DATA CENTER KNOWLEDGE

THE INFORMATION SOURCE FOR THE DATA CENTER INDUSTRY

Data Center Knowledge Guide to

Data Center Infrastructure Management (DCIM)

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Overview of DCIM

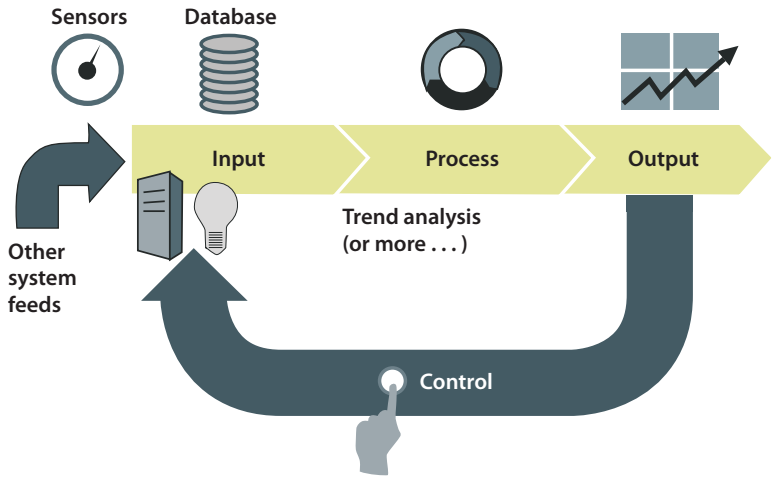
Today's data centers are more complex, more interdependent and more critical than ever before. This has led to the need for more intelligent and automated IT infrastructure management. The tools which enable the data center team to effectively and efficiently operate this complex environment have been grouped into a classification of solutions known collectively as Data Center Infrastructure Management (DCIM). Gartner defines DCIM as "tools that monitor, measure, manage and/or control data center use and energy consumption of all IT-related equipment (such as servers, storage and network switches), and facilities infrastructure components (such as power distribution units [PDUs] and computer room air conditioners [CRACs])." Multiple DCIM models have been put forth by analyst firms such as Gartner, Forrester and the 451 Group. While similar in many respects, there are subtle differences between the various views of DCIM.

Contents

DCIM Models

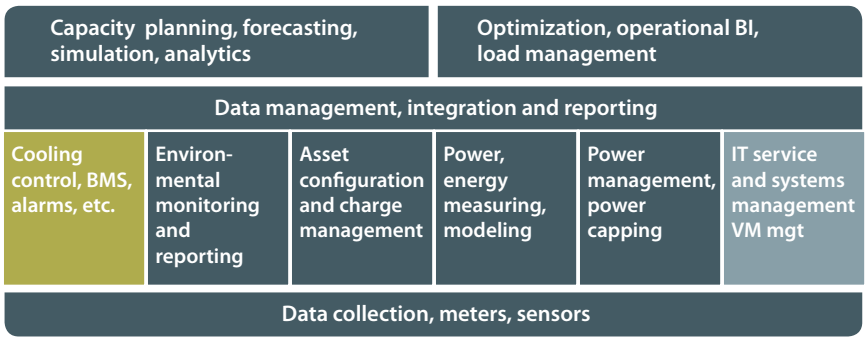
In the Gartner model, the primary components of a DCIM solution are Input, Process and Output. Various sensors and other system feeds (BMS system, user input, etc.) comprise the **input**. This raw data then sent through an analysis **process** to create actionable data — real information which can be used to manage the data center. The processed data is then presented as **output** to the user, perhaps in the form of a dashboard or trend graph, and is also used as control data back into the input component.

Gartner DCIM Model



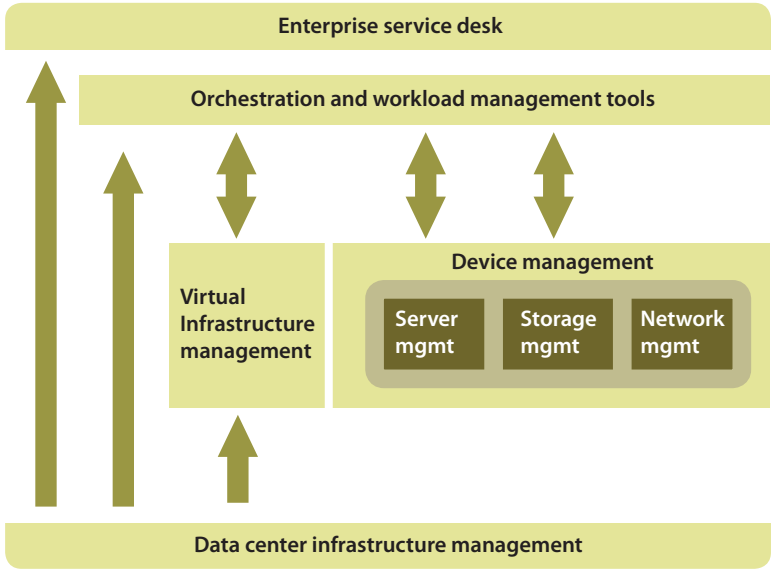
The 451 Group model breaks down DCIM into functional blocks, with data collection at its base. The data is used as input to the other functional areas, including Asset and Change Management, Environmental Monitoring, Power and Energy Measuring and Modeling, Power Management and IT Service and Systems Management. A data management layer integrates data from the lower layers to facilitate reporting as well as providing input to higher level planning, forecasting and optimization layers.

