

A MODEL FOR DISTRIBUTED RESOURCE MANAGEMENT OF SMES USING DIRECTORY SERVICE

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Received September 2015; accepted November 2015

ABSTRACT. *Continuous progress of Information and Communication Technology (ICT) has kindled the constant introduction of various business IT systems. Nowadays enterprises encounter with the problem of integrating those systems in order to have competitive advantages over the others. More and more enterprises are now struggling to secure their IT systems against unauthorized infiltration or information leakages as well as to effectively manage their distributed resources. Of course there already exist several IT asset management solutions that handle those challenges in the market. However, those are somewhat expensive or complex for Small and Medium Enterprises (SMEs) with limited financial capabilities and personnel capacities to use. In this paper it is suggested that a directory service based system can be used to cost-effectively manage distributed IT resources for SMEs. By implementing a pilot solution over directory service, it is demonstrated that our approach is applicable to real business affairs. The contribution of this paper lies in that suggested approach does not require large investment. Since directory services are already deployed to many enterprises within several operating systems, it is expected that it can be more practical for SMEs to utilize directory service for their resource management.*

Keywords: Resource management, Directory service, Small and medium enterprises

1. Introduction. Since the first introduction of computer system to business environment, effective utilization of IT resources has been one of keen capabilities to uphold enterprise's competitive advantage. Companies are actively incorporating advances of ICT to their existing systems, and thus enterprise information systems have been developed into more complex network of distributed resources. Nowadays, in an enterprise there are lots of IT systems such as ERP (Enterprise Resource Planning), EKP (Enterprise Knowledge Portal), SCM (Supply Chain Management) and BPM (Business Process Management). All those enterprise IT systems are now demanding more intelligent integration to cooperate with each other, and to reduce integration overheads caused by an addition of new IT system [7,8]. Almost all new IT systems introduced to enterprises have their own account management scheme and resource management policy. To effectively integrate or interlink those IT systems each other, enterprises have to manage multiple accounts and policies in accordance with their organizational structures. Enterprises

are struggling to secure their IT systems seamlessly against unauthorized infiltration or information leakages as well as to effectively manage their distributed systems.

Of course there already exist several enterprise IT solutions in the market to handle above challenges such as EAI (Enterprise Application Integration), SSO (Single Sign On) and IT asset management solutions [8,9]. However, those are somewhat expensive or complex for SMEs that have limited financial capabilities and personnel capacities. SMEs demand more cost-effective way of management that fits to their enterprise environment. In this paper we suggest the utilization of directory service to meet their needs. Since directory services are already deployed to many enterprises within several operating systems, SMEs can easily develop their own solution while minimizing additional investment. The simplicity of our model also makes it possible for it being managed by minimal personnel efforts. We expect that our suggested model can be more practical for SMEs.

The rest of this paper is organized as follows. Section 2 shows related works on information resource management in enterprise environment. In Section 3, our directory service based resource management is explained in detail. In Section 4 we demonstrate the applicability of our model by implementing pilot Human Resource (HR) management system. Finally in Section 5, we conclude our paper with some future research directions.

2. Information Resource Management in Enterprise Environment. Enterprises have invested quite some of money to IT resources for a long time and thus own lots of IT systems and solutions within their enterprise environment. Most of those obtained resources are geographically distributed and managed over heterogeneous networks. Effectively managing those resources can be a tough job when the business environment is constantly changing. There have been lots of researches to manage distributed resources such as GRID or mobile environment [10,11]. Those are, however, focusing mostly on huge distributed networks and protocol level solutions. For SMEs to use resource management solution, it is needed to be proper for small intranet environment, and to be an application level solution. In this section we simply describe how the enterprises are endeavoring to manage and control their distributed IT resources.

2.1. Distributed resource management. Standardization is the key to manage distributed resources from various vendors. In order to obtain interoperability between heterogeneous resources while not inhibiting diversity, standardized management scheme together with common information model is needed. DMTF (Distributed Management Task Force) is one of such standardization organizations that bring IT industry together to collaborate on systems management standards development, validation, promotion and adoption. DMTF provides CIM (Common Information Model) to establish a common framework of managed environment of networked systems. DMTF also provides WBEM (Web-Based Enterprise Management) that is a set of management and Internet standard technologies developed to unify the management of distributed computing environments, facilitating the exchange of data across otherwise disparate technologies and platforms. Nowadays, WBEM/CIM is applied in a wide range of application domains from networked servers to ubiquitous sensor devices [1,2].

