

# EMC Smarts IP Availability Manager

## *Technology for IP Network Management, Including Network-Attached Storage*

**Abstract:** This paper discusses the technologies that enable EMC Smarts IP Availability Manager to automatically discover and model IP networks, including network-attached storage elements and connectivity, and to automate root-cause and impact analysis of faults across IP and related domains.

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***Table of Contents***

**Introduction .....4**  
**The Importance of Automation .....4**  
**Automating the Hardest Tasks in Network Management .....4**  
**Auto-discovery .....5**  
**Modeling .....5**  
**Mediation Layer .....6**  
**Analysis .....6**  
**Business Benefits .....9**  
**Conclusion.....9**

## Introduction

Today's complex IP networks are comprised of thousands of interconnected devices. Any outage can cause a flood of alarms on the console screen, leaving operators with the largely manual task of trying to distinguish root-cause problems from their sympathetic symptoms. As operators struggle to isolate the service-affecting problems that need to be fixed, mean-time-to-repair lengthens, revenue and productivity suffer, and customer loyalty is jeopardized.

Included among the many business processes that depend on the IP network is network-attached storage (NAS). Organizations use NAS as a platform for the consolidation of storage and data and to support business collaboration, regulatory compliance, disaster recovery, data availability, and centralized backup. With these key functions depending on NAS connectivity, organizations need new methods, not only to manage NAS as a silo, but also to understand how problems in the IP network impact NAS availability.

## The Importance of Automation

At the same time that network size and complexity are making management more difficult, operations teams are being asked to hold down costs by doing more with less. Automation is the only answer to this challenge. It is the key to reducing data overload, improving productivity of skilled resources, and aligning network management with business objectives.

While all management tools offer some level of automation, the real need today is to automate those high-cost, labor-intensive tasks that have the greatest impact on business. To provide the actionable information needed to sustain service, management solutions must automate the following functions:

Discovery—Determining what elements exist in the environment

Modeling—Combining the results of discovery with data from other sources to map:

- Where elements are located and how are they related
- How each element's behavior correlates with related elements
- What and how business processes and users depend on these underlying elements

Root-cause and impact analysis—Providing the actionable intelligence necessary to sustain service by revealing:

- What precisely are the problems that need to be fixed?
- What is the impact of these problems on the business; that is, how urgent is it to fix them?

## Automating the Hardest Tasks in Network Management

EMC® Smarts® IP Availability Manager provides powerful discovery, modeling, and root-cause and impact analysis capabilities across the IP network, including network-attached storage. By correlating events across IP and NAS devices, EMC Smarts IP Availability Manager Extension for NAS gives NOC and NAS administrators the information they need to ensure that the right teams are working on the right problems to protect business-critical services. The result is faster mean-time-to-repair and dramatically improved IP network and NAS availability.

## Auto-discovery

An important step in automating network management is the ability to automatically discover as much information as possible about network elements and their relationships. A comprehensive auto-discovery mechanism enables fast, efficient, and accurate population of an information repository with information about the managed environment. Auto-discovery eliminates a large amount of manual administration and automatically keeps the management system in synch with the real world.

EMC Smarts provides the most comprehensive and efficient auto-discovery in the industry. It discovers a rich set of objects and relationships in Layer 2, IP, and the application layer, including: hosts, network devices, cards, ports, virtual LANs, cables, network connections, interfaces, IP networks, operating systems, databases, application processes, application agents, and others. EMC Smarts IP Availability Manager auto-discovery includes NAS system elements: EMC Celerra<sup>®</sup> chassis, data movers, control stations and NetApp filers.

EMC Smarts Auto-discovery leverages a wide range of data sources and interfaces, including SNMP, and system and application agents. In addition, open APIs support importing data from proprietary element and network managers, provisioning systems, and GUI tools to compile a complete picture of the environment.

## Modeling

Today's network management solutions are required to:

- Provide end-to-end management across related infrastructure domains by integrating and correlating management of network, systems, applications, storage, and other technologies—because the high level of interdependence among these domains makes silo management insufficient.
- Integrate and correlate information across different Operations Support Systems (OSSs) and enterprise management disciplines including fault, performance, and configuration.
- Bridge the gap between IT and the business by understanding relationships between business and IT, and the impact IT health has on business performance.

