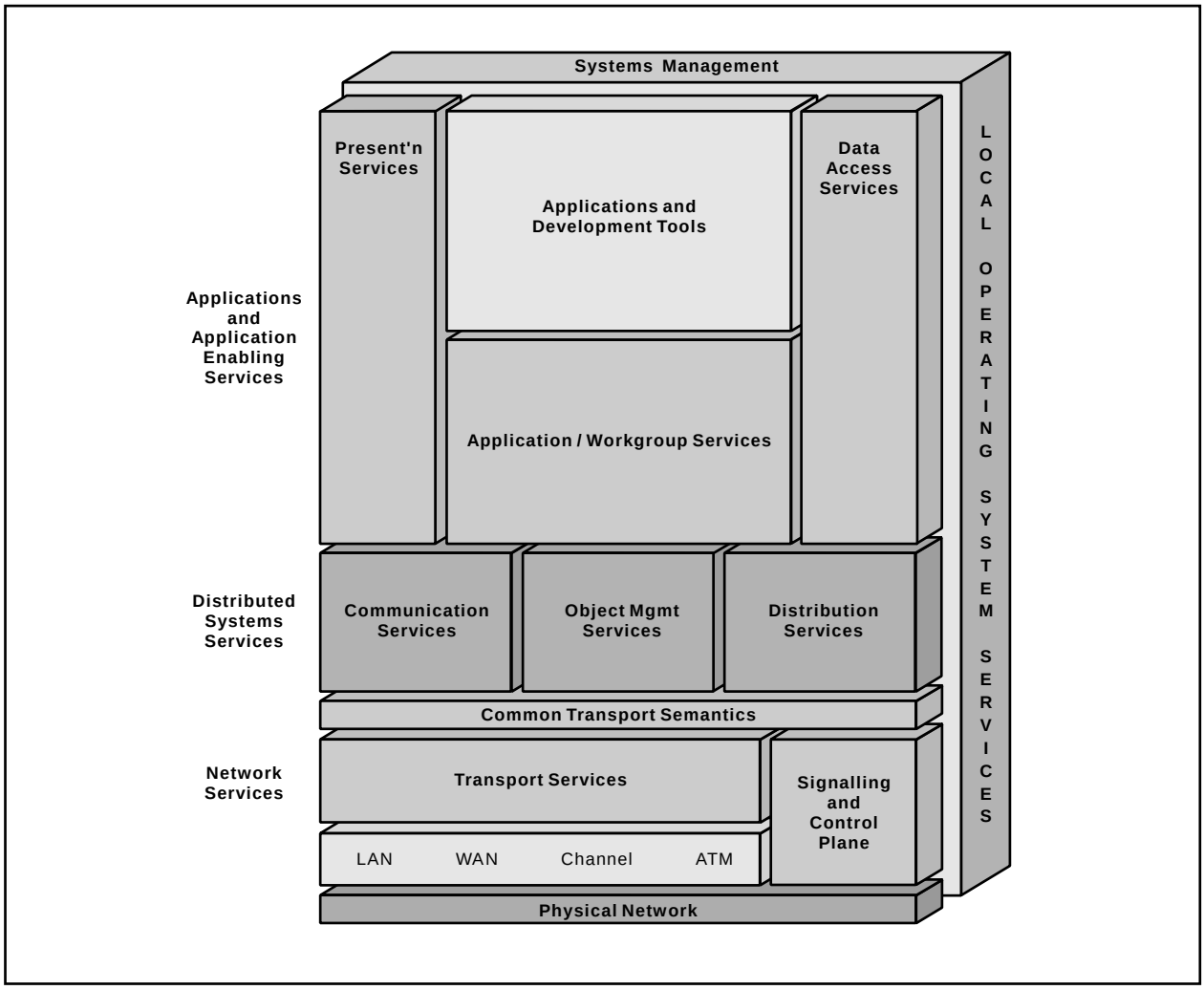
Open Blueprint

Systems Management in the Open Blueprint



GC23-3937-01

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About This Paper

Open, distributed computing of all forms, including client/server and network computing, is the model that is driving the rapid evolution of information technology today. The Open Blueprint structure is IBM's industry-leading architectural framework for distributed computing in a multivendor, heterogeneous environment. This paper describes the Systems Management component of the Open Blueprint and its relationships with other Open Blueprint components.

The Open Blueprint structure continues to accommodate advances in technology and incorporate emerging standards and protocols as information technology needs and capabilities evolve. For example, the structure now incorporates digital library, object-oriented and mobile technologies, and support for internet-enabled applications. Thus, this document is a snapshot at a particular point in time. The Open Blueprint structure will continue to evolve as new technologies emerge.

This paper is one in a series of papers available in the *Open Blueprint Technical Reference Library* collection, SBOF-8702 (hardcopy) or SK2T-2478 (CD-ROM). The intent of this technical library is to provide detailed information about each Open Blueprint component. The authors of these papers are the developers and designers directly responsible for the components, so you might observe differences in style, scope, and format between this paper and others.

Readers who are less familiar with a particular component can refer to the referenced materials to gain basic background knowledge not included in the papers. For a general technical overview of the Open Blueprint, see the *Open Blueprint Technical Overview*, GC23-3808.

Who Should Read This Paper

This paper is intended for audiences requiring technical detail about the Systems Management in the Open Blueprint. These include:

- Customers who are planning technology or architecture investments
- Software vendors who are developing products to interoperate with other products that support the Open Blueprint
- Consultants and service providers who offer integration services to customers

Contents

Figures

Summary of Changes

The Systems Management backplane is now based on the Tivoli TME 10 structure. As a result, there are changes in the taxonomies for systems management applications and services. Systems management agent services is more tightly coupled with the managed resources. A description of the use of profiles to improve scalability and simplify administration has been added, as well as a description of the management support for applications as managed resources.

