



## Managing Complexity

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# Distributed Systems Management at Intel®

Many factors complicate the management of today's corporate computing infrastructure. This increasing complexity threatens corporate productivity. Distributed Systems Management (DSM) ameliorates this threat by consolidating the management of geographically distributed, heterogeneous computing components. Intel® IT provides DSM services and tools that monitor, measure, upgrade, and direct all aspects of corporate computing. DSM's ability to rapidly isolate and respond to current problems, and its potential to anticipate and respond to future problems, make it an important enterprise IT tool.

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## Introduction

Many factors complicate the management of today's corporate computing infrastructure: new users, escalating user demand, geographically dispersed sites, remote and wireless access, diverse technology, virus attacks, security threats, dynamic storage requirements, and conflicting standards. This increasing complexity threatens corporate productivity.

Distributed Systems Management (DSM) ameliorates this threat by consolidating the management of geographically distributed, heterogeneous computing components. Intel® IT provides DSM services to improve network management

with tools that monitor, measure, upgrade, and direct all aspects of corporate computing. As these services become integrated, they shift from problem monitor-and-response tools, which are primarily reactive, to proactive tools that anticipate and address problems before they affect the customer.

## DSM Delivers

According to Intel's DSM position statement, DSM strives to deliver "...innovative distributed systems management solutions worldwide—increasing cost effectiveness for business units, product and service owners, and Intel stockholders."

To accomplish this goal, Intel's DSM team centralizes the monitoring and management of the heterogeneous, connected, geographically distributed hardware and software components that comprise Intel's computing infrastructure.

By monitoring and reporting events that occur on the system, these tools identify existing and potential problems. DSM tools also monitor system configuration and use, so that problems on the system can be anticipated and proactively addressed. Finally, DSM tools facilitate fixes and modifications.

## DSM Services

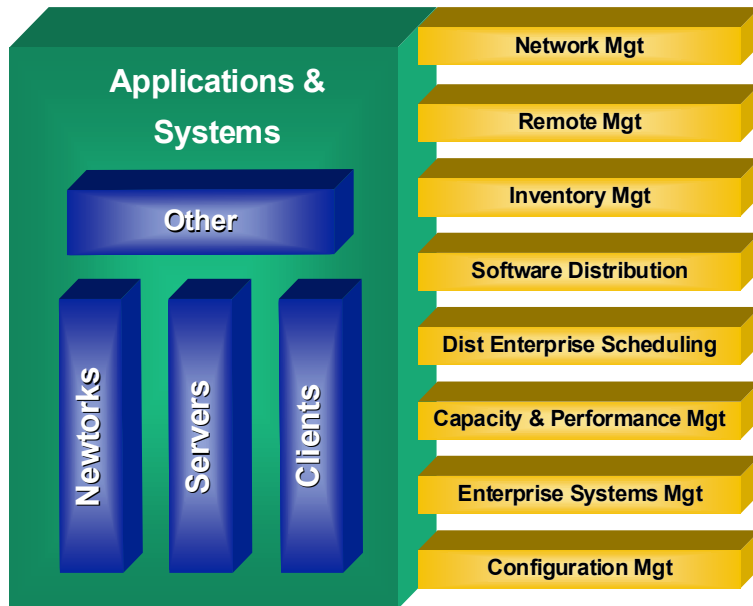


Figure 1: The DSM model

## Current DSM Model at Intel

Figure 1 depicts the current relationship between the components that support day-to-day activity at Intel, and the system and network management services that comprise DSM provided by Intel IT. Using DSM, applications and their constituent distributed components are centrally managed by some or all of the DSM services.

### APPLICATIONS AND SYSTEMS

The Applications & Systems box on the left side of Figure 1 represents the distributed hardware components (hubs, switches, servers, workstations, etc.) and applications (Intranet, Internet, e-mail, ERP system, etc.) that combine to form the foundation of Intel's computing infrastructure. These objects are the physical and logical computing components of the environment—the building blocks to be connected into a cohesively functioning unit by the DSM services.