To meet these requirements, management systems must incorporate a robust information model that can define the components, relationships, behaviors, and interactions across technology and business. The EMC Smarts ICIM Common Information Model™ is a semantics-rich common information model based on the industry-standard Distributed Management Task Force (DMTF) Common Information Model (CIM). ICIM adds behavioral modeling to existing CIM semantics to support powerful automated analysis of dynamic systems.

The ICIM Repository is a representation of a specific customer environment, populated using results of EMC Smarts Auto-discovery plus data about business objects and their “last-mile” relationships to the infrastructure. The Repository provides a rich context for integrating third-party topology, events, data, and results of analysis, as well as for interpreting the significance of events and correlating them with one another. Open APIs support easy import and export of Repository information.

Dynamic by nature, Repository information updates automatically as new entities or relationships are added or deleted, and others are configured or updated.

During auto-discovery, each managed device is probed to determine its configuration and its relationship to other entities. For example, if an application is discovered on a particular server, two objects are created—the application and the server—and a relationship is created between them: *HostedBy*. This information is accessible to other Smarts technology components, including the correlation engine, which uses entities and relationships to calculate the sets of symptoms that point to specific problems and the impacts those problems will cause. For example, Smarts solutions calculate that when a server failure occurs, all the applications and services hosted by the server become unavailable.

## Mediation Layer

The Repository represents abstract objects, such as routers, cards, servers, or applications. The Mediation Layer associates concrete data from the customer environment with these abstract objects—for example, a router to a specific vendor and model. This separation of the mappings between abstract and concrete real-world managed entities makes it easy to expand the Repository to cover new products—for example, in the case of EMC Smarts IP Availability Manager, the ability to extend root cause and impact analysis to network-attached storage. The Mediation Layer is modular and incrementally extensible. Product-specific information is organized in Mediation Layer entries, one per product. Adding information on a new product requires a simple insertion of a new entry, a process known as certification.

The design of the Mediation Layer allows certification of new devices without writing code. In addition, Smarts root-cause and impact analysis automatically applies to the newly certified devices. This capability allows Smarts and its users to extend Smarts applications to apply to new vendor offerings, and even new technologies, in a completely open-ended fashion. Such dynamic extensibility is key to assuring application robustness in a dynamic market.

## Analysis

Event management systems that collect every event and alarm overwhelm network operators with raw data. To alleviate this problem, management vendors typically use rules to add intelligence to the event collection and filtering process. The size and complexity of today's business-critical networks makes rules-writing an expensive and time-consuming effort that consumes scarce expert resources. And since dynamic networked systems are constantly changing, rules quickly become obsolete, requiring ongoing and costly development.

EMC Smarts' patented Codebook Correlation Technology™ automates root-cause and impact analysis in complex distributed systems. Codebook is unique in its ability to isolate potentially any type of problem that exhibits symptoms, in any technology, and proactively identify any exceptional condition by analyzing combinations of events and polled data.

Codebook Correlation Technology is based on two simple facts:

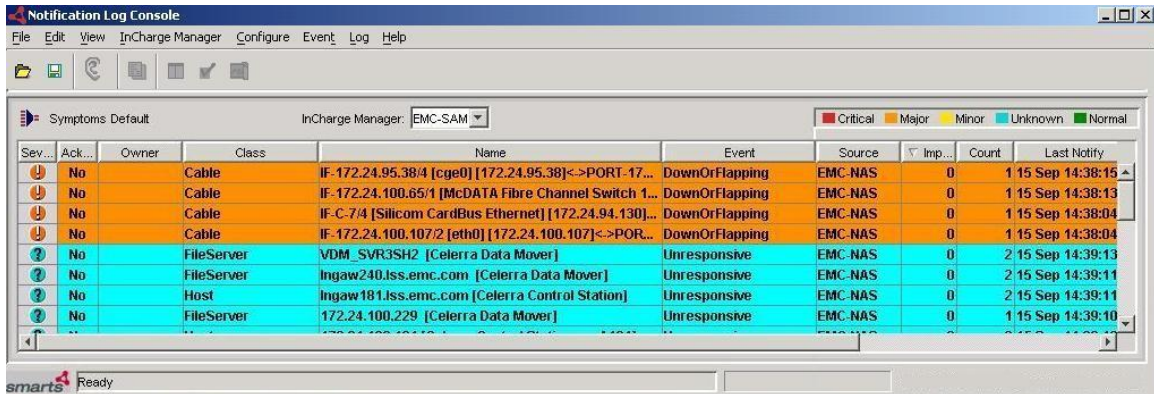
- Every problem that matters—an authentic problem™—has characteristic symptoms.
- Each instance of a problem has a unique set of symptoms—which EMC calls a signature.

