XML

o,   ,

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.

SNMP   EWS(Embedded Web Server)   .

                                                            .   XML
                        .   XML
        XML
XML   .   Cisco   Juniper Networks
                XML   (XBM)   XML
        .
            .   ,   ,
                            XBM(XML-Based Management)
    ,   XBM   .
                                                                                            .

Keywords: XML, XML   , XML   , SNMP

1.

                                                                        EWS
                                        .   XML

                    .   .
                                    SNMP[1]   XML
        (Embedded Web Server)[2]   XML   (XBM)
                                                SNMP   EWS
    .   XML   [3, 4]
                                . 1988   .
                    SNMP   XML   HTTP[7]
                                                                        EWS   XML
                                                                            XBM(XML-Based
                        [3].   EWS   Management)   .
                                                                    CPU

(Management Information Model)
                                    ,   , XBM   ,
                    ,   .

                                [4].
        SNMP   EWS   .
XML(Extensible Markup Language)[5]   Cisco   Juniper Networks
                    . XML   [6]   XBM
                                        ,   . Cisco   Configuration
                XML   Registrar[8]   Juniper Networks   JUNOScript[9]
                                                            XBM
        . XML   (Configuration Management)   .

EWS

，

，   (Performance
Management)   (Fault Management)
                        XBM
，XBM
                                .   2
                    XML
                ，
                                XBM
            . 3   XBM
                                    ，4   XBM
3   XBM
                . 5   4
                            IP
    XBM   . 6
        XBM
        ，   7
                                    .

2.

XML
    ，   XBM

2.1 XML
    XML   XML DTD
    XML   [6]
    XML   .
    XML
XML   . XML
                                        .
    ，   XML
                            SNMP MIB
XML   .   HTTP
                                    ，
                                    .

        J.P. Martin-Flatin   Web
            (WIMA)[10]   XML
        .   XML/HTTP
        SNMP MIB   XML
            .   [11]
                    EWS   XML
    .   IETF   IP
                        XML
            XMLCONF   [12, 13,

14]   2002   6   .

                                                ，
                                    XML
                            .
                XML   SNMP
                                XML/SNMP
                    . J.P. Martin-Flatin   SNMP
MIB   XML   (specification
translation)   Model-level   Metamodel-level
                        [10]. F. Strauss   SNMP
MIB   Java, CORBA, C, XML
                    SMI   MIB
'libsmi'   [15]. Avaya Labs
Research[16]   SNMP
            XML   .
SNMP SMI   XML
                            XML-RPC[17]
                                        .
                        XML/SNMP
        SNMP SMI   XML
            [18]
(interaction translation)[19]
                    .

2.2   XBM
        Cisco   Juniper Networks

                            XBM
                .   Cisco
Configuration Registrar[8]   Juniper   Networks
JUNOScript[9]   .
                XBM
                    .

2.2.1 Cisco   Configuration Registrar
        Cisco   Configuration Registrar
Cisco   IOS
                    . Configuration Registrar
                CNS(Cisco Networking Services)
                            .
    Cisco   ，
Configuration Registrar
        CNS   .
Configuration Registrar   XML
HTTP   .
                                XML
        XML
            . CNS   Cisco
                    Cisco
    XML
        XBM   .

2.2.2 Juniper Networks   JUNOScript

Juniper Networks 의   driven)
    JUNOS   JUNOScript   을 소개한다.
JUNOScript 는 Juniper Networks 의 XML   SNMP

                                                                    (notification)
                . JUNOScript   . 한 XBM
                        XML-RPC
                    . JUNOScript
RPC   DTD(Data Type Definition)
    .   DTD
JUNOScript   SNMP
JUNOScript   . JUNOScript

                    . 한 JUNOScript

    .

3.

                XBM
                    .
XBM

    .

3.1
            (Embedded Web Server)

                    . EWS   , CPU
HTTP   HTML
            . 한 HTML

                    . 한 EWS   .

                        . 한 HTML

XML   XML
        EWS   . 한 XBM
  [11].
    XBM   .
        HTTP   XML
                    .
HTTP   (EWS)
            . HTML   HTTP
            EWS   .
XML
        XML   . ## 4. XBM
XML   Xpath[22]
                                                        3
    .   XBM
            EWS   (Client-   .   4.1

4.2

XBM
.

4.1 XBM

XML   XML
DTD   XML   [6]   . DTD
.
XML
. XML
.   XML
.

