

Web Based Enterprise Management for Distributed Heterogeneous Computing Environment: A Review

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Abstract---Web Based Enterprise Management (WBEM) specifies standard for a unifying architecture that allows access to data from a variety of underlying technologies, platforms, and presents that data in a consistent fashion. The aim of this article is to systematically review of work done by various researchers regarding WBEM and provide guidelines to adopt Efficient XML Interchange (EXI) binary xml technology instead of xml in the WBEM architecture so that more improved results may be achieved in the distributed heterogeneous network. Study reflects that selection of methodology and parameters are application specific. Furthermore improved solution for WBEM using EXI is also discussed.

Keywords—WBEM; XML; Binary XML; FastInfoset; Efficient xml interchange (EXI); Heterogeneous Network;

I. INTRODUCTION

WBEM is an emerging technology designed to deal with resource interoperability solution which focus on integration aspects in the current heterogeneous computing scenario. The wide spread use of web service standards give the opportunity to use this technology to integrate management applications and services for the current disparate systems. Beside WBEM other network management technologies are Simple Network Management Protocol (SNMP) [1], Common Management Information Protocol (CMIP), Desktop Management Interface (DMI) [2] but these technologies are unable to provide a common, consistent, portable and uniform solution of overall system. This creates incompatibility and lack of interoperability among distributed heterogeneous computing system. Due to lack of interoperability between these various available distinguish management solution; it is necessary to implement a standardized integration approach or single operating panel that provides a consistent transition path among currently available management solutions of distributed computing

environment. So the present work focus on WBEM technology. This paper analyzes work regarding WBEM performed by eminent resource persons and provide guidelines to incorporate EXI binary xml methodology in WBEM prototype for high performance and resource utilization.

Rest of the paper is structured as follows: Section II describes the background of work related to heterogeneous network management techniques. Section III presents WBEM. EXI latest solution for WBEM is given in section IV. Finally Section V concludes the paper.

II. BACKGROUND

The SNMP is a communication de facto protocol that defines how all devices are managed over the networks [1].SNMP is an application layer protocol and transmits data in TCP/IP network by User Datagram Protocol (UDP) which is a connectionless, unreliable communication. CMIP provides enhanced features compared to SNMP regarding security, the handling of tasks, or the detection of errors. The CMIP provides a much richer network management and is more costly than SNMP due its complex architecture. DMI generates a standard framework for managing and tracking components in a desktop, notebook or server computer; by abstracting these components from the software that manages those applications [2]. The development of DMI marked the first move by the Distributed Management Task Force (DMTF) into desktop-management standards. Before the introduction of DMI, no standardized source of information could provide details about components in a personal computer. The comparative analysis among SNMP, CMIP, WBEM and DMI based network management technologies are summarized in table I [1] [2]. Among them WBEM is the most effective technology which provide a uniform, portable solution for heterogeneous computing environment using CIM-XML.

TABLE I. COMPARISON OF SNMP, CMIP, DMI AND WBEM TECHNOLOGIES

Dimensions	SNMP	CMIP	DMI	WBEM
Information Model	Object Based	Object Oriented	Object Based	Object Oriented
Specification Language	SMI	GDMO	MIF	CIM(MOF)
Operations	GET, SET, TRAP	M-GET, M-SET, M-CREATE, M-DELETE, M-ACTION, M-EVENT REPORT, M-CANCEL-GET	Get, Set, Implicit Action, Add, Delete Events	GetClass, EnumerateClasses, GetProperty, EnumerateClassNames, GetInstance, EnumerateInstanceNames, SetProperty, CreateInstance, ModifyInstance, DeleteInstance, CreateClass, ModifyClass, DeleteClass, GetQualifier, SetQualifier, DeleteQualifier, EnumerateQualifier, Associators, AssociatorNames, References, ReferenceNames, ExecQuery
Standard Body	IETF	ITU-T, ISO/OSI	DMTF	DMTF
Addressing	MIT with OID at leaves of the Tree	MIT with Scoping/Filtering	Components/Group/attributes IDs	Name and Association