A major advantage of Codebook is its ability to build intelligent problem analysis into software that automatically adapts to the managed system, no matter how complex or dynamic, and automatically analyzes any authentic problem. Codebook does this by automatically calculating the signatures for all authentic problem instances in the customer environment, and automatically adapting signatures as the environment changes. By pre-calculating the spread of symptoms only when topology changes, Smarts solutions reduce root-cause analysis to a simple process of matching symptoms to signatures in real time. This process is extremely fast and highly accurate.

When presented with a set of symptoms, Codebook automatically calculates the best explanation for the symptoms. Even when some of the symptoms are delayed or lost, or if unexpected symptoms occur, the Codebook can accurately pinpoint the root cause by identifying the signatures that are the closest match. Symptoms that do not help to pinpoint authentic problems (e.g., a symptom that appears in the signature of every problem) are disregarded, which improves the efficiency of the system.

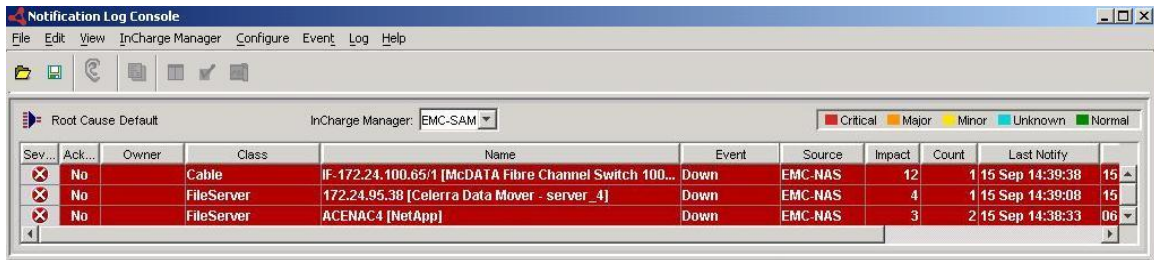
EMC Smarts solutions eliminate the need to write and maintain rules by automatically adapting their built-in intelligence to the managed environment at discovery, and then continuing to adapt it automatically as the environment changes. Because Smarts understands all components, relationships, behaviors, and interactions across the technology and business environments, it can determine the true cause of business service problems wherever they occur—in related applications, systems, or network resources—and

calculate the impact of problems on business. The figures that follow display the results of EMC Smarts IP Availability Manager analysis.



**Figure 1: Symptoms of a Network Outage**

In Figure 1 the EMC Smarts notification console displays a list of symptoms of a network outage. When problems generate floods of symptoms, network administrators must expend considerable resources to manually correlate the symptoms and isolate the problems causing them. And, with symptoms spanning NAS devices, cables, file servers, hosts, switches, and other IP devices, multiple groups may need to participate in the analysis.



**Figure 2: Root Cause Identification**

In Figure 2, EMC Smarts IP Availability Manager automatically identifies the root-cause problems that are causing the list of symptoms. By automatically isolating both the authentic problems and their impacts on related objects in the network infrastructure, IP Availability Manager provides the actionable intelligence NOC administrators need to correct service-affecting problems proactively, often before users or business services are affected. In this case, the first root-cause problem listed is a down network cable that is impacting 12 related elements.

When EMC Smarts Business Impact Manager is added to the solution, administrators can see the business impact of network problems (Figure 3).

