agency data center that is working toward complying with the mandates of the DCOI, the suite should include purpose-built modules that are specifically tailored to help agencies report and validate their data center optimization efforts.

Looking at DCIM software components

A well-designed DCIM solution quantifies the costs associated with moving, adding, or changing equipment on the data center floor. It understands the cost and complexity of operation of those assets, and clearly identifies the value that each asset provides over its lifespan. The views provided by DCIM software bring together the IT and facilities worlds.

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TIP

Key components and capabilities of a robust DCIM solution include the following:

- **Asset life-cycle management**
  - Get detailed information about assets and environment.
  - Leverage intuitive, drill-down dashboards and customizable reporting.
  - Gain flexibility to work in any environment.
  - Ensure support for receiving, provisioning, changes, tech refresh, and decommissioning processes and workflows.
- **Capacity planning**
  - Visualize space, cooling, power, network connections, storage, and virtualization.
  - Enable proactive rather than reactive data center management.
  - Provide accurate data center lifespan predictions.
- **Real-time data collection**
  - Track power cooling, central processing unit (CPU) usage, and alarms.
  - Integrate real-time analytics into artificial intelligence (AI), machine learning (ML), and third-party systems.
  - Avert bottlenecks with comprehensive visibility of operations.
- **Automated workflow and change management**
  - Coordinate activities across independent agency and department resources.
  - Ensure that change management requests are completed accurately and submitted and approved 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, and change processes.
  - Deliver end-to-end visibility of time and costs.

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- Automate physical assets to configuration item (CI) reconciliation.
- Gain visibility of physical connectivity dependencies.
- Validate locations.
- Map virtual to physical dependencies.

» **Audit and reporting**

- Log all asset changes completely and accurately.
- Verify that the proper configuration was executed according to the request.
- Automate reports to reduce labor-intensive, repetitive, and error-prone manual processes.
- Identify key metrics instantly.

Figure 4-1 shows how DCIM software is positioned 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 all monitored and controlled by the DCIM processes, which, in turn, interface with the virtual infrastructure overseen by the IT function. The DCIM suite provides an overview of system health and functioning, and enables drilling down to any desired level of detail for fine-grained control of operations.

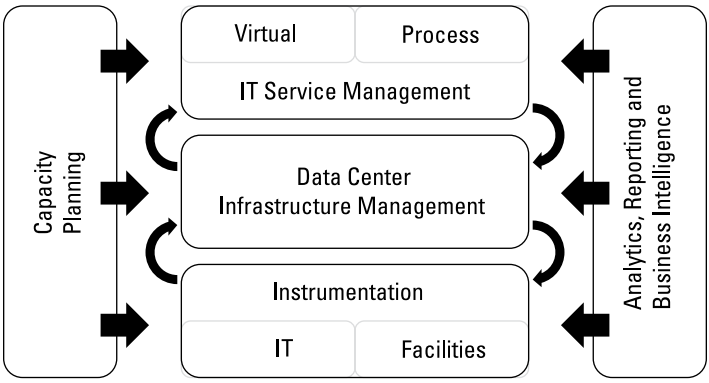


FIGURE 4-1: DCIM software is the layer of infrastructure that supports the agency's IT function.

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Aligning DCIM software to the DCOI mandates

Commercially available DCIM packages were originally developed for enterprise data centers, which have much in common with federal data centers but without the need to comply with the DCOI. In many cases it would probably be good for them to do so, because it would save them considerable money.



TIP

Full-suite DCIM software vendors, such as Nlyte, are addressing the federal market with products that are specifically aimed at helping federal data centers comply with the DCOI mandates. Some of these products are designed to help with data center optimization, while others concentrate on cost reduction. Some even provide guidance as to which data centers should be closed.

Optimizing data centers

Before you can implement procedures to optimize a data center, you must have a clear idea of its current state. DCIM software with asset life-cycle management functionality can give you that insight. Ideally, asset life-cycle management will be in place from the inception of the data center all the way to its ultimate decommissioning.

When you have a clear idea of a data center's current state, you'll understand what can be easily done, what can be done with more difficulty, and what cannot be done cost-effectively.

A DCIM package with power metering capability will address both the DCOI's automated infrastructure management and advanced energy metering requirements.

Beyond mere visibility, if your DCIM package enables you to run "what if" scenarios where you eliminate or replace some of the assets you have, and then see what effect those changes have on power usage effectiveness (PUE), you'll be able to make effective interventions and avoid making changes that have a negligible impact. Figure 4-2 shows a view of one of the screens of the Nlyte Energy Optimizer, which monitors and tracks energy consumption. The PowerView feature provides power chain analysis, giving fast and accurate insight into power capacity and availability.