The 451 Group DCIM Model



The Forrester model focuses on DCIM as a component of the overall data center management architecture. In this model, DCIM interacts with other management systems, with DCIM tools providing input to virtual infrastructure management, workload management tools and the enterprise service desk. In the report *Put DCIM Into Your Automation Plans,* Galen Schreck says, "The long-term value of DCIM is tied to a product's ability to integrate with other system management tools or orchestration tools that optimize data center workloads. The winners will be those DCIM platforms that achieve wide adoption and forge integration with key management vendors like BMC, CA, HP, IBM, Microsoft, and VMware.

The Forrester Model



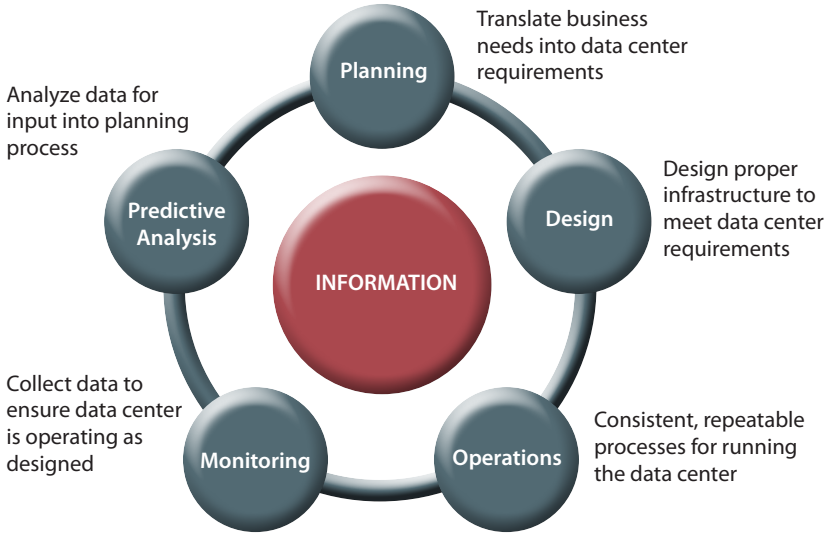
While the DCIM models vary in many ways, there are some key similarities found in each:

- DCIM provides actionable data for data center management
- DCIM requires instrumentation in order to gather data center metrics
- DCIM is not a standalone solution, but is instead a component of a comprehensive data center management strategy

Why Do I Need DCIM?

There are a number of benefits in implementing a DCIM solution. To illustrate this point, consider the primary components of data center management.

Data Center Management Components



In the ***Design*** phase, DCIM provides key information in designing the proper infrastructure. Power, cooling and network data at the rack level help to determine the optimum placement of new servers. Without this information, data center managers have to rely on guesswork to make key decisions on how much equipment can be placed into a rack. Too little equipment strands valuable data center resources (space, power and cooling). Too much equipment increases the risk of shutdown due to exceeding the available resources.

In the ***Operations*** phase, DCIM can help to enforce standard processes for operating the data center. These consistent, repeatable processes reduce operator errors which can account for as much as 80% of system outages.

In the ***Monitoring*** phase, DCIM provides operational data, including environmental data (temperature, humidity, air flow), power data (at the device, rack, zone and data center level), and cooling data. In addition, DCIM may also provide IT data such as server resources (CPU, memory, disk, network). This data can be used to alert management when thresholds are exceeded, reducing the mean time to repair and increasing availability.

In the ***Predictive Analysis*** phase, DCIM analyzes the key performance indicators from the monitoring phase as key input into the planning phase. Capacity planning decisions are made based during this phase. Tracking the usage of key resources over time, for example, can provide valuable input to the decision on when to purchase new power or cooling equipment.

In the ***Planning*** phase, DCIM can be used to analyze "what if" scenarios such as server refreshes, impact of virtualization, and equipment moves, adds and changes.

If you could summarize DCIM in one word, it would be **information**. Every facet of data center management revolves around having complete and accurate information.

DCIM provides the following benefits:

- Access to accurate, actionable data about the current state and future needs of the data center
- Standard procedures for equipment changes
- Single source of truth for asset management
- Better predictability for space, power and cooling capacity means increased time to plan
- Enhanced understanding of the present state of the power and cooling infrastructure and environment increases the overall availability of the data center
- Reduced operating cost from energy usage effectiveness and efficiency

In his report, *Datacenter Infrastructure Management Software: Monitoring, Managing and Optimizing the Datacenter,* Andy Lawrence summed up the impact of DCIM by saying "We believe it is difficult to achieve the more advanced levels of datacenter maturity, or of datacenter effectiveness generally, without extensive use of DCIM software." He went on to add that "The three main drivers of investment in DCIM software are economics (mainly through energy-related savings), improved availability, and improved manageability and flexibility."

One of the primary benefits of DCIM is the ability to answer questions such as the following:

1. Where is my data center asset located?
2. Where is the best place to place a new server?
3. Do I have sufficient space, power, cooling and network connectivity to provide my needs for the next 6 months? Next year? Next five years?
4. An event occurred in the data center — what happened, what services are impacted, where should the technicians go to resolve the issue?
5. Do I have underutilized resources in my data center?
6. Will I have enough power or cooling under fault or maintenance conditions?

Without the information provided by DCIM, the questions become much more difficult to answer.