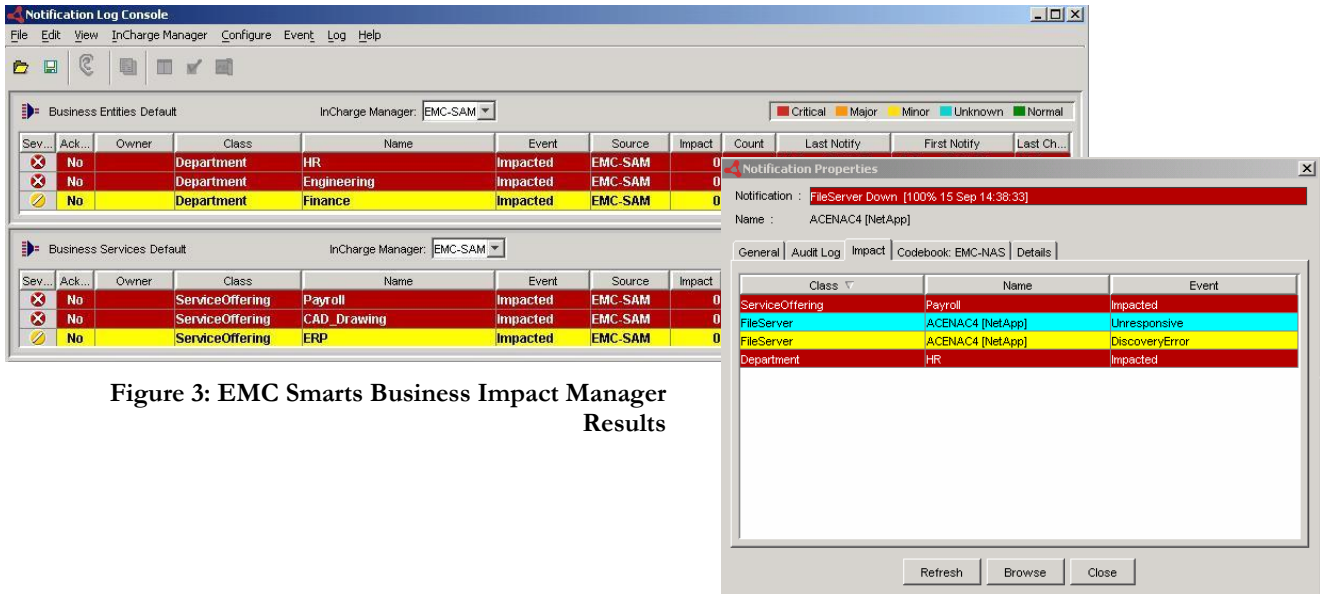


Figure 3: EMC Smarts Business Impact Manager Results

With the EMC Smarts IP Availability Manager Extension for NAS, root-cause and impact analysis is extended to network-attached storage. Figure 4 shows a Notification Console indicating the impact of a down Celerra file server on the Engineering Department.

