A METHODOLOGY FOR PLANNNING AND OPERATION OF INTEGRATED MANAGEMENT SERVICES

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ABSTRACT

The current dynamic evolution of networks and distributed systems present a variety of challenges with respect to the identification, planning and operation of Management Services to meet required service levels. This paper provides an overview of the requirements, goals, methods and decisions made in performing Network and System Management. It introduces and outlines a methodology that provides a basis for the planning and operation of Integrated Network and System Management Services. This methodology is based on a high-level logical model in order to accommodate the range of requirements and environments applicable to Integrated Network and System Management.

KEYWORDS

Computer Networks, Network and System Management, Planning and Operation

1. INTRODUCTION

A large number of IT systems are still managed in an unstructured style without an overall elaborated plan and lack appropriate Network and System Management tools and services (Lewis, 2003). This paper provides an analysis of the requirements for Management Services. The paper outlines a methodology that can be used as a basis for the planning and operation of Management Services. Management Systems are divided into different functional areas and can be derived from a set of Building Blocks in order to accommodate the range of requirements and environments applicable to Integrated Network and System Management (INSM). The paper further presents ways to utilize SW implementations for the provision of integrated Management Services based on the proposed principles. The construction and maintenance of Management Systems is facilitated by the use of existing solutions.

2. ANALYSIS

In the course of the problem analysis, a number of requirements that a Management System should meet have been identified. To further structure the derived key aspects into a structured requirements catalogue, the distilled requirements are further subdivided into two categories, namely *Architectural* and *Operational* requirements (see Table 1). Architectural requirements refer to overall characteristics and criteria that a Management Architecture should fulfill and are of primary concern for this research. One essential architectural requirement is concerned with the system distribution. The Management Architecture has to enable the distribution of Management Services to reflect the requirements of a given infrastructure (Lewis, 2003). The extensive overhead resulting from this requirement results from the challenges associated with the distributed system technologies of the existing and future heterogeneous infrastructures and the wide variety of the mobile systems and services. Therefore the architecture must neither impose additional constraints on the underlying distributed systems technology nor rely on specific system environment (e.g. with respect to the location of certain services and resources). This further facilitates future extension of the architecture. Operational requirements refer to an actual implementation and operation of the Management Architecture.

The requirement for system evolution in the context of this research refers to the ability to change (e.g. to extent or to modify) the behaviour of a Management System. System Evolution is a key requirement as Management Systems have to be adapted to the changing requirements and to the different environments in which they run.

Archtitectural	Operational
1. System Distribution	1. System Evolution
2. System Extensibility	2. System use and development
3. Compact Architecture	3. Support of distributed environment
4. Modular Architecture	4. Efficient resource utilisation
5. Based on open standards	5. System portability and generality
6. Based on generic development methodology	6. Support of Internet standards
7. Support of existing development languages and technologies	7. Support of management standards
8. Integration with 3rd Party Building Blocks	8. System scalability and performance
9. Reuse of existing Building Blocks	9. Support of specific platform features
10. Security support	10. System administration

Table 1: Requirements for new Management Systems

An Integrated Management Architecture has to provide end-to-end Management Services providing the required set of information to enable the network administrator to perform the appropriate planning, control and maintenance tasks. One industrial body that has considered integrated management planning and operation in some detail is the TeleManagement Forum (TMForum) (TMF-OM, 2000). The TM Forum has suggested an approach to open telecommunications management interface development drawing upon object-oriented analysis and design techniques and developed some specific management interfaces focusing on Service Provider and Carrier Networks. However the heterogeneity of today's communication infrastructures and services in which Management must be performed means that a common and accepted architecture for the provision of Integrated Network and System Management is currently not available (Foster, 2004; Menasce, 2004; Naik 2004).

3. PLANNING AND OPERATION APPROACH

The central Building Block of the planning and operation approach is the Management Engine (eg to be implemented in Software) to facilitates the definition, creation and control of Management Services in the ISNMware model (Knahl, 2004). For the planning and operation of Management Services the Management Engine is the central control instance providing the INSM provision, INSM support and INSM data. The Management Engine defines Management Services and generic related support activities. The Service Manager supports the creation and provision of a Management Service. It provides the Management Engine Access Interface with a set of interfaces for requesting services. The actual services are based on the functions and requests provided by the Management Service Domain. The Service Manager must interact with other processes to achieve the required connectivity to supply the service specified (eg with a Management Service Scheduler). The Service Manager further controls the state of the service resources in terms of their availability, activity, etc. The Service Manager performs these actions by invoking the Service Configuration Process. The Service Configuration Process aims to facilitates the configuration of Management Services and Managed Objects and acts as an integration point between service processes and network processes. It is a key process to support the integration between abstract Management Services and Network and System Management processes. The Service Configuration Process groups elements, which represent the resources, involved in providing the Management Service. The details of the Service Configuration Process depend on the nature of the Management Service. The Management Service Scheduler and Service Monitor further support the Service Manager in the tasks of Management Service administration (e.g. integration of established thresholds in the form of SLAs or scheduling mechanisms).