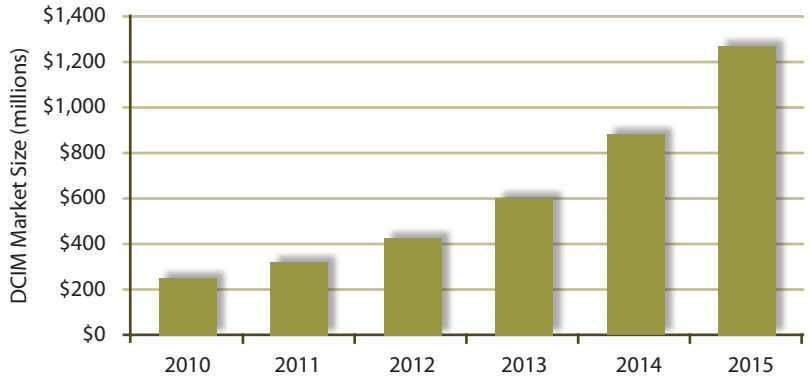
DCIM Market

The DCIM market is growing at a rapid pace as data center managers recognize the benefits such a solution could provide in helping them to manage their data centers. DCIM vendors have provided anecdotal evidence of this increased interest, stating that questions from potential customers at trade shows have progressed from "What is DCIM?" to "Which DCIM solution would be best for addressing my problems?". There are a number of factors which are driving the increased interest in DCIM, but there are two primary demand drivers. First, the increased complexity of the data center architecture, including higher densities and virtualization, has exceeded the capabilities of managing through the use of spreadsheets. Second, there are financial pressures, particularly when it comes to the need to decrease energy costs. The drive toward higher efficiency is also being pushed through legislation and industry standards, including the EPA Energy Star program for data centers and the European Union Code of Conduct.

> ***"The DCIM market was worth US$245m in annual revenue in 2010, and it will grow to $1,247m in 2015 — a growth rate of 39% a year."***
>
> ***Andy Lawrence***

When asked about the key topics of interest to data center managers in the Data Center Knowledge audience survey in August 2011, DCIM was the newest and fastest rising area of interest at 70%. Based on polling at the December 2011 Gartner conference, Jay Pultz reports that "More than 60% of the data center managers that Gartner polled will have implemented data center infrastructure management (DCIM) tools at some point in 2013 — with penetration climbing to 90% by 2015." Pultz recommended that data center managers should not wait to begin the DCIM evaluation process.

DCIM Market Expansion 2010 – 2015



Source: 451 Research

"For clients who have not yet purchased DCIM, evaluate DCIM tools, including pilot testing," he suggested. He added "If the evaluation is positive, then include operationalizing DCIM in your 2013 budget. Make DCIM a mandatory requirement for all major data center builds and refurbishments."

Prior to evaluating DCIM tools, however, it is very important to put together a detailed list of requirements. Since DCIM is intended to provide information, the requirements list should focus on the information you need to manage your data center. Based on your specific requirements, one DCIM solution might be a better fit than the others.

DCIM Functionality

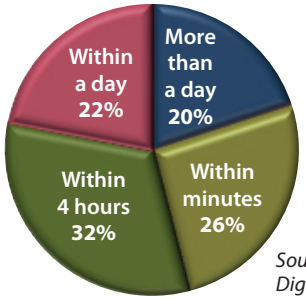
With more than 100 companies offering some type of DCIM solution (see Appendix 1 for a partial list), it is difficult to narrow down a defined set of functional components." There are some common elements found in many of the solutions, however.

Asset/Change/Configuration Management

Asset management is a key component of DCIM. A data center can contain thousands of assets, from servers, storage and network devices to power and cooling infrastructure equipment. Tracking these assets is an ongoing and often monumental task. A Digital Realty Trust survey asked data center managers how long could it take to find a server that has gone down. Only 26% of the respondents said they could locate the server within minutes. Only 58% could find the server within 4 hours and 20% required more than a day. The inability to locate equipment in the data center increases the mean time to repair (MTTR) for the equipment and decreases the overall availability.

Asset management encompasses more than simply locating a data center asset, however. It also involves knowing detailed information about the asset's configuration. Consider a server, for example. It may be powered by one or more rack power strips. Disconnecting these power sources will shut down the server. The server may be connected to one or more switches or routers. Rerouting these network devices may make the server unreachable. The server may host multiple virtual machines. Shutting down the server will disable these virtual machines. Without knowing the details of the server configuration, it is very difficult to make reasonable decisions concerning that server and its supporting infrastructure. Changes to any part of the configuration may render the server — and its associated services — unusable.

How Long Could It Take to Find a Server?



Source: Digital Realty Trust

In order to accurately manage assets and their detailed configurations, we must also manage change. It is estimated that change is often the cause of as much as 80% of system downtime and that 80% of mean time to repair (MTTR) is used trying to determine what changed. Change management therefore becomes an important part of a DCIM solution. In the book The Visible Ops Handbook: Implementing ITIL in 4 Practical and Auditable Steps, the authors examined a number of high performing IT organizations and found that by just looking at the scheduled and authorized changes for an asset (as well as the actual detected changes on the asset) problem managers could recommend a fix to the problem over 80% of the time, with a first fix rate of over 90%. The authors also found that organizations which implemented automated change auditing were "surprised and alarmed to see how many changes are being made 'under the radar'." The ability to track both authorized changes and detected changes — changes made but not necessarily authorized — is key DCIM functionality which can reduce MTTR and increase overall system availability.