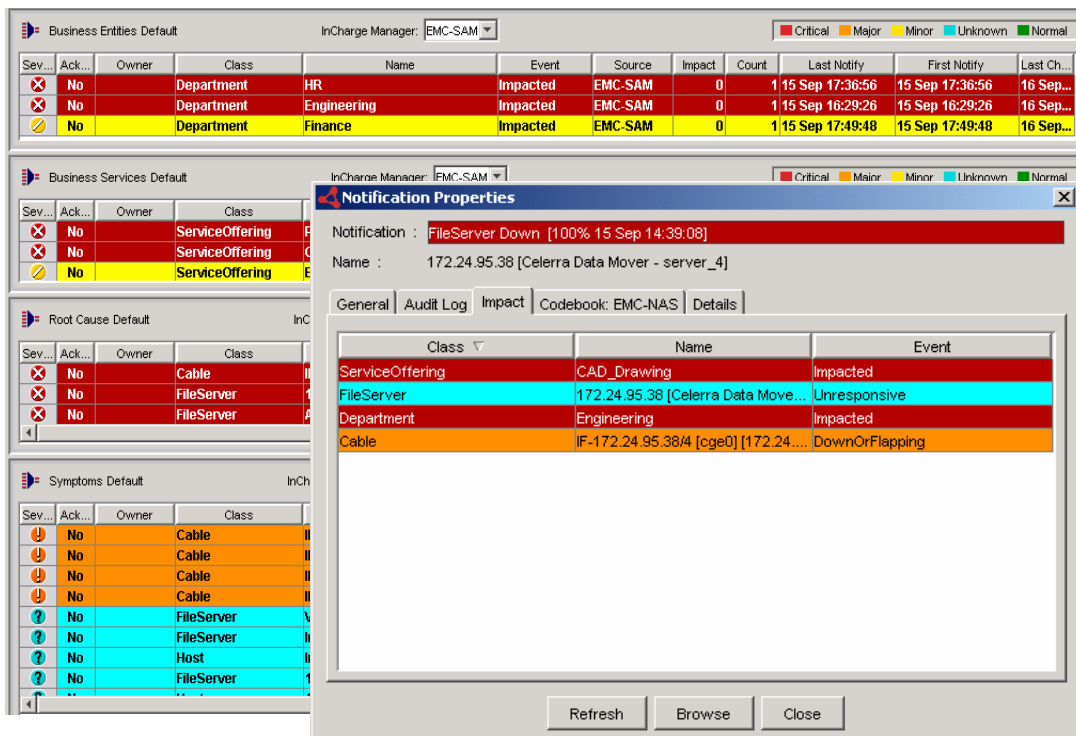


Figure 4: Impact of IP NAS Problems on Related Departments and Processes

## Business Benefits

EMC Smarts patented technologies enable high levels of automation that are unique among management systems available in today's marketplace. This automation passes significant benefits on to user organizations.

**Dramatically reduces unplanned downtime.** EMC Smarts solutions maximize the availability of IP networks and network-attached storage elements that support mission-critical services. Mean-time-to-repair decreases because NAS and NOC administrators have complete visibility into how network connectivity problems impact NAS elements and know exactly what problems to fix to assure service delivery.

**Streamlines operations and processes between NOC and NAS management.** Realtime fault isolation reduces open tickets between NOC and NAS teams. Rapid isolation of IP network root-cause problems that impact NAS systems eliminates finger-pointing and ensures that the right teams take the correct action every time, the first time.

**Reduces total cost of ownership.** By eliminating high-cost rules writing and maintenance, and improving productivity of expert resources, EMC Smarts solutions dramatically reduce the cost of network management. Organizations realize fast return on investment as manual tasks are replaced by innovative, automated processes.

**Provides a platform for end-to-end management.** EMC Smarts IP Availability Manager integrates seamlessly with other EMC Smarts and third-party systems to build a true end-to-end management solution across networks, systems, applications, and storage. By deploying EMC Smarts Service Assurance Manager as the intelligent manager of managers, organizations can add value to and protect existing management investments while gaining the cross-domain correlation and visibility that streamline network operations.

## Conclusion

Today's dynamic distributed infrastructures are comprised of hundreds of thousands of diverse devices, applications, databases, and technologies. To gain visibility across these enormous infrastructures, and to manage technology in alignment with business objectives, organizations must be able to understand the complex web of relationships that connects all these domains.

EMC Smarts Auto-discovery, modeling, and Codebook Correlation Technology work together to bridge the gap between infrastructure, applications, and services, delivering the actionable intelligence organizations need to direct the right teams to solve the problems that matter most to business. EMC Smarts solutions automate root-cause and impact analysis not just in a single domain but across domains, drilling down through the applications to the underlying network that supports business-critical services.

As EMC expands its business to encompass strategic resources that surround the information infrastructure, Smarts technology provides the foundation for unified management of the entire technology environment. Development is already underway in a number of areas, including:

- Adding root-cause analysis for storage area networks
- Providing greater insight into applications
- Supporting complete active change and configuration management
- Extending end-to-end performance management from servers to storage

In the future, EMC Smarts technology will play an increasingly important role in automating information fault and performance management, extending the platform for configuration, provisioning, and other functions, and correlating management of information, applications, infrastructure, and business services for true end-to-end resource lifecycle management.