Systems Management

Since the early 1970's, IBM has been an industry leader in providing premier systems management solutions to the information technology marketplace. In the late 1980's, IBM recognized a significant shift in the industry to a distributed computing environment, such that functions previously concentrated in a centralized System/390 platform are now also performed on workstations that access and control large multi-vendor networks. IBM established a vision for systems management that could support the needs of customers well into the future.

This vision, strongly influenced by standards work within the International Organization for Standardization (ISO), X/Open, Open Systems Foundation (OSF), and Network Management Forum (NMF) systems management reference models, was formally announced in 1990 as the SystemView structure. It was also acknowledged that important work at Object Management Group (OMG) would play an increasing role in future directions. Key aspects of the vision were openness, integration, comprehensive coverage and automation.

In 1996, with the merger of Tivoli Systems and the systems management business of IBM, another milestone was reached in the SystemView vision. The Tivoli Management Environment (TME) embraces distributed computing and is acknowledged as a standard in this area. Tivoli's object based technology to manage open, heterogeneous, client/server and network computing environments provides a framework for systems management solutions that are open, global, and provide comprehensive end-to-end capabilities.

The TME 10 structure defines the necessary systems management functions and services in support of Open Blueprint resource managers and applications. The TME 10 structure is an integral part of the Open Blueprint and provides the capability to meet the unique systems management requirements that address an enterprise's open multi-vendor environment. The TME 10 structure is fundamental to the successful implementation of open client/server and network distributed computing solutions (as well as more centralized computing environments).

This paper describes the TME 10 based Systems Management components of the Open Blueprint that provide the capabilities to manage resources across open environments in a seamless fashion, with minimum human intervention and maximum efficiency.

What is Systems Management?

The term *systems management* refers to those information technology activities that are not business application execution or development. It includes everything from the daily operations, management, and service of an information system to the long-range configuration planning for future business needs. This includes such tasks as defining, resolving and managing problems, operating networks and multi-vendor systems, distributing and managing software and data, controlling operations, planning and managing performance, administering security and users, maintaining asset information, and planning for the future capacity of systems. Systems management is composed of the processes, procedures, tools and techniques that are implemented through personnel and automation to ensure the cost-effective operation of information systems.

Why is Systems Management Important?

There are several key reasons why systems management is so important:

- The changing environment of computing

  With the movement to distributed and network computing environments, many workstations are purchased by individual departments who subsequently have the need to interconnect with other existing systems. This results in increasingly complex computer networks made up of products from multiple vendors. These networks are more difficult to manage and require more time, money and staff than the typical company wants to commit. Tight budgets and low profit margins leave little or no room for mistakes.

- The time it takes to operate a system

  Regardless of how big or small a computer system or network is, it can take a significant amount of staff time just to perform daily operations. Answering questions, upgrading software, configuring a new piece of hardware, monitoring performance, resolving systems problems - all these things require time. Time spent fixing a problem with a resource is a direct expense. Time spent operating without that resource contributes to lost revenue or an increase in overhead expense. Time spent upgrading software around the network is time that can be better spent.

- The costs associated with managing a system

  Money spent managing the system is money that does not produce revenue. It has been estimated from various consultant studies that of the total cost of implementing a distributed computing environment over a 3 - 5 year period, only 15% is the cost of the hardware and software, and 85% is the cost for management and support. Companies who find ways to reduce or eliminate these expenses are the companies who have a better chance of surviving in today's business environment.

- The distribution of data

  In the past, if you had a question about your company's operation, you walked down the hall and spoke to the person who had the answer. However, with the globalization of industry and the proliferation of computers, information is no longer centralized but is distributed in nature, making it more difficult to obtain and requiring more people to control and manage it.

- Information technology advances

  The ability to exploit information technology enables automation of factories, improves customer service, creates entirely new businesses, and reduces cycle time. Rapid and effective deployment of new information technologies can significantly improve the competitive advantage of a company.

Effective systems management addresses these areas and enables companies to reduce the cost of owning a system, increases personnel productivity, maximizes the investment in information technology, increases customer satisfaction, and increases speed to market. All these factors have a positive impact on bottom-line profits.

Architectural Objectives

In designing an architecture for systems management, a number of key requirements must be considered. To provide effective support for the productive use of information technology, systems management must enable the following:

Cost-effective Implementation and Operation

Cost effectiveness encompasses a broad scope of components and issues including software and hardware, networking, implementation, administration, operations of these environments, and so on. Elements critical to the overall cost effectiveness of a distributed computing solution are automation, code reuse, and usability.

Diverse and Scalable Implementations

The architecture must be robust enough to support multiple implementation scenarios. This should not only be in terms of the technology and components used to construct these solutions but also in the management models and processes adopted by organizations to operate and manage these solutions. The management function must be equally broad in its support and utilization of distributed computing concepts if it is to be able to support a wide variety of distributed applications. The systems management structure must be highly scalable if it is to be used pervasively in distributed environments.

Security

Security must be an integral part of the structure such that every management function implemented is automatically provided with this function. The addition of the systems management framework and its applications must not compromise the security of the system.

Ease of Use and Integration

This requirement encompasses many areas from a common look and feel across all platforms and applications to functions such as single signon and an integrated view of underlying system elements. Although these requirements can be simple in isolation, they become increasingly complex in the context of a distributed multi-vendor network. The management function must be flexible, configurable, and customizable.

Protection of Investment

The majority of information technology projects have an existing computing environment as their starting point. As with new applications, new systems management solutions will generally need to coexist with established solutions. Ideally they will enhance the current environment.