Real-Time Monitoring

There are three categories of real-time monitoring systems in the data center:

- *Building Management System (BMS) –* A BMS is typically a hardware-based system utilizing Modbus, BACnet, OPC, LonWorks or Simple Network Management Protocol (SNMP) to monitor and control the building mechanical and electrical equipment. These are often custom-built systems priced on the number of individual data points being monitored (a data point might be the output load on a UPS or the return temperature on a computer room air conditioner unit). In some cases, the BMS system is extended into the data center to monitor and control power and cooling equipment.
- *Network Management System (NMS) –* An NMS is typically a software-based system utilizing SNMP to monitor the network devices in the data center. Network devices can usually be auto-discovered, so installation can be automated to some degree.
- *Data Center Monitoring System (DCMS) –* A DCMS can be hardware-based and/or software-based and is used to monitor a data center or computer room. Device communication is typically done using SNMP, although some data center monitoring systems can also communicate using Modbus, IPMI or other protocols.

There are some important attributes to consider when evaluating the real-time monitoring capabilities of a DCIM solution. One of the key considerations is what devices you intend to monitor. The answer to this question may have the biggest impact on the solution chosen.

If, for example, you want to monitor some devices which use SNMP to communicate and others which use Modbus, it would be important to choose a solution which supports both SNMP and Modbus protocols. Avoid solutions which only work with one vendor's specific equipment as you will then need to purchase multiple disparate systems to monitor your entire data center. Ideally, you want a DCIM solution that can work with a wide variety of hardware "out of the box" — in other words, without any vendor customization — and can also integrate with other existing monitoring systems such as a BMS.

Another attribute to consider is whether or not the real-time monitoring utilizes a hardware component. There is nothing inherently wrong with a hardware-based system. In fact, a hardware-based system may be capable of gathering data more quickly and frequently than a software-based system. Depending on the number of hardware components required and the price of each component, however, the hardware cost may cause the overall DCIM solution to become prohibitively expensive.

One additional attribute to consider is whether or not the system supports auto-discovery of devices. Auto-discovery provides many benefits, including faster, easier installation and less chance for user error in manually configuring a device. It is important to note that not all devices can be auto-discovered as discovery is dependent on the device configuration and the communication protocol used (SNMP devices can usually be discovered while Modbus devices cannot, for example).

Workflow

Many data centers have implemented at least some level of ITIL-like processes. A DCIM solution can help you to orchestrate these processes. For example, the installation of a new server typically has multiple steps, some of which may be performed by different groups within the data center.

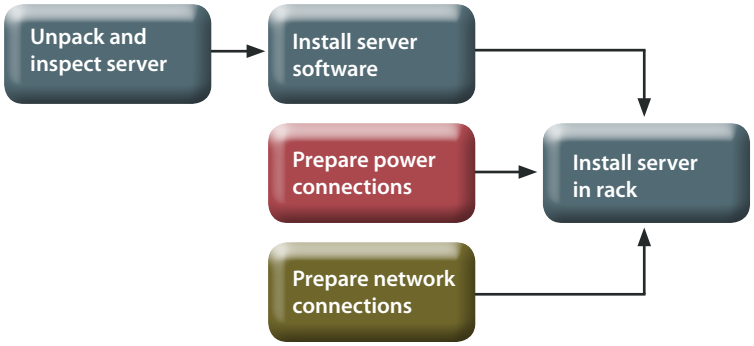
A DCIM solution might allow tracking of the various steps, with different groups able to report status of their individual tasks in order to verify that all required steps have been completed. In this case, workflow functionality will coordinate the server installation steps so that all preparatory work been completed before the technician installs the server in the rack, thereby streamlining the entire process.

It is important that the workflow functionality provided by the DCIM tool is adaptable to work within your defined process structure rather than having to modify your processes to match a pre-defined workflow.

Analytics and Reporting

Another important capability of a DCIM solution is data analysis and reporting. With thousands of devices in the data center each reporting multiple measurements, the amount of data collected can quickly become overwhelming. It is imperative that the DCIM tool can quickly sort through this data and provide actionable recommendations for the management team. These recommendations can be presented in the form of alarm messaging, graphing of historical data to show changes over time, dashboards and reports. The DCIM tools may come with pre-defined reports but should also support ad hoc reporting based on user-selectable parameters.

New Server Installation



Visualization of the Physical and Virtual Infrastructure

One important component of a DCIM solution is the ability to view the physical and virtual infrastructure. The DCIM tools on the market today vary widely in their capabilities here. Some interact with visualization tools such as AutoCAD or Visio, while others provide a visual editor to allow you to lay out your infrastructure entirely within the tool. While most of the current solutions provide top-down views, some also provide 3-D views with the ability to "fly through" the data center. Many solutions provide various layered views of the data center with the ability to view various parameters such as temperature, rack utilization, power and so on.

This visual view is typically extended down to the rack level, with DCIM tools providing a visual view of the devices in the rack. This view shows the actual location of a device within a rack and also serves to provide additional data such as the temperature in the rack at various points and the power usage within the rack.

User Interface

If DCIM boils down to information, a good DCIM user interface boils down to providing that information in such a way as to allow the user to make informed decisions. In his white paper *Five Essential Components of an Elegantly Engineered Data Center Operating System,* Kevin Malik describes the importance of the DCIM user interface, saying "It is essential for a data center operating system to have an intuitive interface so users can quickly navigate through alerts, review environmental levels and review other detailed analytics." He goes on to add, "Companies should be able to customize the views of real-time data of mechanical, power, cooling and electrical usage so decision-makers see information needed based on their roles to optimize data center operations."