III. WEB BASED ENTERPRISE MANAGEMENT

In 1996, leading companies such as Cisco Systems, Compaq Computer, Intel, Microsoft and BMC Software announced the WBEM initiative [3]. The goal of the initiative is to unify and extend the existing management standards with help of object-orientated constructs and design [2]. In 1998, the Distributed Management Task Force (DMTF) took over responsibility of WBEM [3] DMTF objective is to accelerate adoption of management standards, to unify industry management initiatives and to promote interoperability among management solution providers. Evolution of WBEM is represented in Table II.

TABLE II. WBEM HISTORY

DATE	EVENT
17-07-1996	WBEM is announced.
18-09-1996	DMTF adopt CIM
9-04-1997	CIM v1 Released.
11-12-1997	CIMv2 Released.
2-06-1998	DMTF adopted WBEM.
15-12-2003	CIM compliance specification v1.1 Released.
9-12-2004	CIM operations over HTTP specification v1.2 Released (DSP0200).
9-12-2004	Specification for the representation of CIM in XML v2.2 Released.
4-08-2005	CIM infrastructure specification V2.3 released.
20-04-2006	CIM schema V2.12 released.

The three major standards of WBEM are Common Information Model (CIM) [4], CIM-XML encoding specification and the CIM operations over HTTP specifications [6]. The CIM is conceptual

information model for describing computing and business entities in enterprise environments [3]. The standard language used to define elements of CIM is Managed Object Format (MOF). The CIM is comprised of a CIM Specification and CIM Schema. The CIM Specification defines the syntax and rules. There are three levels of the CIM Schema: (1) Core Schema (2) Common Schema and (3) Extension Schemas. The DMTF working group is also standardizing additional technologies for WBEM such as WBEM CIM Query Language [6], WBEM Discovery using SLP [7] and WBEM URI mapping [8]. On the basis of these technologies various researchers presented WBEM prototype.

In 1997 James Won-Ki et al [2] presented an integrated web based management architecture used to manage all the networking and computing resources in an intranet. In 1998, J.Patrick Thompson [9] of Microsoft Corporation elaborated an article entitled "Web Based Enterprise management Architecture". Kristofer Sandlund [10] in 2001 discussed, Network Management using WBEM. Kenneth Carry and Fergus O' Reilly [11] outlined experiences of developing a heterogeneous network management system with broad range of heterogeneous tools. So-Jung Le et al [12] presented the design of WBEM-based Management System for ubiquitous computing servers. Another article given by So-Jung Lee [13] illustrated WBEM/SNMP Gateway Architecture. The article proposed two mechanisms; a specification translation and interaction translation so that communication between client and server may be permitted. In 2005 Pedro Goncalves et al. [14] proposed WBEM Policy Based

Network Management System (PBMNS) architecture that use policy based management concept associated with WBEM to control QoS aspects in the network management. Then Jong-cheol Seo and young Tak kim [15] in 2006 proposed a policy based mgmt with WBEM architecture. It includes certain policies applied for complex network management. Shanmugham Sundaram et al. [16] proposed a design and implementation of WBEM based network management system for inter-traffic engineering for QOS guaranteed Diff-serv provisioning using Linux based Open Pegasus WBEM. Abdurakhmon Abdurakhmanov et al. [17] designed and implemented distributed fault management on openPegasus for WBEM based Inter-AS Traffic Engineering (TE) for QoS guaranteed DiffServ-over-MPLS using existing CIM MOFs with hierarchical inheritance and future plan is to the integrate proposed distributed fault management with Service Level Agreement (SLA). After that another WBEM-based inter-AS performance management architecture for QoS-guaranteed DiffServ-over-MPLS networks is also proposed by them [18]. It provides performance management of QoS and traffic parameters for end-to-end, edge-to-edge and TE link. Sun Mi Yoo et al in 2006 presented performance evaluation of WBEM Implementations namely the Open Pegasus, WBEM Services and open WBEM. The outcome of evaluation revealed that WBEM services performed worst where as Open Pegasus and OpenWBEM performed relatively the same. In 2008 George Oikonomou and Theodore Apostolopoulos discussed web based management of Content Delivery Network WebDMF, a management framework for distributed services based on the WBEM family of specifications. Michael Hutter et al [21] presented the design and implementation of an embedded IP See-gateway prototype that uses WBEM as a management