Future Technologies and Standards

As computing environments evolve to incorporate new concepts, trends, standards and technologies, a systems management model must incorporate sufficient vision to encompass and exploit changes. Some examples of these emerging technologies include mobile computing, virtual LANs, LAN switches, Internet connections, and advances in storage and print technologies.

TME 10 Structure

Today's information technology environments include hardware and software components from multiple vendors. To manage this environment efficiently and effectively, the need for integration and interoperation are critical. Managing such a diverse environment requires imposing some order. The widespread recognition of that need is clearly visible in the industry in an increased demand for interoperability that is accomplished through open, vendor-neutral standards.

Management of a diverse environment requires a structure to incorporate many management protocols, such as Simple Network Management Protocol (SNMP), and technologies such as distributed, object-oriented programming applications based on the Object Management Group object services and X/Open Systems Management Services.

The TME 10 strategic direction is based on distributed object-oriented technology. Object-oriented technology is well-suited to Systems Management Applications because object-oriented design allows effective modeling of the real world. Using an object-oriented approach, systems management application developers can use objects to closely match the features and characteristics of hardware and software resources that are to be managed. Use of objects for management function allows that function to be accessed and used by multiple applications, thus allowing management applications to be more tightly integrated and automated. Duplication of function is also minimized. The TME 10 structure supports both procedural and object applications to support multi-vendor environments.

The TME 10 structure addresses the full range of tasks associated with managing information technology resources in an enterprise, and in conjunction with Open Blueprint services makes it possible to perform those tasks in a centralized or distributed manner, as appropriate to the business needs of the enterprise. The tasks associated with managing an enterprise are very broad in scope. The need for comprehensive coverage and integration goes beyond even the broad discipline of systems management. The enterprise personnel that perform systems management activities also perform other roles as users of office automation tools, users of integrated manufacturing tools, users of programming development tools, and so on. Inconsistencies across these roles can be a significant source of errors and can result in high training costs. The TME 10 structure is comprehensive, and through integration with the Open Blueprint enables efforts beyond the arena of systems management, so that systems management activities fit seamlessly with other activities performed by enterprise personnel.

Systems Management Component Structure

Implementation of a systems management solution requires a robust structure that can handle the broad and diverse requirements and objectives stated previously and a flexible design to meet the ever-changing needs caused by rapidly changing technology. The Systems Management component structure is based on the TME 10 structure. This section describes the Systems Management component structure.