Like the visualization component, DCIM user interfaces vary widely in both their look and feel and their overall capabilities. While most DCIM products are web-based, allowing access to the data from anywhere, the user interfaces can take many forms, including dashboards, touch screen technology, and application support for hand-held devices such as iPads and smart phones.

Capacity Planning

One of the primary uses for the data collected by DCIM applications is to provide information for capacity planning. Data centers operate most efficiently when they maximize the use of key resources, particularly power and cooling. By storing the resource consumption over time and analyzing growth patterns, data center managers can more accurately predict when a given resource will be exhausted. Through the use of DCIM tools, data center builds can frequently be postponed due to more effective management of key resources.

Integration with Other Data Center Management Solutions

Contrary to what some DCIM vendors might have you believe, DCIM solutions will likely never replace all of the management tools available for the data center space. Typical management solutions include change management, CFD modeling, asset management, building management systems, maintenance management and a number of other third-party or in-house developed tools. A good DCIM solution will provide some type of integration with external systems, ranging from loading Excel spreadsheets to direct database interaction to sophisticated web-based API (application program interface) which might allow the data to be passed both into and out of the DCIM solution.

Getting Started with DCIM

Although similar in many respects, every data center is unique. In choosing a DCIM solution, data center managers might choose very different solutions based on their needs. It is somewhat analogous to two people choosing a lawn care service. One might simply want the grass mowed once a week. The other might want edging, fertilizing, seeding and other services in addition to mowing. As a result, they may choose different lawn service companies or, at the least, expect to pay very different amounts for the service they will be receiving. Before choosing a DCIM solution, it is important to first know what it is you want to receive from the solution.

It is also important to remember that DCIM cannot singlehandedly do the job of data center management. It is only part of the overall management solution. While the DCIM tools, or sometimes a suite of tools working together, are a valuable component, a complete management solution must also incorporate procedures which allow the DCIM tools to be effectively used.

Choosing a DCIM solution

It is important to remember that DCIM solutions are about providing information. The question which must be asked (and answered) prior to choosing a DCIM solution is "What information do I need in order to manage my data center?" The answer to this question is the key to helping you choose the DCIM solution which will best suit your needs. Consider the following two data centers looking to purchase a DCIM solution.

Data Center A

Data Center A has a lot of older, legacy equipment which is being monitored using an existing BMS. The rack power strips do not have monitoring capability. The management staff currently tracks assets using spreadsheets and Visio drawings. The data has not been meticulously maintained, however, and has questionable accuracy. The primary management goal is getting a handle on the assets they have in the data center.

Two different data centers with different sets of DCIM requirements may choose two very different DCIM solutions to meet their requirements for management.

Data Center B

Data Center B is a new data center. It has new infrastructure equipment which can be remotely monitored through SNMP. The racks are equipped with metered rack PDUs. The primary management goals are to (1) collect and accurately maintain asset data, (2) monitor and manage the power and cooling infrastructure, and (3) monitor server power and CPU usage.

While both data centers would likely benefit from DCIM, they may very well choose different solutions. The goal for Data Center A is to more accurately track the assets in the data center. They may choose to pre-load the data they have in spreadsheets and then verify the data. If so, they will want a DCIM which will allow them to load data from spreadsheets. If they feel their current data is not reliable, they may instead choose to start from ground zero and collect all of the data manually. If so, loading the data from a spreadsheet might be a desirable feature but is no longer a hard requirement. Since the infrastructure equipment is being monitored using a BMS, they might specify integration with their existing BMS as a requirement for their DCIM.

Data Center B has entirely different requirements. It doesn't have existing data in spreadsheets, so they need to collect the asset data as quickly and accurately as possible. They may specify auto-discovery as a requirement for their DCIM solution. In addition, they have infrastructure equipment which needs to be monitored, so they will want the DCIM to be able to collect real-time data down to the rack level. Finally, they want to be able to monitor server power and CPU usage, so they will want a DCIM which can communicate with their servers.

Prior to choosing a DCIM solution, spend time determining what information is required to manage the data center. Start with the primary management goals such as increasing availability, meeting service level agreements, increasing data center efficiency and providing upper level management reports on the current and future state of the data center. Next, determine the information you need to accomplish these high level goals. A sample of high level questions you might ask includes the following:

- What data do I need to measure availability?
- What data do I need to measure SLA compliance?
- What data do I need to measure data center efficiency?
- What data do I need to forecast capacity of critical resources?
- What data do I need for upper level management reports?

These questions will begin to define the scope of the requirements for a DCIM solution. As you start to narrow down the focus of the questions, you will also be defining more specific DCIM requirements. For example, you might start with a requirement for the DCIM to provide real-time monitoring. This is still rather vague, however, so additional questions must be asked to narrow the focus.

How do you define "real-time" data?

To some, real-time data might mean thousands of data points per second with continuous measurement. To others, it might mean measuring data points every few minutes or once an hour. There is a vast difference between a system which does continuous measurement and one which measures once an hour. Without knowing how you are going to use the data, you will likely end up buying the wrong solution. Either you will purchase a solution which doesn't provide the data granularity you want or you will over-spend on a system which provides continuous measurement when all you want is trending data every 15 minutes.

What data center equipment do you want to monitor?