The Managed Object Interaction Broker provides an interface between the Management Engine and the Managed Objects and enables the communication with the various, heterogeneous Managed Objects and must integrate different management protocols and technologies (e.g. to provide access to networks and to enable the integration of legacy systems). To provide Integrated Management Services, it is required to achieve integration between different management technologies and domains, e.g. between CMIP and SNMP in different subsystems. Furthermore, it might be advisable to place the Managed Object Interaction Broker close to the Managed Objects to minimise management overhead. It might be required to operate a number of Managed Object Interaction Brokers simultaneously. The Event Manager deals with event notification and information forwarding of Management Service related problems. The process is entered when events are reported to the management system (e.g. high error rates) and ensures appropriate notification.

The INSMware Domain Model provides the information needed to develop a specific service in a specific domain. The Domain Model can be something that already exists in its whole or just in part. After analysis has been completed, potentially reusable Domain Classes can be identified. The next time that a Management Service that requires a particular domain is being developed those reusable Domain Classes can be taken into account. Domains will represent important parts of the overall organisation and infrastructure containing the different resources that provide a common set of functions for the provision of a Management Service. It is through Domain Analysis that domain knowledge can be transformed into generic specifications, designs and architectures for reuse in developing new systems within the domain. The Building Block Model describes the assembly of Building Blocks for the provision of Management Services within a Domain Model's scope. The Building Block Model may be built taking into account the Domain Classes that could be reused (e.g. as a result of Domain Modelling). Starting from the requirements capture in the System Model analysis, other models and refinements of existing ones are added to the model, refining associations between them. The Building Block Model identifies Building Blocks grouping objects and domains of the system for the provision of Management Services. The resulting Building Block description further specifies the functions of the identified Building Blocks. The identification of static and dynamic collaboration provides the connectivity and interaction among Building Blocks and enables the definition of Building Block distribution. These specifications can be used to identify required interactions, methods and attributes of the design to further refine the Building Block Model.

4. SYSTEM OPERATION

Figure 1 illustrates the different INSMware layers and development aspects that must be addressed. The INSMware framework can be implemented using Software Components for the realization of Building Blocks (Knahl, 2004). Some INSMware Building Blocks, such as those to provide user notifications and data storage, are useful broadly across all INSM environments (i.e. Horizontal Domain Common Building Blocks). Other INSMware Building Blocks, such as those to provide Configuration Management of a proprietary Managed Object, are useful within a single (or limited number) of management environments (i.e. Vertical Domain Common Building Blocks).

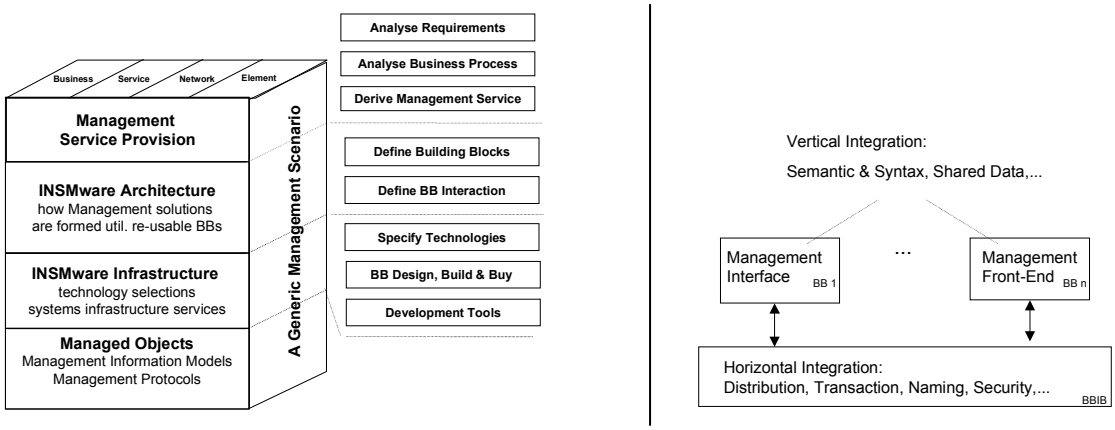

Figure 1: INSMware Operation Layers

The aim of the system is to provide Management Services. In heterogeneous networks, different communication protocols, technologies and services are commonly used to provide communication services. In the deployment of heterogeneous networks, a number of states and events can occur. No operator can control all the resources, processes and events, but several events can occur which require attention from a Network or System Administrator (e.g. a malfunctioning interface that disrupts a number of services). A software system must be developed to support the management of these systems and the provision of end-to-end Management Services. The system should notify users of specific states of systems (e.g. "high-error rate on router interface") the appropriate destination (e.g. E-Mail or voice message). Additionally, users of the system should be able to monitor and control relevant Management Services. It is further required to enable system administrators to monitor and control the management system itself.