Consolidated, complementary interaction of these diverse elements ensures consistent, real-time management of the connected environment. To accomplish this consolidation, each of these distributed components is acted upon by a subset of DSM services.

### EVENT MANAGEMENT

An “event” is an occurrence on the network worthy of note, for example, a user login, a failed login, an application failure, a server failure, or a capacity threshold reached. Events are not reported as “good” or “bad”; rather they are simply returned as values to be evaluated. “Alerts” are problem events.

Event management provides the mechanism that checks for events, reports their occurrence, evaluates their significance (either manually by IT personnel or automatically via software), and often uses DSM services to respond.

Agents installed on networked servers and clients report activity; dedicated “pollers” poll the systems to ensure that they are up and running (and able to report). This event management software provides an enterprise-wide view of the network by monitoring for and reporting events. Cumulatively, events provide a snapshot of the network at a discrete point in time.

### DSM SERVICES

The horizontal bars on the right side of Figure 1 represent the DSM services that act on some or all of the distributed applications and systems. These discrete, manageable, measurable services add value to the customer by improving performance, reliability, availability, and fault response. They promote a rapid, targeted response when problems arise or changes are required.

- **Network Management** provides the tools, processes, and policies to manage and maintain Intel's underlying network infrastructure. These tools serve the network framework that makes other system services possible, including configuration management, remote control, real-time monitoring, and event notification.
- **Remote Management** supplies operations and support organizations with tools to remotely manage and control Intel's workstations and servers. For example, using remote control, Intel's Technical Assistance Center (TAC) can remotely access a user's workstation to check its configuration or to isolate and resolve a problem.
- **Inventory Management** provides hardware and software inventory information for all devices connected to the network, as well as metering used to generate reports on its current state.
- **Software Distribution** is a packaging and delivery mechanism through which Intel employees receive business-critical software, pushed down-the-wire or pulled via a browser.
- **Distributed Enterprise Scheduling (DES)** enables automated processing of enterprise application scripts and batches in the distributed environment. This is of particular value for mission-critical applications, such as ERP systems, where the automation and integration capabilities of DES permit send-and-receive data feeds from other applications and companies, as well as event triggering based on a combination of success or failure conditions. Because applications tend to use DES to support mission-critical processing, the benefits of 24X7 job monitoring and automated, high-availability disaster recovery are compelling.
- **Capacity and Performance Management (CPM)** provides threshold exception notification that improves application response time, throughput, and availability, as well as web-based reports. CPM data maximizes efficiency by enhancing daily management of resources and by providing information that facilitates capacity and usage planning.

- **Enterprise Systems Management (ESM)** provides tools to monitor and manage the system's connected hardware components, operating systems, and applications. ESM logs and reports events that affect the system. ESM is a real-time, 24x7 monitoring mechanism that uses agents and pollers (programs that regularly poll the systems hosting the agents to ensure that they are functioning) to provide immediate notification of events that could impact the system.
- **Configuration Management (ConMan)** ensures a good, steady-state configuration of managed components that tend to drift out of specification over time. After standard configuration settings are established, configuration management tools monitor installed software versions and system settings to ensure their adherence to the defined standards.

### END-TO-END DSM MANAGEMENT

The end-to-end management of vertical services means the full application of DSM to specific vertical-services (for example, remote access, e-mail). For a given vertical service, each DSM service is applied to the appropriate system objects, responding to events on the system and anticipating configuration and performance problems.

For each service, end-to-end is defined differently. For example, Remote Access Service (RAS) end-to-end management commences at the instant the remote user attempts to connect to Intel's network; it doesn't terminate until a connection is established or a failure occurs.

While the RAS connection process is complex, involving many sequential steps, the success measurement is simply the user's experience: did the connection succeed? Agents installed on a percentage of RAS client machines provide data on remote access success and failure. This data can be extrapolated to the entire user base, enabling system managers to measure success and failure rates and tune the system accordingly. Reports generated from the data can identify problems before they affect the system.