The answer to this question may have the biggest impact on the solution you choose. If you have some data center equipment which communicates using SNMP and other equipment which communicates using Modbus, for example, you will want to choose a DCIM solution which can speak both of these protocols. If you want the DCIM tool to retrieve detailed server information, you will want to choose a DCIM solution which can speak IPMI and other server protocols. Prior to talking to potential DCIM vendors, prepare a list of equipment with which you want to retrieve information.

Similar questions should be asked for each facet of DCIM — asset management, change management, real-time monitoring, workflow, and so on — to form a specific list of DCIM requirements. Prioritize the information you need so you can narrow your focus to those DCIM solutions which address your most important requirements.

Implementing DCIM

DCIM typically requires some level of vendor support in the installation and configuration of the solution. This can range from simple installation support to thousands of man-hours of effort to collect asset information and configure the solution. Some DCIM solutions are highly customized, providing a very specific solution but often at a steep price. It is important to factor in the effort and cost of implementation when looking at the overall cost of a DCIM solution.

There are two primary efforts involved with implementing a DCIM tool:

- Collecting asset information
- Configuring real-time monitoring

Collecting Asset Information

What is often lost amidst the "bells and whistles" of DCIM solutions is the cost of collecting and maintaining the asset information. People are often surprised to learn that the cost of gathering the asset data is often as much as or even more than the cost of the management system itself.

Data centers can contain thousands of servers, power and cooling devices, and storage and network devices as well as a myriad of other equipment. It is a very daunting task to collect data about each asset, particularly when starting from scratch. The typical cost to have an outside company collect "readily visible" data (manufacturer, model, location, serial number and device name) is $15 per device. For a data center with 8,000 assets, the initial data collection of basic data would be $120,000. Collecting this data yourself would require 40 man weeks of effort.

Of course, readily visible data likely doesn't include important configuration information you may need to properly manage the devices in your data center. For a server, this information may include the hardware configuration (processor, storage, and memory), network connections, virtual machines and installed software and services. Collecting this information is much more difficult, involving logging

into the server and using various tools to collect the information and then manually entering the collected data. For 8,000 servers, collecting this data could cost $600,000 or require 200 man weeks of effort.

There is another key factor to consider when manually collecting asset data and that is the accuracy of the data. In the Computer Associates technology brief *Striving to Achieve 100% Data Accuracy: The Challenge for Next Generation Asset Management,* the authors point out the difficulty in maintaining the accuracy of manually entered information, saying, "Manual tracking with pen and clipboard, or even spreadsheets is time consuming and highly error-prone. Organizations can typically expect a 10% error rate in manual data entry due to typing and transcribing errors." In a data center with 8,000 assets, a 10% error rate would mean that as many as 800 could have inaccurately recorded data.

In a data center with 8,000 assets, initial collection of basic device information could cost $120,000.

Including detailed system data could drive the data collection cost to $600,000 or more!

There are DCIM products and complementary solutions which address the manual entry of asset information. These systems range from Radio Frequency Identification (RFID) solutions which track the location of assets to auto-discovery solutions which automatically collect detailed device data. These systems can significantly reduce the time and cost to collect the asset information as well as improving the accuracy of the data and providing support for auditing efforts.

Configuring Real-Time Monitoring

The real-time monitoring components provided by many DCIM solutions also require configuration before they can begin to collect data. SNMP is the most often used protocol, but some DCIM tools can also communicate using Modbus, IPMI or other protocols. It is important to remember that all monitoring systems require some method of communicating with a device in order to retrieve data. While most new data center equipment should provide some means of retrieving data and alarms, some legacy equipment may not. Even new equipment may not provide the data communication components as a standard, which means you may need to purchase additional components in order to monitor the equipment.

When comparing DCIM real-time monitoring systems, you should look for those that will work with a wide variety of hardware types (power, cooling, servers, etc.) from a range of manufacturers. A DCIM solution should provide a single pane of glass view of the data center, so avoid tools that only monitor one vendor's specific hardware. As with asset management, some DCIM solutions support auto-discovery of devices, providing a faster, easier installation with support for new devices as they are installed in the data center.

DCIM Return on Investment

As with any investment in the data center, the question of the return on the investment should be raised before purchasing a DCIM solution. In the APC white paper *How Data Center Infrastructure Management Software Improves Planning and Cuts Operational Costs,* the authors highlight the savings from a DCIM solution saying, "The deployment of modern planning tools can result in hundreds of man hours saved per year and thousands of dollars saved in averted downtime costs."

DCIM will not transform your data center overnight, but it will begin the process. In his article *"How to make sure your DCIM deployment works",* Todd Goldman illustrates a DCIM maturity model in which a data center moves from "Managed Chaos" to "Strategic Data Center Planning" over a period of time.

Goldman points out that it isn't necessary to reach full maturity before DCIM begins to pay benefits, saying, "While your end goal might be to reach the upper right quadrant of the DCIM Maturity Model you don't need to have a fully mature DCIM deployment to get tremendous value out of DCIM. In fact, just the first step from managing multiple spreadsheets and floor plan diagrams to getting a consolidated view with a single version of the truth is a small step with huge benefits."