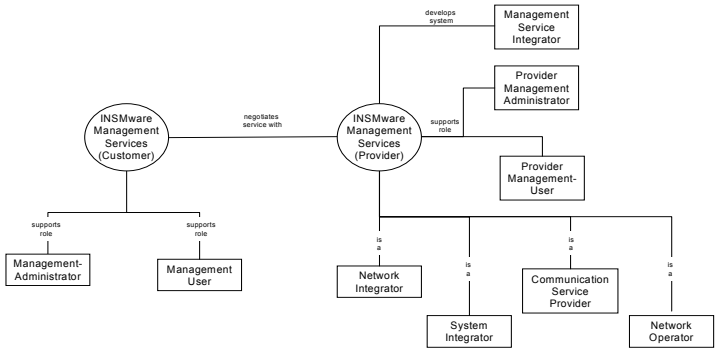

Figure 2: INSMware generic Business Model

Two primary stakeholders in the INSMware Business Model are the *Management Service Customer* and the *Management Service Provider* (see Figure 2). The Management Service Provider can be further specialised (e.g. a Network Operator providing basic network connectivity or a Service Provider providing a value added service such as Virtual Private Networks). A Management Service Integrator develops and supports the system for the Management Service Provider. The roles of Management User and Management Administrator are found in a typical Management Service Provider. On the customer side, the roles of End-User or Customer-Administrator can be identified. The provider supports the roles of Provider Management User and Provider Management Administrator to supervise the Management Services.

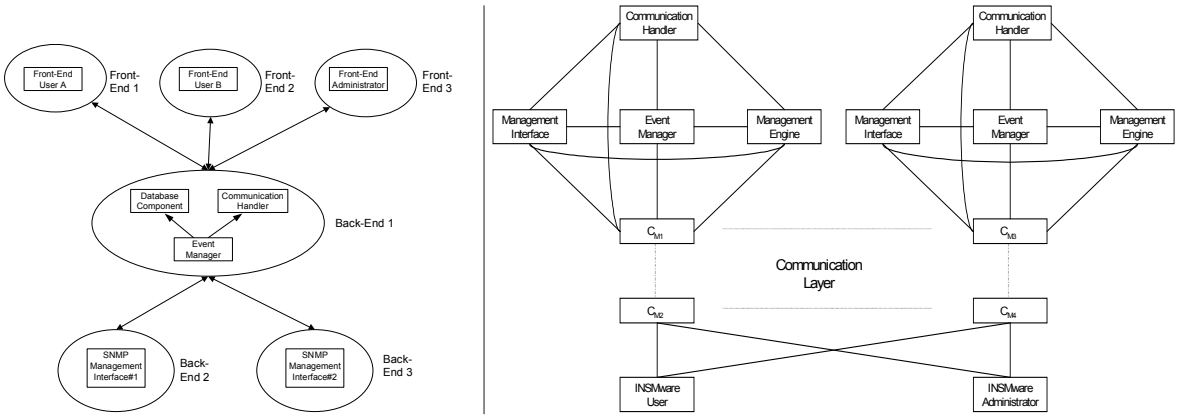

Figure 3: INSMware Implementation and Distribution

Based on this INSMware implementation several distribution scenarios have been modeled and realized (see Figure 3). In a basic configuration, all components are installed on one system whereas in a full distribution all components are installed on different systems. In practical terms it is usually advisable to leave the Backend-Components (ie the Database Component, the Communication Component and the Event

Manager) on one system (to reduce the amount of overhead traffic). Another distribution is to replicate the Back-End Components. However, this solution adds further complexity to the system due to the existence of *replicated data* (e.g. data contained in the separate Management Engines must be synchronised).

The right hand side of Figure 3 shows a distribution scenario where the Back-End Building Blocks are distributed to separate systems. This distribution scenario enables load-balancing. Based on these principles, management solutions can become more modular and thereby easier to plan, construct, maintain and operate. Systems can be adapted by replacing INSMware components with new component versions. Additional Software Components can be linked to the core system and can migrate to other systems thus allowing the system topology to evolve and adapt to new management requirements and network topologies.

5. CONCLUSIONS AND OUTLOOK

The main aim of this paper was to outline a methodology for the planning and operation of Integrated Network and System Management. The paper further illustrated realization principles to support the development process of the proposed management approach. A common set of methodological guidelines further promotes interoperability and efficient development. Management Services can either be seen to facilitate the development of current and new services or to merely add overhead and complexity to a networked environment. However a comprehensive Management Framework is a prerequisite for the provision of optimised services and facilitates the efficient deployment of these services. Issues related to management should be taken into account during the design of each new technology and service. The same applies to the definition of Management Services in connection with the planning and operation of IT infrastructures. Disregard of these rules may increase costs and affect the viability of the provided services.

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