Recent advance in IT environment has given birth to virtualization of physical devices. Instead of managing physically distributed multiple resources, managing them under a high performance system with separated virtual environment can be more effective and flexible. DMTF's VMAN (Virtualization Management) standard is a set of specifications that address the management lifecycle of a virtual environment. VMAN has been adopted and published by the ANSI (American National Standard Institute) International Committee for Information Technology Standards (INCITS) as INCITS 483-2012. VMAN's Open Virtualization Format (OVF) specification provides a standard format for packaging

and describing virtual machines and applications for deployment across heterogeneous virtualization platforms, while VMAN's profiles standardize many aspects of the operational management of a heterogeneous virtualized environment [3,4,6].

2.2. IT asset management. Enterprise Asset Management (EAM) is for optimal life-cycle management of the physical assets of an organization. It covers subjects including the design, construction, commissioning, operations, maintenance, and decommissioning or replacement of plant, equipment and facilities. While the DMTF's efforts are focused to IT assets, EAM deals with overall enterprise assets. There are lots of EAM systems that are already offered in the market. Those are, however, somewhat expensive and complex for SMEs to use. Since full featured solutions cover a wide range of enterprise resources, those are mainly used in big enterprises with high financial and personnel capabilities. Many SMEs are demanding a budget EAM system that provides simple managerial functions for core corporate assets, especially IT resources, and requires less personnel involvement for managerial tasks. To meet those requirements, a lightweight system that initially focuses on the management of IT asset, but extensible to other assets as the company grows is needed. For such an IT resource/asset management system to be implementable, conformance to industry standards like DMTF's is crucial to ensure interoperability between heterogeneous systems. Even the in-house system needs to adopt those standards to properly access and manage other systems. In that perspective, directory service that supports industry standards can be a good alternative to implement SMEs managerial demands.

2.3. Directory service and active directory service. A directory is an information repository that contains descriptive and attribute-based data. In a networked computer system directory becomes the information source of distributed objects, and organizes accesses to network resources. Standards like LDAP (Lightweight Directory Access Protocol) enable the access to directory regardless of underlying Operating System (OS) or network architecture. There are wide ranges of LDAP implementations available from open source initiatives as well as from commercial vendors [4-6].

Directory service makes it possible to establish enterprise-wide shared information repository by identifying distributed resources and systematically archiving the attributes of individual resources. By exploiting these features of directory service, one can register IT assets to directory and thus manage and control their configurations somewhat easily. Since the cost of implementation for directory service is by far lower than full-featured EAM system, it can be a cost-effective alternative for SMEs to acquire IT asset management system that has extensibility with the industry standards support.

Active Directory (AD) is the Microsoft's implementation of directory service within the Windows server OS. Information is hierarchically organized in the AD as a name space for users can easily lookup and access. Network resources such as user, computer, printer, user group and even software are identified as object that can have named attributes. AD controls the access from user/group account domain-wisely. Since Organizational Units (OU) can be configured within each domain, objects with similar managerial or security requirements can be configured as OU, and thus can be applied to the same standard access policies, which is simply depicted in Figure 1. AD provides delegation of managerial control as well as central management of group policy [5,7]. All these features of AD make it possible to implement simple and extensible resource management system with less development efforts.

3. Directory Service Based Resource Management. AD supports LDAP, ADSI (Active Directory Service Interfaces) and DSML (Directory Services Markup Language). It also supports x.509 digital certificate, Kerberos and SSO [4,5,7]. With all these features we can strengthen IT governance somewhat easily by unifying user identification scheme