solution. During experiments, it has been shown that the complexity and effort of managing their prototyping platform using WBEM has become relatively high due to multitude of different CIM classes. The proposed WBEM prototype uses CIM-xml protocol but xml consist of some limitations. The size of xml document is very large due to which data transmission is slow and inefficient. Xml consists of great overhead [22]. Parsing of xml documents consume great deal of CPU times which reduces throughput and scalability. So binary xml technology used. It consists of new format and has the ability to compress the xml data transmission and represent in binary format. The major challenge for binary xml is to create a single, widely adopted standard. The International Organization for Standardization (ISO) and the International Telecommunications Union (ITU) published the Fast Infoset standard in 2007 and 2005, respectively. The World Wide Web Consortium (W3C) has produced the first draft of the EXI format specification. The main advantages of binary xml over xml technologies are: It reduces verbosity of xml document [20] and minimizes cost of parsing. Therefore Jong-Geun Park et al [23] in Feb. 2006 proposed architecture for WBEM uses a new method for representing and transporting CIM operations. This is the only article about WBEM prototype which incorporates binary xml technology, FI. The EXI is a proposed data format from the Efficient XML Interchange Working Group of the W3C. EXI was chosen as W3C's binary xml format after an evaluation of various protocols that included FI. EXI format is derived from Agile Delta Inc [24]. EXI is very compact representation for the xml Infoset i.e. intended to simultaneously optimize performance and utilize computational resources [25]. An overview of various WBEM Schemes is summarized in Table III.

TABLE III. TAXONOMY OF WBEM SCHMES

S.N.	YEAR	AUTHORS	DOMAIN	REMARKS
1	1997	James Won-Ki Hong et at [2]	Network and Resource Management	Presented an integrated WBEM architecture for network and resource management
2	1998	J. Patrick Thompson [9]	Network Management	Presented article WBEM architecture for network environment
3	2001	Kristofer Sandlund [10]	Network Management	Web-Based Enterprise Management (WBEM) standard is evaluated for the possible use in the Ericsson NMS (Network Management System).
4	2002	Kenneth Carry & Fergus O'Reilly [11]	Heterogeneous Network Management	Discussed Experiences of developing heterogeneous management system tools and toolkits using WBEM
5	2004	So-Jung Lee et al. [12]	Ubiquitous Computing Management	Presented Design of WBEM based management system for ubiquitous computing server also discussed comparative analysis among WBEM implementation