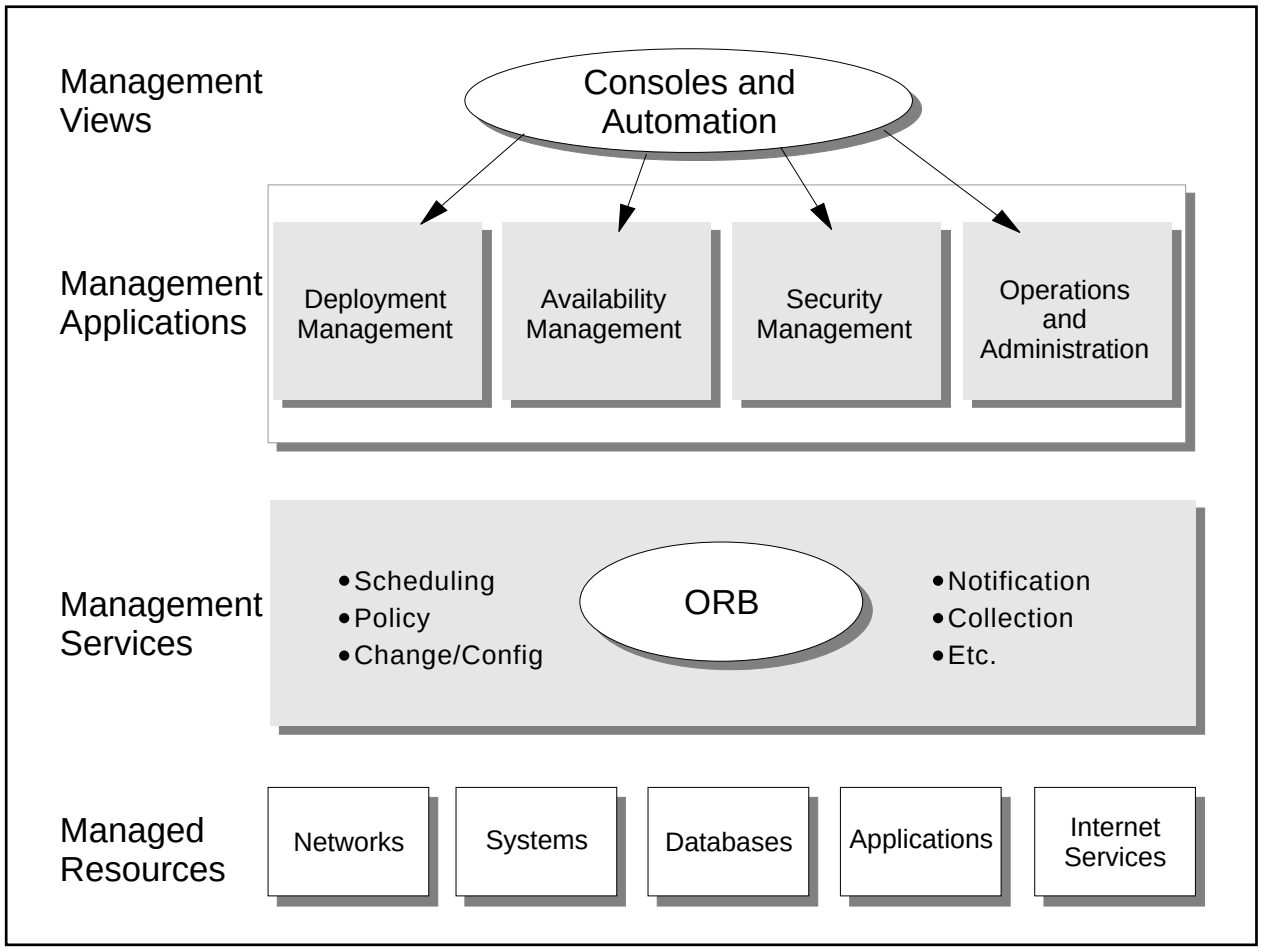

Figure 1. TME 10 Structure

General Model

The Systems Management component structure is comprised of four major elements as depicted in Figure 1 above. Together, these elements provide a robust and flexible structure for providing systems management solutions. The structure is modular, allowing for easy addition of new management applications and support for the management of new types of resources; flexible in allowing for installation of only the functions required; robust in its ability to support implementation in new technologies; and scalable in its use of Open Blueprint components that allow pieces of the system to be distributed across a network.

The four major elements are:

- **Systems Management Views**

  Provide a common access to systems management end user data. Views provide a common way to see and handle sets of systems management data and the ability to automate management tasks and processes, which is key to controlling information technology costs.

- **Systems Management Applications**

  Provide functions to automate management tasks and interact directly with system administrators, systems programmers, and other personnel involved in the operation and administration of information systems.

- **Systems Management Services**

  Provide common services to resource managers and Systems Management Applications unique to the needs of systems management. Through the use of these services and the use of the services provided by other resource managers, Systems Management Applications can have an integrated appearance, share data between applications, and be shielded from the underlying technology used to access management information from remote systems.

- **Managed Resources**

  Are resources owned by resource managers and are available for interrogation and control by Systems Management Applications.

Relationship to Resource Manager Structure

As described in the *Open Blueprint Technical Overview*, resource managers are responsible for both the functional and management support aspects of their resources. Thus, Systems Management Applications use application programming interfaces (APIs) to access the resource manager systems management support functions. These support functions use the Systems Management Services to provide their systems management support. Because resource managers are distributed, some Systems Management Services will be in the client part of the resource manager, and some will be in the server part.

Systems Management Component Structure Elements

This section contains detailed information about the four major elements of systems management.

Systems Management Views: The various Systems Management Applications provide a variety of information targeted at the end user. Some of this data will never reach the user console, but will be used as input to automation routines. For the data that does need to be seen and deciphered by an end user, an organization or *view* is needed pertaining to that user's interest. A view can be a subset or a combination of an application's output. For example, a user might be interested in monitoring the well-being of a payroll application. Useful information might include: which users are presently using the application, the performance of the part of the network that pertains to those users, or the level of payroll

application code running on the user's machine. This information would be collected by multiple applications and presented to the user focused totally on their view of what they are managing. Although different users will view different sets of data, the data will be presented in a common, consistent, and integrated fashion.

Systems Management Applications: Systems Management Applications cover a broad range of functions required to manage the information system. Management applications are categorized into disciplines according to how management tasks are performed (see Figure 2 on page 10). The four management application disciplines are:

- **Deployment Management**

  Support tasks associated with the configuration and change management activities for all of the frequently changing components of the enterprise.

- **Availability Management**

  Gather, collect, and route information regarding the state of all aspects of the enterprise computing environment for proactive management action.

- **Security Management**

  Ensure that users have access to the applications and data they need to do their job. Security management applications provide functions for administrative support for Open Blueprint Security resource managers.

- **Operations and Administration**

  Facilitate the automation of activities that provide the integrity and reliability of the entire computing environment. Operations and administration applications also support the administration of resource managers and their resources.

Applications in these disciplines use Systems Management Services and services from other resource managers for scalability, integration, and ease of use.