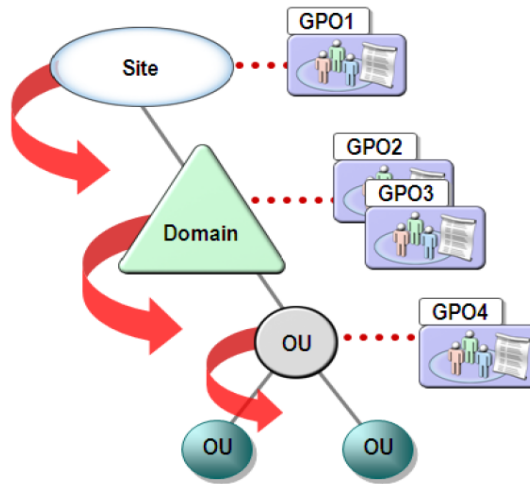


FIGURE 1. Group policy in Active Directory

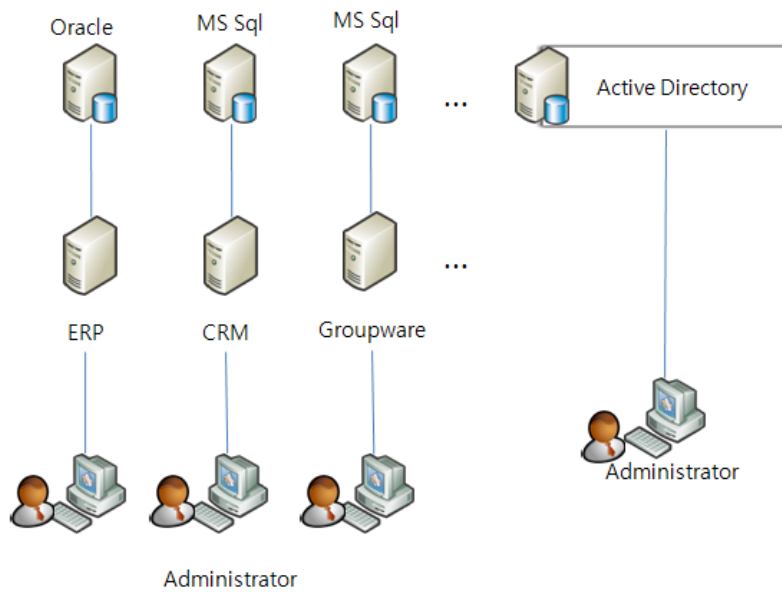


FIGURE 2. Managing individual DBs

and access control as well as by implementing security policies. In order to utilize AD more effectively, however, integration mechanism between directory configuration and target solution should be carefully considered beforehand.

Maybe one of the most popular integration approaches is to use separate databases for each system as is depicted in Figure 2. Information that is stored in AD plays the role of enterprise standard, and is replicated into individual systems' account structure. In this case frequent organizational changes and personnel repositioning can incur repetitive administrative tasks to corresponding databases together with possible information inconsistencies between target systems.

Another approach given in Figure 3 is to implement direct accesses from individual systems to AD. This can be preferable when real-time synchronization between AD and system account is highly demanded. However, this also incorporates some inefficiency that needs repetitive implementation of similar access logic from each system. When redeployment of access logic due to changes of business requirements happens frequently, this approach also suffers exhaustive managerial tasks.

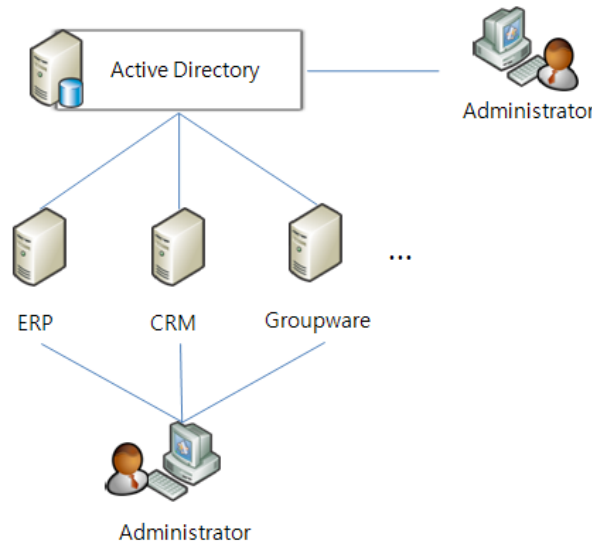


FIGURE 3. Direct access to AD from resources

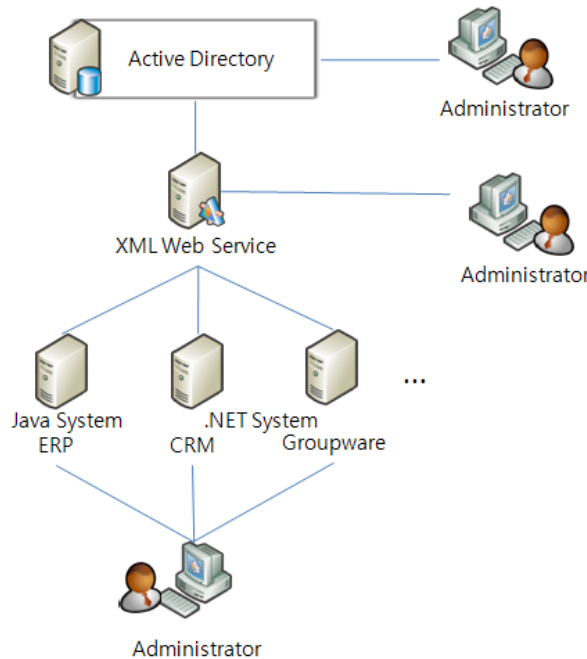


FIGURE 4. Web services mediated access

Above two approaches depend on client platforms, and have the shortcomings of coarse business integration that does not exploit distributed network environment more actively. They have limited extensibility and flexibility to cope with business requirement changes. To overcome such drawbacks we can think the third approach of Figure 4 that utilizes Web Services. In this Web Services mediated integration approach, we can overcome client dependency while minimizing repetitive administrative tasks. Any client systems can access remote resources over AD with RPC (Remote Procedure Call) and XML. Now enterprises can integrate/interlink a new resource easily without implementing separate solutions to AD. This Web Services mediated integration approach is the key to our IT asset management system for SMEs.