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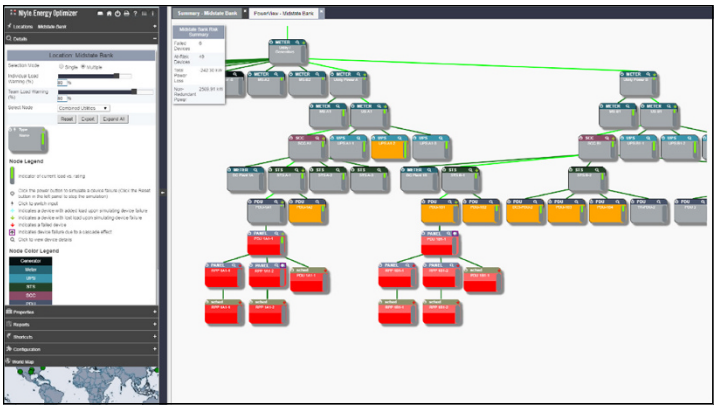


FIGURE 4-2: The Nlyte Energy Optimizer.

To address the server utilization metric, you need a DCIM product that is capable of reporting on the percent of time a server spends idle. Continuous and automated monitoring is the only accurate way to do this. Some system monitoring tools that you already have may do this. If so, your DCIM software needs to be able to integrate with what you have.



TIP

Virtualization software is probably not a product that you would find in the portfolio of a DCIM software vendor. That being the case, you want to select a DCIM vendor that has a prebuilt integration to the virtualization product that you're using.

In order to keep track of all these things in an easy-to-comprehend way, you also want a DCIM product that provides customizable dashboards that can track all the DCOI mandates and compare them against the actual state of the data center in a single pane of glass. Figure 4-3 shows a typical DCIM dashboard.

Reducing some costs and avoiding others

To save on costs, you must understand where your money is going right now. Only when you have that knowledge can you take effective steps to reduce costs. When you have a full DCIM suite in place, that tracks and manages both a data center's IT and facility assets, you have a view of which assets are and are not being productively employed. From there, it's easy to decide which steps to take to reduce costs without compromising productivity or weakening security.

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FIGURE 4-3: The Nlyte main operational dashboard.

Closing data centers

You must assume that if a data center exists and is operational, then it must be doing at least some useful work. As a prelude to closing a data center, that useful work must be transferred somewhere else. The Office of Management and Budget (OMB) is encouraging agencies to rise above any silo mentality that may exist and find a place with excess computational resources that can accept work from a data center that is closing down, even if that place is located in a different agency.

Mandated data center closings will continue, but further candidates for closure will become more difficult to identify, because the "low-hanging fruit," in most cases, has already been identified and closed. This will call for major evaluations of the value of the work being done at each data center. If that work is worth continuing, a new place for it must be found. Agencies should use risk-based decision-making and service delivery when considering cloud-based options, in alignment with the Cloud Smart strategy. If the data center facing closure has DCIM software, it will show exactly what resources are needed by running applications, and that requirement can be matched with the excess

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capacity of a destination data center that is also running DCIM software.


REMEMBER

Many DCIM products are available. Some address only one or a small number of tasks that are needed to monitor and manage a data center, others offer a more complete suite of functions, and still others cover the full gamut of functionality. You can cobble together a system from multiple products supplied by multiple vendors, but that isn't the best way to have a well-integrated, smoothly running system with a consistent look and feel across the board.


TIP

When shopping for a DCIM solution to monitor the operational parameters of your data center, look for a vendor with a track record and with a product that covers all the bases. Doing so will give you the best chance of meeting the goals of the DCOI. It will also be critical to keeping your data centers running smoothly.

Extending DCIM Software to the Modernization and Optimization Pillars

The updated DCOI mandate, along with the Application Rationalization and Cloud Smart mandates, form three pillars of government modernization and optimization (see Chapter 2).

A comprehensive DCIM solution does the following:

- Binds the DCOI components providing data center optimization
- Leverages AI and ML to provide the foundation for Cloud Smart
- Provides asset life-cycle management to deliver Application Rationalization

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GETTING SMART ABOUT YOUR CLOUD SMART STRATEGY

Although the Federal Data Center Consolidation Initiative (FDCCI) drives agencies to adopt a cloud strategy, it must be done smartly. A cloud migration is a journey, and it's quite a long one for well-established private-sector enterprises. Given current industry feedback, most large organizations discover that some portion of their current IT infrastructure — roughly 20 percent — should or needs to remain in a physical data center. These applications remain due to compliance concerns, cost of operating from an owned asset versus an on-demand operating basis, or the need for low-latency performance provided by edge computing infrastructure. Whatever the case, DCOI reporting provides the analytics to guide your decisions, processes, and ongoing management of infrastructure placement. DCIM software is as much for planning today's hybrid IT strategy as it is for long-term infrastructure optimization.

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Chapter 5
Ten (Or So) Questions to Ask a DCIM Vendor

A data center infrastructure management (DCIM) package is a key piece of infrastructure. It forms a bridge between IT and the facilities aspects of a data center, and it facilitates the smooth execution of workflows. Even if the Data Center Optimization Initiative (DCOI) didn't mandate that every federal data center in the DCOI program have DCIM software, it would make a lot of sense to have it anyway. Products containing modules specifically designed to address the mandates of the DCOI are the cream of the crop.