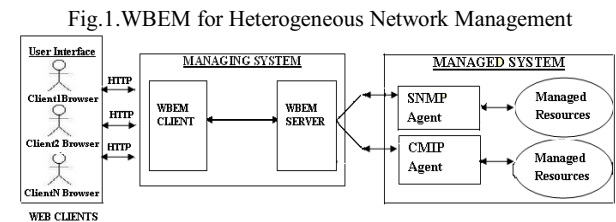
6	2005	So-Jung Lee et al. [13]	Integrated Enterprise Management	Illustrated WBEM/SNMP Gateway architecture and proposed mechanism for specification translation and communication translation
7	2005	Pedro Goncalves et al [14]	Policy Based Network Management	Proposed WBEM Policy based Network Management System (PBNMS) architecture, aspect in Network Management based on certain predefined policies
8	2006	Jong-Cheal Seo and Young Tak Kim [15]	WBEM based Network Management	Proposed a policy based management with WBEM architecture For Qos- guaranteed Diff-Serv-Over MPLS services network and inter AS environment.
9	2006	Shanmugham Sundaram et al. [16]	Network Management	Proposed design and implementation of WBEM based network management system for Qos guaranteed Diff- Service Provisioning.
10	2006	Abdurakhmon Abdurakhmanov et al. [17]	Distributed Fault Management	Designed and implemented distributed fault management for WBEM based inter-AS TE.
11	2006	Abdurakhmon Abdurakhmanov et al. [18]	Performance Management	Proposed a WBEM-based Inter-Autonomous system (AS) performance management architecture for QoS-guaranteed DiffServ-over-MPLS network.
12	2006	Sun Mi Yoo et al [19]	Open Source WBEM Implementation	Presented Performance evaluation of WBEM Implementation such as Open Pegasus, WBEM Services and Open WBEM . Outcome shows openPegasus is the best technique.
13	2006	Jong-Geun Park et al [23]	Binary xml Methodology Fast Infoset with xml	Proposed architecture for WBEM which uses binary xml methodology for representing and transporting CIM operation.
14	2008	George Oikonomou and Theodore Apostolopoulos[20]	Web Based Content Delivery Network Management	WebDMF utilization for management of Content Delivery Networks
15	2009	Michael Hutter et al [21]	Embedded System Management	Presented design and implementation of an embedded IP See-gateway prototype using WBEM
16	2012	ManviMishra et al [28]	Heterogeneous Network Management	Proposed enhanced object oriented WBEM prototype for network management with EXI component

After analyzing EXI and FI Binary XML technologies on various issues, It is concluded that EXI appears to be superior choice than FI[24] [25], [26] [27]. However both binary xml technologies are directly readable, writable, self contained and include portability feature [25]. EXI preserve all features found in xml documents such as comments, processing instructions. This property ensure that technologies such as web services, XHTML,SVG etc that are based on xml, are amendable to EXI representation [28]-[29]

IV. WBEM - FEATURES, LIMITATIONS AND ENHANCED SOLUTION

WBEM framework permits management solution to be constructed covering the configuration management, fault management, accounting management, performance management, security management, operation management etc. [1][3] It provides single, common unifying solution for heterogeneous network using WBEM CIM shown in Fig. 1. The main component of WBEM prototype is

CIM-XML.



Besides its remarkable attributes, as an interchange language of web, xml is problematic for resource utilization due to processing overhead, the verbosity associated and memory footprints etc. Therefore there is a requirement EXI to overcome these bottlenecks. In the current state of research, research articles used for WBEM in last 18 years have been identified and summarized in table III. Many authors have worked on but performance of WBEM with EXI is the area of future research. The main objective of EXI method adoption is to add-on the performance, efficiency of message communication between WBEM Client and Server. Efficiency is provided by several components such as compact nature of EXI Streams and the fact that EXI uses

information from the schema to improve compactness and processing efficiency [27]. It is compatible with the xml Infoset which permits EXI to have the potential for minimizing the impact on xml application interoperability while still providing a more efficient alternative to xml syntax and grammar.[29] The two primary benefits of EXI are data compression and processing efficiency [30][31].

V. CONCLUSIONS AND FUTURE SCOPE

In this article comprehensive overview of WBEM based network management techniques have been studied. Many researchers have proposed their work on WBEM and gained significant results. There

also exist several WBEM implementations such as OpenPegasus, WBEMServices, OpenWBEM, WMI and SNIACIMOM. From these observations it can be inferred that OpenPegasus is a potential approach of open source WBEM implementation. It provides the optimum results among other techniques. Based on reviewed work and presented analysis, it is apparent that EXI application in WBEM would bring significant improvements in distributing computing scenario. EXI appears to be superior choice than FI, therefore WBEM architecture should incorporate EXI encoder- decoder layer or component in the prototype to achieve more improved results in terms of performance and efficiency of message communication between client- servers.

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