4. Pilot HR System. A pilot HR system has been developed over AD to demonstrate the possibility of proposed approach. In most enterprises the operational boundaries of distributed resources are shaped alongside the managerial units within organizational

structure. This will be the reason why the most of IT asset management systems in market are designed to work based on organizational structure, especially HR hierarchy. Thus, an implementation of HR system over AD can be a good example that probes the potential of proposed approach in the IT resource management.

In most SMEs the configuration of AD is flat and monolithic that only identifies groups, users and computers while not reflecting organizational structure. This AD structure removes all administrative tasks that accompany any organizational changes. This also inhibits application of departmental and regional resource policies that enables specific access control. In this configuration administrator's task ends at issuing account. And the utilization of AD for IT asset management is also strongly limited.

To the contrary when we reflect organizational structure into AD configuration, we can establish and exert fine control for each department and region. However, this configuration can incur severe administrative tasks under frequent organizational reforms. To cut repetitive tasks, synchronization between modified AD configuration and individual systems should be executed automatically by the management system. We have implemented Web Services mediated integration approach with database synchronization of each system. Our pilot HR system's simplified architecture and snapshot screen are given in Figure 5. In the left side of Figure 5, a Web Services component that actively synchronizes AD and databases of individual systems is depicted. This component takes the role of two-way synchronization, and thus reduces the administrative tasks to redeploy changes to each system. As is shown in Figure 5, databases and spreadsheet file can be used as synchronization target that shows hierarchical AD configuration for organization structure.

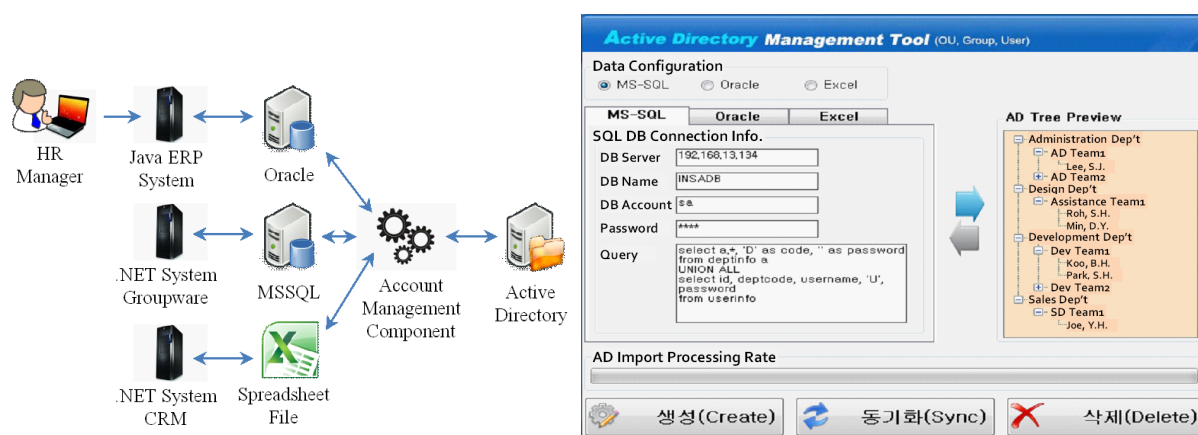


FIGURE 5. Implementation of pilot HR system over AD

5. Conclusions. Wise administration of distributed IT resources can be a good competitive strategy for a company in this highly networked and global business environment. For SMEs to manage those IT assets, directory service based approach can be a cost-effective alternative. By inspecting conventional integration approaches between AD and target systems, we suggest Web Service mediated synchronization method. In this paper we demonstrate the applicability of proposed approach by implementing a pilot HR system over AD system. With this pilot system we can minimize administrative tasks for synchronization of information while reflecting organizational structure in AD configuration. Though directory based approach can be restrictive for now compared to full featured EAM systems in market, it can be extended to support wider application areas due to its standard conformance. To cover other asset's management features, further study to enhance the constructs of proposed approach is needed.

Acknowledgment. This work was supported by a Research Grant of Pukyong National University (2015).

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