There are three primary methods in which DCIM provides an ROI:

- Improved Energy Efficiency
- Improved Availability
- Improved Manageability

Improved Energy Efficiency

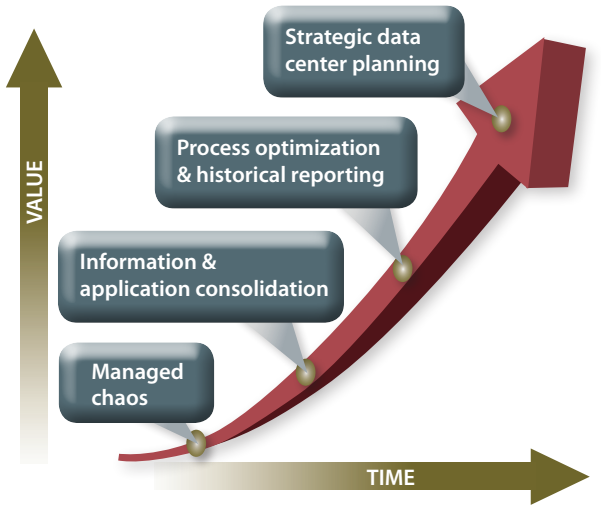
In his blog Dan Fry gets right to the heart of DCIM's role in improving energy efficiency when he says, "To improve energy efficiency inside the data center, IT executives need comprehensive information, not isolated data. They need to be able to 'see' the problem in order to manage and correct it because, as we all know, you can't manage what you don't understand."

The information provided by DCIM can help data center managers in reducing energy consumption:

Matching supply with demand

Oversizing is one of the biggest roadblocks to energy efficiency in the data center. In an APC survey of data center utilization, only 20% of respondents had a utilization of 60% or more, while 50% had a utilization of 30% or less. One of the primary factors for oversizing is the lack of power and cooling data to help make informed decisions on the amount of infrastructure required. DCIM solutions can provide information on both demand and supply to allow you to "right-size" the infrastructure, reducing overall energy costs by as much as 30%.

DCIM Return on Investment



Identifying underutilized servers which could be decommissioned, repurposed or consolidated

As many as 10% of servers are estimated to be "ghost servers", servers which are running no applications yet still consume 70% or more of the resources of a fully-utilized server. DCIM solutions can help to find these underutilized servers as well as servers which do not have power management functionality enabled, reducing IT energy usage as well as delaying the purchase of additional servers.

Measure the impact of infrastructure changes on overall energy efficiency

DCIM tools can measure energy efficiency metrics such as Power Usage Effectiveness (PUE), Data Center Infrastructure Efficiency (DCiE) and Corporate Average Datacenter Efficiency (CADE). These metrics serve to focus attention on increasing the energy efficiency of data centers and to measure the results of changes to the infrastructure. In the white paper *Green Grid Data Center Power Efficiency Metrics: PUE and DCiE,* the authors lay out the case for the introduction of metrics to measure energy efficiency in the data center.

The Green Grid believes that several metrics can help IT organizations better understand and improve the energy efficiency of their existing datacenters, as well as help them make smarter decisions on new datacenter deployments. In addition, these metrics provide a dependable way to measure their results against comparable IT organizations.

Improved Availability

DCIM solutions can improve availability in the following areas:

Understanding the relationship between devices

A DCIM solution can help to answer questions such as "What systems will be impacted if I take the UPS down for maintenance?" It does this by understanding the relationship between devices, including the ability to track power and network chains. This information can be used to identify single points of failure and reduce downtime due to both planned and unplanned events.

Improved change management

When investigating an issue, examination of the asset's change log allows problem managers to recommend a fix over 80% of the time, with a first fix rate of over 90%. This reduces the mean time to repair and increases system availability. DCIM systems which automate the change management process will log both authorized and unauthorized changes, increasing the data available to the problem manager and increasing the chances the issue can be quickly resolved.

Root cause analysis

One of the problems sometimes faced by data center managers is too much data. Disconnecting a router from the network might cause tens or hundreds of link lost alarms for the downstream devices. It is often difficult to find the root cause amidst all of the "noise" associated with cascading events. By understanding the relationship between devices, DCIM solution can help to narrow the focus to the single device — the router, in this case — which is causing the problem. By directing focus on the root cause, the problem can be resolved more quickly, reducing the associated downtime.

Improved Manageability

DCIM solutions can improve manageability in the following areas:

Data center audits

Regulations such as Sarbanes-Oxley, HIPA and CFR-11 increase the requirements for physical equipment audits. DCIM solutions provide a single source of the data to greatly reduce the time and cost to complete the audits. Those DCIM tools utilizing asset auto-discovery and asset location mechanisms such as RFID can further reduce the effort to perform a physical audit.

Asset management

DCIM can be used to determine the best place to deploy new equipment based on the availability of rack space, power, cooling and network ports and to then track all of the changes from the initial request through deployment, system moves and changes, all the way through to decommissioning. The DCIM solution can provide detailed information on thousands of assets in the data center including location, system configuration, how much power it is drawing, relationship to other devices, and so on, without having to rely on spreadsheets or home-grown tools.

Capacity planning

With a new or expanded data center representing a substantial capital investment, the ability to postpone new data center builds could save millions of dollars. DCIM solutions can be used to reclaim capacity at the server, rack and data center levels to maximize space, power and cooling resources. Using actual device power readings instead of the overly conservative nameplate values will allow an increase in the number of servers supported by a PDU without sacrificing availability. DCIM tools can track resource usage over time and provide much more accurate estimates of when additional equipment needs to be purchased.

"At a typical cost in the range of several hundred thousand dollars, it is likely that DCIM will pay for itself in about two years for a 5,000-square-foot data center — given its potential to reduce energy and other operational costs."