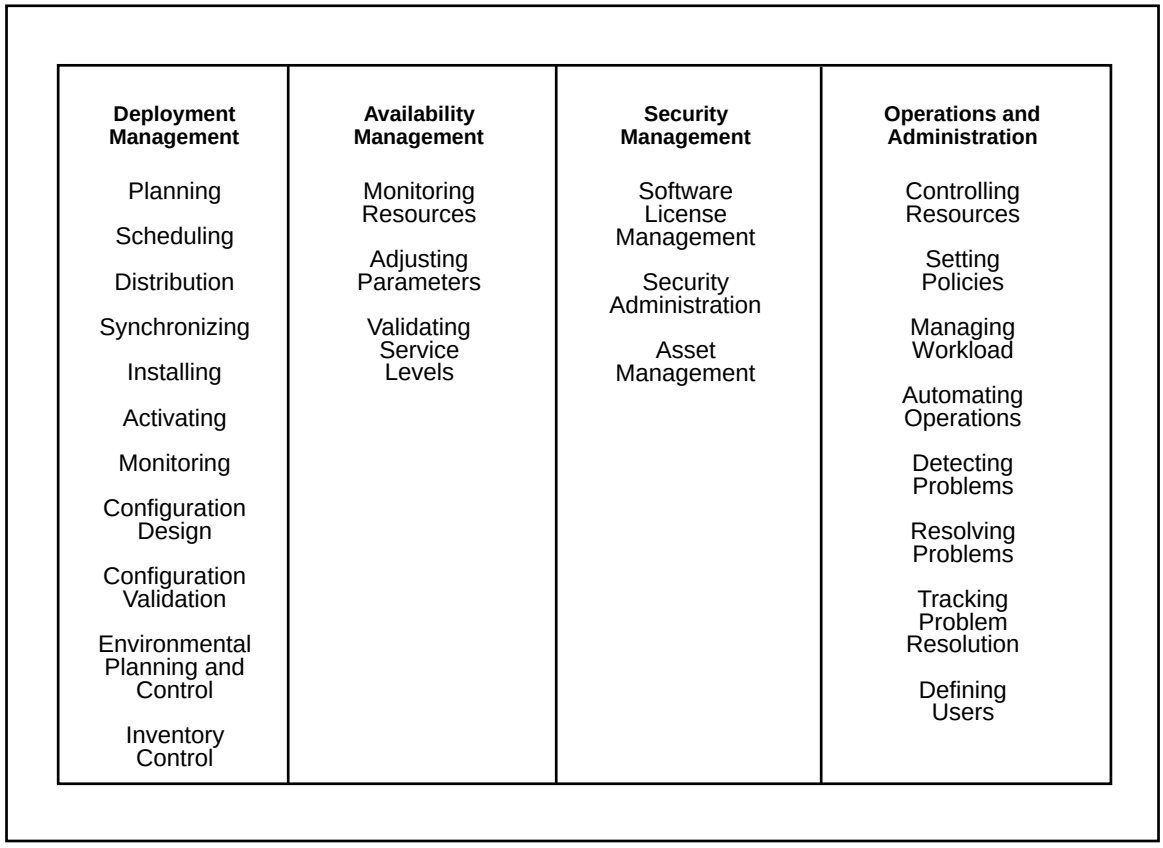

Figure 2. Systems Management Application Disciplines

Systems Management Services: Systems Management Services are used by both Systems Management Applications and resource managers. These services:

- Free the application from implementing specific functions related to the underlying transport, communications, and management protocols used to obtain management data and issue management requests.
- Provide a set of facilities to access information on resources being managed. This allows applications from different disciplines to share data.
- Provide facilities to applications that give systems administrators and other users of the applications an integrated, task-oriented, easy to use, flexible, and customizable user interface that minimizes training requirements and maximizes productivity.
- Provide resource managers with the capability to make information about their resources available to Systems Management Applications.

Systems Management Services are built on top of existing system facilities. As shown in Figure 3 on page 11, the Systems Management Services can be placed in three categories:

- Framework Services
- Application Services
- User Interface Services

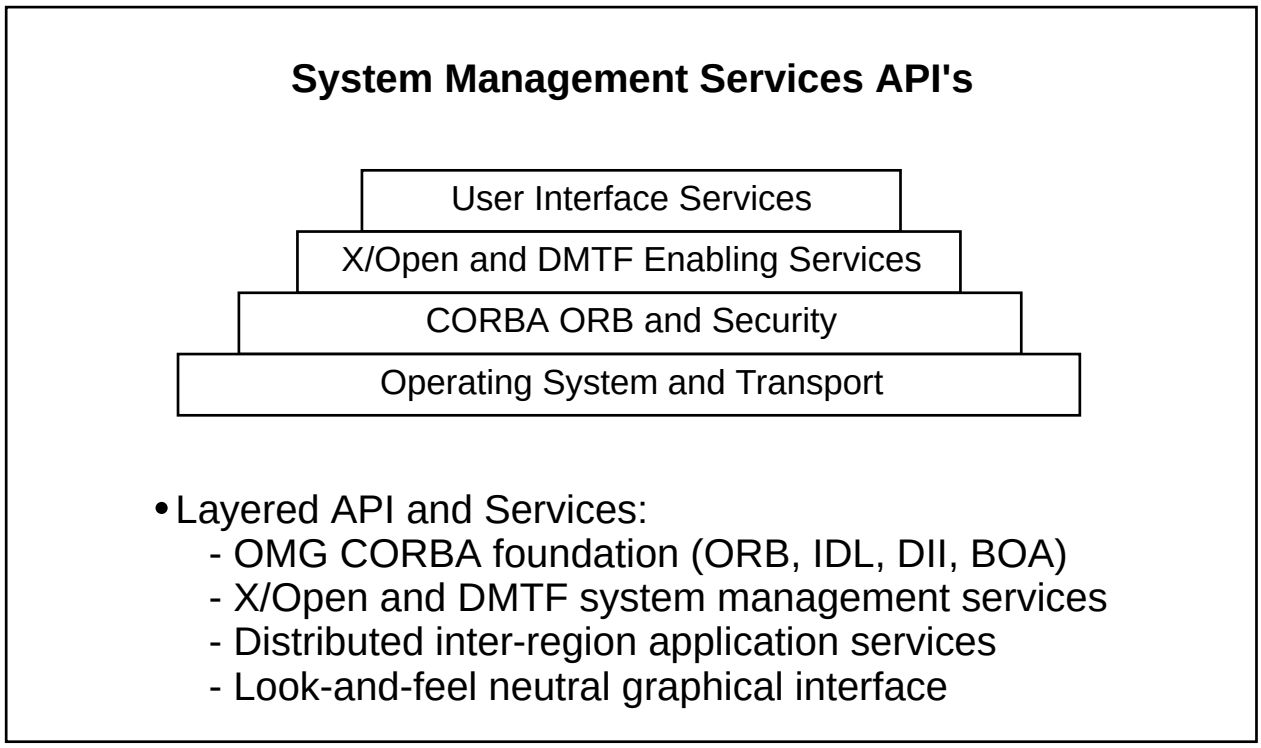

Figure 3. Systems Management Services APIs

Framework services implement the Common Object Request Broker Architecture (CORBA) specified by the Object Management Group (OMG). These services are included as part of the Open Blueprint Object Management Services. On top of these services are a set of application services that incorporate the X/OPEN Common Management Facilities (XCMF) of naming, events, and life cycle. At the top are a set of user interface services for allowing end user access to management facilities and data which support the management views component of the TME 10 structure.