SNMP MIB II   . MIB   (object)
XML   ,   (syntax)   ,
(access)   (arrtibute)   XML
.
1   MIB II   XML
.   'sysDescr'
XML   . XML
DTD   XML
ALTOVA   xmlspy[20]
XML   .

```
<xsd:element name="system">
  <xsd:complexType>
    <xsd:all>
      <xsd:element ref="sysDescr" minOccurs="0"/>
      <xsd:element ref="sysObjectID" minOccurs="0"/>
      <xsd:element ref="sysUpTime" minOccurs="0"/>
      <xsd:element ref="sysContact" minOccurs="0"/>
      <xsd:element ref="sysName" minOccurs="0"/>
      <xsd:element ref="sysLocation" minOccurs="0"/>
      <xsd:element ref="sysServices" minOccurs="0"/>
    </xsd:all>
  </xsd:complexType>
</xsd:element>
<xsd:element name="sysDescr">
  <xsd:complexType>
    <xsd:simpleContent>
      <xsd:restriction base="DisplayString_0_255">
        <xsd:attribute name="access" type="xsd:string"
use="fixed" value="read-only"/>
      </xsd:restriction>
    </xsd:simpleContent>
  </xsd:complexType>
</xsd:element>
…
```

1. XML Schema of MIB II – System Group

XML   HTTP[7]
.
HTTP   TCP
.

.
HTTP   Get   Post   .
SNMP Get   Set   HTTP Get
, HTTP Post
. Get
XML   , Post
HTTP OK   .
XML
XPath   . Get
XPath
,
.   .

2   XBM   XBM
Get, Set(Post), Trap
.   MIB   II
sysContact   . Trap
SNMPv1   coldStart
.
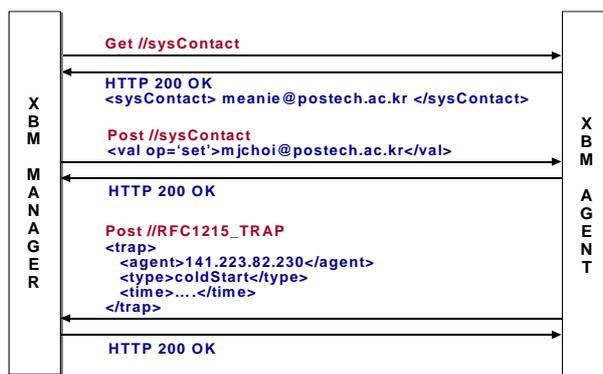
2. Communication Ex. between Manager & Agent

(notification)   XBM   Post
Push   .
Push
.

Post   Push
.

. XML   HTTP
Get   Post
.

4.2 XBM
3   XBM
EWS   XML
.
3   XBM

. XBM 의 *EWS* [2]
. *EWS*
XML Processor . *XML*
Processor XML XML Parser
SAX(Simple API for XML) Parser *XPath*
Handler . *SAX Parser*[23]
Write
Module . [11]
XML
XBM DOM[21] XPath[22] .

XML

DOM API
.

[11]
Linux CPU
.
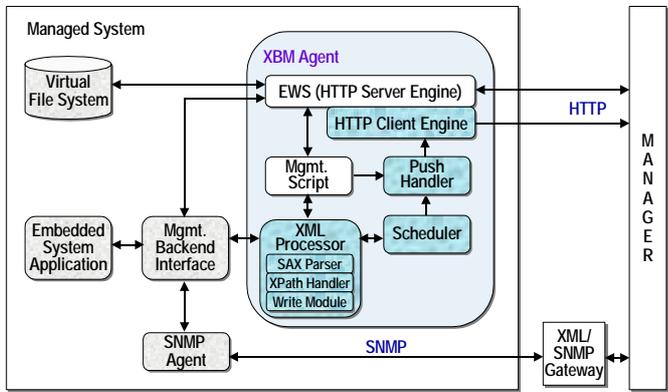
3. XBM Agent Architecture

DOM XML
XML DOM
. CPU
.
DOM XPath
,

.
DOM SAX[23] .
SAX
DOM [24, 25].
SAX XML
(event-driven) DOM
XML
. SAX
DOM . SAX XML
(serial)

DOM XPath
.

XML SAX
. SAX
Write Module .
SAX XBM
.
SAX Parser XML

. XBM
Management
Backend Interface
, SAX *Write*
Module XML
.
XML Processor
(Notification)
Push Handler *HTTP Client Engine*
.

Scheduler .
HTTP Client Engine
,
.
Scheduler
(subscription)
.
(subscriber), (item),
(schedule)
,
. *Scheduler* .
Scheduler
Push Handler *HTTP Client*
.
Mgmt. Script *Push*
Handler
HTTP Client .
XBM *SNMP*
Agent *SNMP Agent*
, XBM
Management Backend Interface
.
SNMP Agent XML/SNMP [18, 19]
.