Here are some questions to ask when you're considering a DCIM vendor's solution:

- **Does your product address all four DCOI optimization metrics?** For tiered data centers, the target values of all four DCOI optimization metrics (virtualization, advanced energy metering, server utilization, and availability) must be achieved by the end of fiscal year 2020. There are two possible ways to do this:
  - Procure a full-featured solution that addresses all the metrics.

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- Piece together a solution from the offerings of vendors that have more limited capabilities, and hope that they work together, without leaving any gaps and without interfering with each other.



TIP

It makes sense to go for the first option, which provides a consistent user interface across all functions.

- **Do you have a comprehensive DCIM suite that covers the entire data center life cycle?** Covering the four DCOI metrics is one thing, but a DCIM suite must do much more than that. Your DCIM suite needs to help you throughout the entire life cycle of your data center, from the day you power it up to the day you shut it down.

  There are different things to be concerned about at different stages of the life cycle. Your DCIM suite should provide the information and management functionality you need throughout all those stages.

- **Do you have a long-established roster of federal clients who can vouch for deployment success?** Nothing instills confidence in a vendor like a track record of success in providing similar services to similar customers. Doing business with the government is very different from doing business with commercial enterprise customers. A vendor that understands the ins and outs of doing business with the federal government will be a lot easier to work with than one with an existing customer base that is largely or entirely made up of commercial enterprises.

- **Is DCIM software key to your business, or is it peripheral?** The comprehensiveness of a DCIM solution is likely to depend on its overall importance to the vendor's business. A vendor founded to provide a DCIM product and totally committed to making that product a success is more likely to develop a product with more depth and comprehensiveness than a vendor whose main emphasis is elsewhere and for whom DCIM software is a minor part of its overall business. Companies that "bet the business" on a single product line have more at stake and are more likely to make sure customer needs are met and continue to be met over the long term.

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- **Is your solution hardware agnostic, or are you trying to sell me hardware along with your software solution?** When a vendor shows up to perform a service at your facility, is it also on the lookout for additional things it can sell you? Not only is that annoying, but it could also mean that the vendor's number-one priority is something other than meeting the need that you called it for. Look for vendors that are exclusively dedicated to providing you with a DCIM solution that meets your needs.

  
  REMEMBER

  Adding more hardware is counterproductive. You're trying to minimize hardware!

- **Do you provide a workflow to link facilities to IT?** Traditionally, IT and facilities are two different worlds, with two different staffs and two different fields of expertise. However, those two different worlds need to mesh together harmoniously. A complete DCIM solution incorporates a workflow that links the two realms.
- **Do you have prebuilt integrations to IT service management (ITSM) solutions such as ServiceNow, BMC, and HPE?** Your DCIM solution needs to be able to exchange information easily with your existing or planned ITSM solution. Make sure the integration capability that you need will be available.
- **Do you meet stringent security thresholds certified by a third-party security auditor?** Practically every day, there is a new report of an organization being attacked and sensitive or classified information being compromised. Often, these cyberattacks succeed because of flaws in code. It takes a knowledgeable third-party security auditor to thoroughly vet the code of a DCIM solution and provide high confidence that the system won't be breached. Ask about relevant certifications and accreditations.
- **Do you provide top-quality after-sales support and professional services?** Talk to some of the vendor's existing customers to get the answer to this question, preferably customers that are similar to your agency. Ask the vendor for referrals, but also do some investigating on your own so that you talk to some people with a more objective opinion who are not necessarily among the vendor's "hero" customers for whom the vendor can "do no wrong."

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- **Do you provide simple-to-customize dashboards that can be configured to track actual performance against all the DCOI mandates?** If moving toward compliance with the DCOI mandates is a priority, you want to be able to track how you're doing right now, as well as whether you're making progress toward the target goals. A dashboard specifically configured to provide that information will make it easier for you to monitor progress and see which of the interventions you employ are most effective.
- **Does your product have the ability to calculate utilization in a server, and also take advantage of any data that is being collected by other tools?** Processor usage and storage space are key factors in the calculation of one of the DCOI's four optimization metrics (server utilization). You need a product that can measure it, or at least be able to receive it from an existing tool that already collects that data.
- **Does your product have native discovery, inventory, and artificial intelligence from machine learning?** The ability to support your Application Rationalization and Cloud Smart goals becomes much simpler if your solution comes from a single vendor that can provide a single source of truth across your agency's IT modernization needs.

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Satisfy the DCOI mandates

The data centers of most federal agencies must comply with the requirements of the Data Center Optimization Initiative (DCOI). The latest update of the DCOI mandates the implementation of automated monitoring and management tools, such as data center infrastructure management (DCIM), in any new data center development, significant data center expansion, and data center migration projects. DCOI has also been aligned to the Cloud Smart initiative and, along with Application Rationalization, now forms the three pillars of government modernization and optimization.

Inside...

- Discover what the updated DCOI requires
- Learn how DCIM helps with DCOI compliance
- Align your strategy with Cloud Smart
- Report metrics for continuous improvement
- Adopt virtualization and containerization
- Know what to look for in DCIM software



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