Framework Services: Framework services provide basic object specification, creation, interaction, and method invocation. Other services are needed to support these basic functions. These include transaction services for the management of shared states and persistent data, concurrency and locking services for datastore consistency, and access to security services for authentication, authorization, and encryption. Framework services are provided in the implementation of the Corba-compliant Object Request Broker (ORB) and Basic Object Adapter (BOA).

Application Services: Application services provide the fundamental services for modeling or storing objects for management purposes. These services define the set of intrinsic operations that all policy-driven objects can inherit and implement. These services are being standardized by X/OPEN and OMG as the Common Management Facilities. These services comprise three categories:

- **A Set of Enabling Services for Managed Objects**

  Are the building blocks for systems management application developers. Enabling services include a collection service for arbitrary grouping, navigation, and filtering; a policy service for enforcement of user-defined rules; an instance management service for object creation, location, and persistence in association with policy regions, and a customization service for enhancing and changing the configuration of applications.

- **A Set of Advanced Application Services**

  Give additional capabilities to systems management applications. Advanced application services include a common managed node interface for querying resources, installation of applications, and

basic management operations; a scheduling service for management tasks; and a change and configuration management service to enable the performing of distributed configuration management tasks.

- **A Set of Run-Time Services**

  Simplify the task of creating robust, distributed, heterogeneous applications. Areas covered by run-time services include distributed exception handling; inter-object message facility; message logging; pattern matching; and data manipulation.

User Interface Services: User interface services offer a set of platform independent and presentation independent user interface services that allow simplification of application design and construction.

Managed Resources: In the management structure, the resources managed by a resource manager are called *managed resources*. Managed Resources are the hardware and software components in the information system. In fact, a resource manager itself is also a managed resource. Management operations on this resource include resource manager initialization and termination, restart, work prioritization and control, accounting, problem determination, tracing, configuration management, and performance tuning.

Resource managers support systems management functions by:

- Defining their management functions and externalizing those functions through the management interface, so that external entities (for example, Systems Management Applications) can monitor and control the resources. Agent services are provided to resource managers to facilitate this integration with Systems Management Applications.
- Exploiting the common management services of systems management.

Agent Services: As shown in Figure 4 on page 13, agent services are used by the resource managers to access and set the state of their managed resources. Agent services can insulate resource managers from awareness of the location and the transport being used to communicate with the managing system. Agent services include the ability to send notifications of significant conditions to Systems Management Applications through the use of Systems Management Services. They also include the ability to:

- Collect vital product data.
- Respond to operational commands and requests for state information about managed resources.
- Collect performance information.
- Enforce software license policies.
- Capture error and problem determination information.
- Request distribution of software.

Communication between the Agent Services and the Application Services used by the resource manager is through the Object Request Broker when the code is object oriented. In this mode, the Agent Services are object methods. This provides a highly flexible model for systems management by allowing both the management applications and the resource managers to implement all management functions in a consistent manner, which is the strategic direction for IBM Systems Management. However, resource managers deployed today that use procedural technology must work with Systems Management Applications that are implemented using object technology. These procedural implementations must interface with object based implementations and, at the same time, must support the SNMP procedural protocol. Systems Management Services provides object wrappers so that management applications can be insensitive to the management protocols being used to interact with their managed resource data.