5. XBM

4 IP
XBM
. CPU
.

C ... ,
.

EWS ID
XBM
.
HTTPS EWS
. XBM
IP
MPC850DE[26] 16MB
.
linux-2.2.13-7
, powerpc-linux-gcc
XBM .
XBM Get/Set
.

. 4 XBM
Get/Set
.

4. Flow of Get/Set Process

XBM Get
. Get
Mgmt. script xml filename Xpath
Get .
xml filename *xmlOpen()*
XML , Xpath
getXpath() Get
. *xmlOpen()*
xml document *getXpath()*
Xpath *parseXml()* xml
document Xpath .
*Mgmt. Backend
Interface* , *setXML()*
xml document .
xml document *returnXml()*
Mgmt. Script
xmlClose() xml document
file .
Set Get

. Get
xml document Xpath
xml document *setXml()*
xml document *Mgmt. Backend
Interface* .
Set xml document
returnXml() . *Mgmt. script*
Set HTTP OK
.
4 *getXpath()* XPath
XPath Handler . XPath
XPath
.
[27], XPath [28]
XPath Handler

XPath
XBM

. XML
XPath
. 1 XPath
XBM XPath
. XPath

XPath XPath
.

/		/AAA/BBB
//		//BBB
*		//*
@		//@id
[]		BBB[@id='b1']
=		BBB[@id='b1']
|	OR	/AAA | // BBB
&	AND	/AAA & // BBB

1. Supported XPath Grammar of XBM Agent

4 *parseXml()* *SAX Parser*
XML
XPath . XML

getXpath()
Xpath
. *setXml()* *Write
Module* Set XML
XPath XML

XML .
5

Trap .
XML

4

Set
．　　　　　　　　　　　　*Management Backend*
Interface 　　　XBM
　　　　　XML 　　　　　　　　　．

5. Flow of Trap/Schedule Process

　　　　　pthreads
．　　　　　　　　*getJob()*
, *getJob()* 　 job list file
　　. job list file 　 4.2
　　　　　　(subscriber), 　　　　(item),
　　(start) 　　　　　(end),
(interval) 　　　　　　　(schedule)
　. *getJob()* 　　　　(no. of jobs)
checkJob() 　　　, *checkJob()*
pthreads
　　　 thread 　　　(*insertJob()*)
(*deleteJob()*) 　. 　　　　thread
　　　　　　timerHandler()
　　　　　runWget()
. *runWget()* *Push Handler*
　　　　Wget[29] 　*Http*
Client Engine 　　XBM
　　．
　　　Management Backend Interface
　Trap 　*genXmlTrap()*
Trap 　　XML 　　　．
runWget() 　　　XBM
　．

6. XBM

　　　　　　XBM
　　　　IP
Net-SNMP[30] 　　　SNMP
　　　　．
　　　CPU 　　(run-time)
, 　　　　．
　　　　,
Push
　　　．

SNMP 　　　　　XBM
Get/Set
(response time) 　.
2 CPU, ,
SNMP 　XBM
．　　top
proc 　status
．
SNMP MIB II 　　SNMP
SNMPv1 .

	CPU		
SNMP	17 %	600 KB	400 KB
XBM	20 %	700 KB	550 KB

2. Resource Utility of SNMP & XBM Agent

2 SNMP XBM
．　XML
,
XBM
．
3 MIB II
SNMP
XBM
．
Ethereal[31]
．

	Get (bytes)		Get (bytes)	
	SNMP	XBM	SNMP	XBM
sysDescr	82	238	145	240
sysContact	82	240	103	190
system Group	572	241	722	624
inOctects	169	240	175	252
outOctects	169	241	176	256
interfaces Group	3720	241	3818	1654

3. Message Size and Response Time of Get

3 SNMP
(object)
Get
. XBM HTTP
TCP
SNMP ．

GetNext
SNMP
HTTP

XBM

Set

SNMP   XBM

2

SNMP
in/out   169 bytes
170 bytes
XBM
600bytes
250bytes

Get

SNMP   XBM   Get

time()
SNMP
40ms   , XMB   60ms

SNMP   160ms   , XBM
180ms
in/out   SNMP
80ms   , XBM
110ms
SNMP   700ms
, XBM   760ms
. SNMP   XBM

XML   XBM

XBM
SNMP

7.

XML
, XBM
XML/HTTP

XBM

IP
XBM
,
XML

SNMP
SNMP

XML
XBM   ,
XBM   SNMP

XBM

XPath
, SAX Parser   XPath Handler
. XBM
XBM
Scalability
SNMP

8.

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