## DSM's Proactive Future

The ability to identify and resolve problems is only half of DSM's role. As DSM strives to deliver more value, it shifts from a reactive role to one that anticipates and addresses problems before they impact the customer. While many events cannot be anticipated (for example, a specific user's login), many others offer precursors that need only be detected (for example, a storage threshold exceeded). Use of these precursors can be as simple as reporting and responding when a server's storage reaches 80% of capacity rather than waiting for a "disk full" alert—or as complex as a program that tracks server utilization and evaluates trends to predict when capacity will be reached.

Properly implemented and consolidated, DSM's advance notification and ability to deliver fixes can resolve potential problems before they impact the customer. Some of this proactive capability already exists at Intel; more will be added as DSM becomes woven more completely into the computing infrastructure. Each DSM service contributes to this system-wide proactivity:

- **Network Management** monitors the network for problems that could signal something more significant.
- **Remote Management** provides tools to control clients and servers on the network, install down-the-wire software, and provide firmware patches and upgrades to prevent future problems. Server managers can use remote management to check server status and the success of down-the-wire updates.
- **Inventory Management** assesses the system's currently installed software and hardware so that updates and patches can be applied before the component is affected.
- **Software Distribution** pushes patches and upgrades down-the-wire to systems requiring an upgrade.
- **Distributed Enterprise Scheduling** uses automation tools to prompt and connect other DSM services. DES initiates a job by responding to a time/date milestone or a predefined event trigger such as a filled database table. When these triggers anticipate a problem, a proactive solution becomes possible.
- **Capacity and Performance Management** collects and stores historical system data and reports real-time events. Real-time events can trigger notification of a threatened server storage threshold or a performance problem. CPM's historical data can be evaluated after a problem to identify precursors that might predict similar problems and allow for proactive responses.

## OPERATIONS SERVICE CENTER

Intel's Operations Service Center (OSC) is a prime beneficiary of the company's DSM effort. From its 24x7 command center in Folsom, CA, the OSC monitors the network and responds to events affecting over 100,000 clients spread around the world.

Intel's DSM services provide the OSC real-time and historical data from dedicated software agents installed on client and server machines. The OSC uses DSM services to gain access to remote devices and to gather data that ensures steady-state system configuration status. DSM services also enable the OSC to update obsolete or corrupted files, schedule jobs, and monitor server and network performance.

Using DSM services, the OSC monitors and adjusts resource use, ensures current software levels, identifies and corrects system failures, and identifies and thwarts virus attacks and other security breaches. In addition to the real-time data that DSM services provide, they can also generate predefined and ad hoc usage reports. These reports enhance the understanding of system use, and provide valuable data for deployment and configuration decisions.

- **Enterprise Systems Management** agents and pollers monitor for system events that signal potential problems. Advance notification enables a proactive response that preempts the problem before it affects the customer. Additionally, inferential trend and statistical analysis, performed on the event history data, can predict and resolve problems.
- **Configuration Management** provides the tools to ensure the consistent, steady-state environment necessary to reliably implement proactive bug fixes and software upgrades.

Even with the best proactive tools, some problems (such as hardware failure and user intervention) cannot be anticipated. Often these problems have many symptoms that manifest across different levels of the computing infrastructure and make identification of their root cause difficult. The system snapshot provided by DSM agents can isolate a problem's source, accelerating resolution and minimizing customer impact.

## Conclusion

IT DSM services already enhance Intel's computing capability. From system monitoring to distribution of software, DSM tools help connect and sustain the distributed components that comprise Intel's computing infrastructure. Through DSM, technically and geographically diverse applications such as e-mail, Internet and Intranet access, remote access, virus protection, software distribution, data storage—and the network components that underlie them—can be centrally managed in a consistent fashion. And as Intel IT's DSM services mature and gain acceptance, its proactive capability will expand. Improved integration, enhanced data, inferential analysis; all will combine to enable the identification of problems that currently do not manifest until they impact users.

DSM's ability to rapidly isolate and respond to current problems, and its potential to anticipate and respond to future problems, make it an important tool in the campaign to manage the growing complexity of computing at Intel. The direct beneficiaries of Intel IT's DSM implementation are its employees and therefore, ultimately, Intel.

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