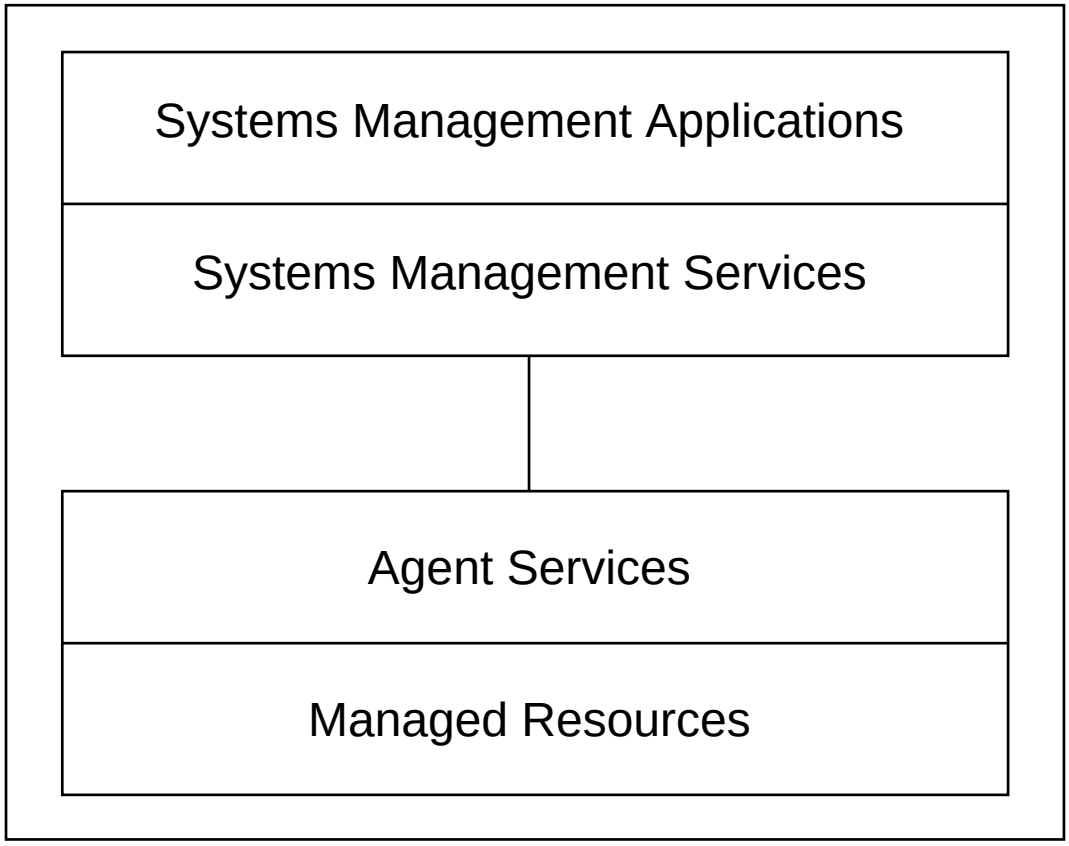

Figure 4. Agent Services

Scalability and Resource Management: Many enterprises deal with thousands of resources that need to be managed. Methodologies are needed to allow administrators to efficiently manage large numbers of heterogeneous resources. Administrators should be focused on the task they are performing, not the targets of their operations. The following example explains the concept of management by subscription, a methodology that uses the concepts of profiles and subscribers to provide administrators with scalable resource management.

Often the same activities need to be performed for many system or network resources. For example, there might be a sales group that needs a certain set of applications on each person's workstation. Members of a marketing group might need another set, some of which overlap with those of the sales group, and a third group might need a completely different set of applications. TME 10 introduces the concept of profiles and profile managers to handle this situation. A profile is a collection of application-specific information. This information is subject to the central establishment of rules and policies and encapsulates differences in architecture and mechanisms pertaining to the systems it will be sent to.

Administrators group profiles into profile managers, then subscribe workstations to a profile manager. When the workstation is subscribed to a profile manager, it is automatically subject to all the activities specified in profiles associated with that manager. If new profiles are added, the information is sent to the subscribers. The result is *management by subscription*, which enables administrators to greatly increase their productivity by performing activities on sets of resources rather than on individual resources. This scheme is especially useful for functions like software distribution and user administration.

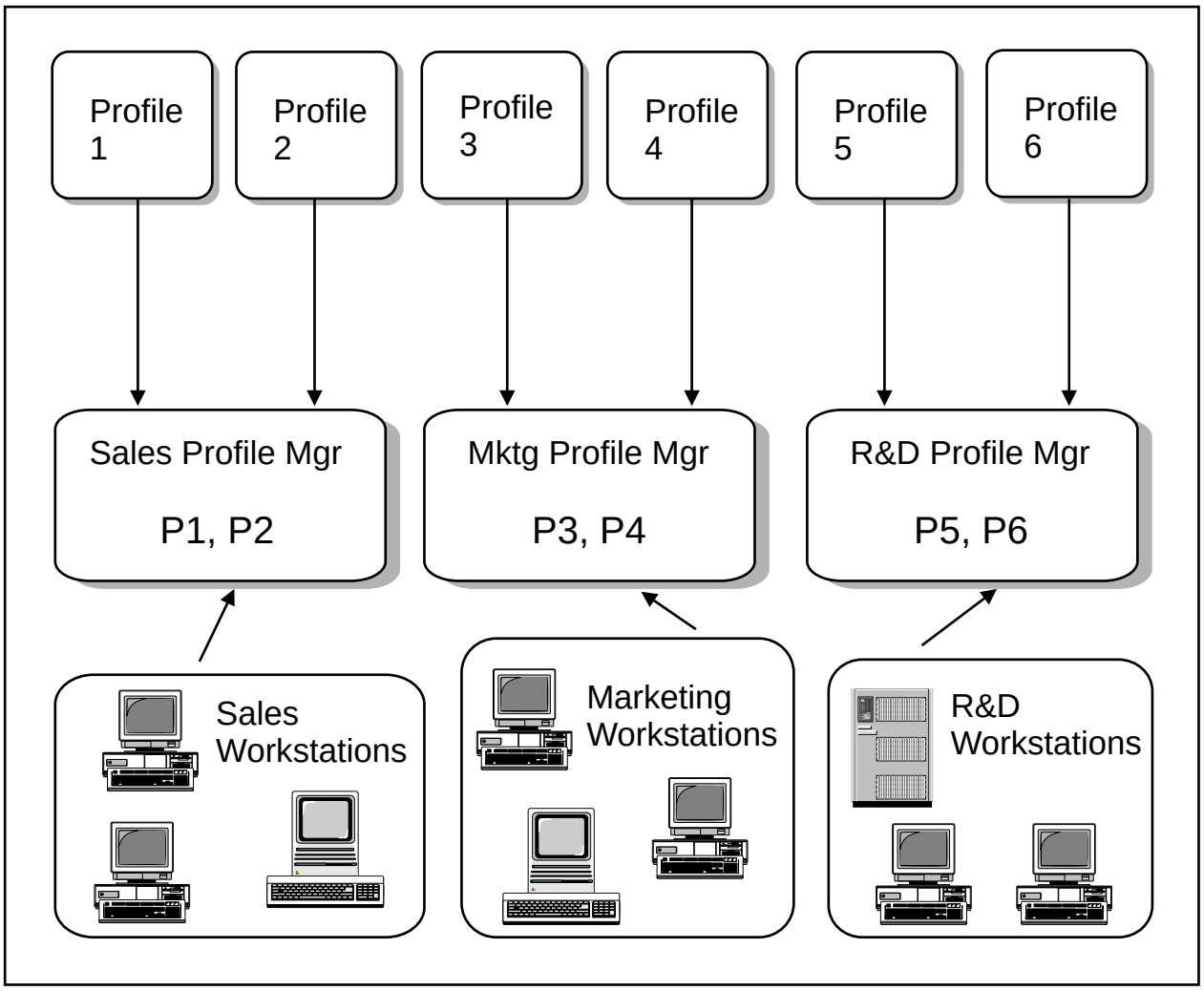

Figure 5. Example of Management by Subscription Using Profiles

In Figure 5, a company has defined six profiles that specify sets of applications to be distributed. The company has defined three profile managers and associated appropriate profiles with each. Finally, the workstations have been subscribed to the appropriate profile manager.