Gartner

The Future of DCIM

The future of DCIM is very bright indeed, with research analysts predicting growth to as high as 60% penetration by 2015. Although there are some large players in the market, there are also a number of smaller vendors who may very well impact the market. In reviewing the results of polling at the Gartner conference in December 2011, Jay Pultz noted, "Newer, smaller vendors can be significant players in the market. 72% of data center managers polled responded that they would consider them versus larger, established vendors — especially if very innovative solutions were offered." DCIM customers are looking for solutions which will provide the information they need to effectively manage their data centers and won't necessarily go with the status quo if a better solution presents itself.

New DCIM Functionality

As DCIM continues to mature, new functionality is making its way to the forefront. Some of the new functionality includes the following:

Automated asset location

Since one of the primary functions of DCIM is tracking the location of assets, automated location systems are now being offered by multiple DCIM vendors. Some of these systems use RFID tags (either passive or active) to determine the asset location within the data center. Others use asset-mounted tags with a physical connection to a location strip or a connection directly to the baseboard management controller (BMC) on a server to determine the asset location down to the rack unit. While not inexpensive, these systems eliminate the manual process of entering the asset's location and also can be used to automatically track the asset's movements.

Asset auto-discovery and change management

Some of the DCIM solutions provide the ability to auto-discover detailed information about the assets. A DCIM auto-discovering a server, for example, might automatically enter detailed server configuration data including hardware (processor, memory, disk, network), software, network services, virtual machines, and so on. This auto-discovery process reduces the time and cost to collect the data while also eliminating the 10-15% typical error rate for manually entered data. Change management is automated on these DCIM solutions so any asset changes (hardware changes, firmware upgrades, software installations, etc.) will be recorded with no manual entry required.

Mobile applications and touch based technology

With the growing popularity of smart phones and tablet technology, some of the DCIM vendors have adapted their tools to these new platforms. Some DCIM vendors have even built their solutions from the ground up with this new technology in the forefront, providing feature-rich mobile applications.

Integration with other data center management tools

With a wealth of data center management tools already in place, DCIM vendors are beginning to open their systems up to more outside integration. This might be as rudimentary as providing a pre-defined Excel spreadsheet for loading data into the DCIM but more solutions are supporting more sophisticated web-based APIs to allow data to be passed both into and out of the DCIM solution. Preconfigured "hooks" into CFD modeling tools or trouble ticket systems such as LANDesk or Remedy help to extend the functionality of DCIM tools.

Control loops

As DCIM has matured from visual asset organizers to more full-fledged management capabilities, some DCIM vendors are beginning to take the next step into closed-loop control systems. Rather than simply alerting that an issue has occurred, some DCIM systems are now taking action to resolve the issue. In a traditional DCIM system, the loss of a CRAC unit would generate an alarm. The staff is notified and maintenance would be performed to restore the CRAC to service. A DCIM which supports event-based actions could identify servers which are at risk due to the CRAC failure and automatically move applications to alternate servers until the CRAC has been restored.

"What if" scenarios

Some DCIM solutions provide the ability to model "what if" scenarios that can help you to plan data center changes such as the addition of new equipment, technology refreshes, equipment failure or even the planning of an entirely new data center. As DCIM solutions continue to mature, more sophisticated planning scenarios will be possible to accurately plan for changes before they are implemented.

What Should I Do About DCIM Today

DCIM solutions, while still maturing, have proven themselves to be very effective tools in more effectively managing the data center. DCIM provides a complete picture of the current state of the data center and, as importantly, allows you to plan future data center capacities, including space, power and cooling resources. DCIM can manage power and cooling consumption and drive energy efficiency in the data center. As DCIM continues to mature and the cost to build and operate a data center increase, the ROI for these products will continue to improve. Get started by putting together a detailed list of requirements. Since DCIM is intended to provide information, the requirements list should focus on the information you need to manage your data center. Based on these requirements, you can then begin to evaluate DCIM solutions.

Appendix 1: DCIM Vendors

Software Vendors

VENDOR	PRODUCT(S)
Align Communications	AssetPoint
AssetGen Software Solutions	AssetGen Connect
CA Technologies	CA ecoMeter
Concurrent Thinking	concurrentCOMMAND, concurrentCONTROL
FieldView Solutions	FieldView
IO	IO.OS
iTRACS	iTRACS Converged Data Center (iCDC)
Modius	OpenData
nlyte Software	nlyte DCIM suite
No Limits Software	RaMP
Optimum Path	Visual Data Center
PowerAssure	EM/4 Data Center Energy Manager
Rackwise	Rackwise
Sentilla	Sentilla Energy Manager
SynapSense	Data Center Optimization Platform

Hardware Vendors

Vendor	Product(s)
APC by Schneider	StruxureWare for Data Centers
Aperture (Emerson Network Power)	Aperture Integrated Resource Manager, Aperture Capacity Manager, Aperture Configuration Manager, Aperture Infrastructure Process Manager, Aperture Integration Manager
Avocent (Emerson Network Power)	DSView 3
Emerson Network Power	Trellis
Hewlett-Packard	HP Assset Manager Platform – Data Center Infrastructure Module
IBM	Maximo Asset Management for Energy Optimization, Tivoli Asset Management for IT, Maximo Data Center Infrastructure Management
Panduit	Physical Infrastructure Manager
Raritan	dcTrack
Rittal	RiZone
Server Technology	Sentry Power Manager
Unite Technologies	Six Zone Data Centre Management

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