When a change is made to profile P2, the change will be sent to all the sales workstations. A new workstation subscribing to the R&D profile manager will receive all of the applications specified in profiles P5 and P6.

Systems Management Enablement of Applications and Resource Managers

The TME 10 Application Management Specification (AMS) is the foundation for systems management enablement of resource managers and distributed applications. To effectively manage an application, the management application needs information on how it is structured and how to control and monitor it. The AMS provides a format and content for Application Description Files (ADFs) which allows developers of these applications to describe standard management information. This management information describes elements of the entire application life cycle, including initial deployment, dependency checking, configuration of the various deployed components, monitoring and controlling the running application, and updating systems with new versions of the application. To be manageable, an application or resource

manager needs to provide information about its structure and topology, vital product data, procedures and programs for distribution and installation, and dependencies in the ADF. The application should use command line or API interfaces for its functions, use local operating system services such as logs, traces and storage dumps, and document these, as well as other relevant logs and files, in the ADF. Applications should instrument themselves with event adapters to monitor their relevant resources. These event adapters can monitor resources and collect events such as error messages, and can filter events and forward them to a management application where they can be acted upon.

The ADF format is based on the Management Information Format (MIF) as specified by the Desktop Management Task Force (DMTF). ADFs are DMTF-compliant MIF files that expand the Software Standard MIF, taking it from a single desktop management focus to distributed client/server application management.

To aid in accomplishing each of the management tasks listed above, an ADF contains the following:

- **Application Topology**

  A specification of how the distributed application is broken up into components and how these components relate to each other.

- **Application Distribution**

  A list of source files and directories that make up the application.

- **Application Installation**

  Identification of scripts to run before or after application distribution.

- **Dependency Checking**

  Identification of scripts to check the hardware and software configuration on target systems to ensure that application requirements are met.

- **Application Monitoring**

  Specification of what metrics and events can be retrieved from the application, and how to obtain them.

- **Operational Control**

  Identification of scripts to perform an arbitrary set of operational tasks.

Applications and resource managers will use System Management Services, including the ADF, to provide the following to Systems Management Applications:

- Information about structure and topology
- Vital product data for inventory and asset management
- Deployment and installation
- Dependency checking
- Monitoring
- Notification of significant conditions to enable problem determination
- Responses to commands for operations management
- Performance information for performance management
- Enablement of software license policy management

Systems Management Use of Open Blueprint Services

As described in the previous sections, the Systems Management component structure makes extensive use of services from other resource managers as follows:

- Presentation Services are used extensively by Systems Management Applications and Systems Management Services for interaction with users and printing of reports and trouble tickets.
- Data Access Services are used by Systems Management Services for storing historical, configuration, problem, inventory, and other systems management information. Databases and files are both used.
- Application/Workgroup Services are used by both Systems Management Applications and Systems Management Services for implementing workflow process models and sending mail.
- Communications and Network Services are used for communications between systems management objects on distributed systems.
- Object Management Services are used extensively by all systems management components on distributed systems.
- Distribution Services are used by systems management components for security and directory functions.

Systems Management and the Internet

With the emergence of the Internet as a powerful force in distributed computing, all the existing aspects of systems management (software deployment, user administration and operations, security, and availability) must be augmented to support the new characteristics found in Internet/World Wide Web (WWW) servers, clients and services. It is important to realize that management for the Internet/WWW is an extension of existing client/server management with the biggest difference initially coming from a multi-client, multi-server paradigm instead of the client/server paradigm often found today. File, Mail, Directory, Proxy, and Web servers as well as client systems, including Web browsers are examples of Managed Resources in this environment. All systems management tasks associated with the existing client/server environment are supported for these resources, augmented as necessary to deal with the Internet/WWW capabilities. Java applications, network computers, and HyperText Markup Language (HTML) programming require additional support. As applications are downloaded for short durations, configuration tracking becomes a more complex task.

Systems Management and the Open Blueprint

The Systems Management component structure and the TME 10 Structure described in this paper meet the architectural objectives described in “Architectural Objectives” on page 4. This structure is key to the successful and cost-effective management and operation of open, distributed systems. The implementation of this structure in today's TME 10 products provide a robust, flexible, and scalable solution that meet the demands of today's multi-vendor environment and will continue to evolve to support tomorrow's fast-paced and ever-changing requirements.

Appendix A. Systems Management Standards

The selection or adoption of a structure is basic to a strong, lasting management strategy and implementation. This chapter reviews the standards that are incorporated into the TME 10 structure.

Current Standards

The Systems Management component structure supports de jure and de facto industry standards:

1. IETF

   TME 10 supports the Simple Network Management Protocol (SNMP).

2. Object Management Group

   The Common Object Request Broker Architecture (CORBA) allows interoperability among independently developed object-oriented applications across heterogeneous computer networks.

3. X/OPEN/OMG

   The system management services in TME 10 incorporate the Common Management Facilities (XCMF) standardized by X/OPEN and OMG. These facilities include a naming service, event service, and life cycle service.

4. DMTF

   The Application Management Specification is based on the software MIF as defined by DMTF.

5. POSIX

   User administration is compliant with the POSIX 1387.3 definition for user groups.

Emerging Standards

In addition to the current standards, there are several emerging standards being incorporated into the Systems Management component structure:

- IETF
  - SNMP V2
  - Internet Standards

Appendix B. Bibliography

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