# DataPower SOA Appliance Administration, Deployment, and Best Practices

Demonstrates user administration and role-based management

Explains network configuration, monitoring, and logging

Describes appliance and configuration management

Gerry Kaplan
Jan Bechtold
Daniel Dickerson
Richard Kinard
Ronnie Mitra
Helio L. P. Mota
David Shute
John Walczyk

Redbooks

ibm.com/redbooks

International Technical Support Organization

# DataPower SOA Appliance Administration, Deployment, and Best Practices

June 2011

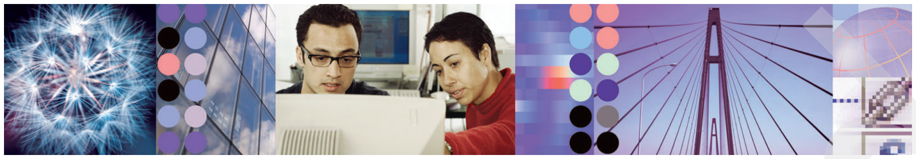
SG24-7901-00

**Note:** Before using this information and the product it supports, read the information in "Notices" on page xiii.

**First Edition (June 2011)**

This edition applies to DataPower firmware version 3.8.2.

## Contact an IBM Software Services Sales Specialist



Start SMALL, Start BIG, ... **JUST START**

architectural knowledge, skills, research and development . . .

**that's IBM Software Services for WebSphere.**

Our highly skilled consultants make it easy for you to design, build, test and deploy solutions, helping you build a smarter and more efficient business. **Our worldwide network of services specialists wants you to have it all!** Implementation, migration, architecture and design services: IBM Software Services has the right fit for you. We also deliver just-in-time, customized workshops and education tailored for your business needs. You have the knowledge, now reach out to the experts who can help you extend and realize the value.

For a WebSphere services solution that fits your needs, contact an IBM Software Services Sales Specialist:
**ibm.com**/developerworks/websphere/services/contacts.html

# Contents

# Notices

# Trademarks

IBM, the IBM logo, and ibm.com are trademarks or registered trademarks of International Business Machines Corporation in the United States, other countries, or both. These and other IBM trademarked terms are marked on their first occurrence in this information with the appropriate symbol (® or ™), indicating US registered or common law trademarks owned by IBM at the time this information was published. Such trademarks may also be registered or common law trademarks in other countries. A current list of IBM trademarks is available on the Web at http://www.ibm.com/legal/copytrade.shtml

The following terms are trademarks of the International Business Machines Corporation in the United States, other countries, or both:

AIX®
CICS®
ClearCase®
CloudBurst™
DataPower device®
DataPower®
developerWorks®
IBM®
IMS™
Rational®
Redbooks®
Redpaper™
Redbooks (logo) ®
Tivoli Enterprise Console®
Tivoli®
WebSphere®
z/OS®

The following terms are trademarks of other companies:

Java, and all Java-based trademarks are trademarks of Sun Microsystems, Inc. in the United States, other countries, or both.

Microsoft, Windows, and the Windows logo are trademarks of Microsoft Corporation in the United States, other countries, or both.

UNIX is a registered trademark of The Open Group in the United States and other countries.

Linux is a trademark of Linus Torvalds in the United States, other countries, or both.

Other company, product, or service names may be trademarks or service marks of others.

# Preface

This IBM® Redbooks® publication focuses on operational and managerial aspects for DataPower® appliance deployments.

DataPower appliances provide functionality that crosses both functional and organizational boundaries, which introduces unique management and operational challenges. For example, a DataPower appliance can provide network functionality, such as load balancing, and at the same time, provide enterprise service bus (ESB) capabilities, such as transformation and intelligent content-based routing.

This IBM Redbooks publication provides guidance at both a general and technical level for individuals who are responsible for planning, installation, development, and deployment. It is not intended to be a "how-to" guide, but rather to help educate you about the various options and methodologies that apply to DataPower appliances. In addition, many chapters provide a list of suggestions.

## The team who wrote this book

This book was produced by a team of specialists from around the world working at the International Technical Support Organization, Poughkeepsie Center.

**Gerry Kaplan** is a Senior IT Specialist with a focus on IBM WebSphere® DataPower service-oriented architecture (SOA) Appliances. He joined IBM in 2006 and has more than 25 years of experience in software development and engineering. He is the author of the DataPower Proof of Technology, as well as several other IBM Redbooks publications.

**Jan Bechtold** is a Client Technical Professional at IBM SWG, Switzerland. He graduated with a degree in Business Informatics from VWA university in Stuttgart, Germany. He works as a WebSphere Technical Sales Specialist and instructor for DataPower SOA Appliances. He has worked with DataPower SOA Appliances since 2007 and has been at IBM Software Group since 2005. His areas of expertise include business integration and web service security.

**Daniel Dickerson** is a Software Engineer with the IBM WebSphere DataPower SOA Appliances, CloudBurst™, and SMASH Level 2 Support Team since 2009 and with WebSphere Level 2 Support since 2006. As a Technical Support Professional, Daniel specializes in client technical resolution by working directly with clients, creating knowledge sharing content, and lab research. Prior experience includes IBM Level 2 Support of WebSphere Application Server, IBM HTTP Server, WebSphere Edge products, and with Nortel Networks as a network engineer. Daniel is an IBM Certified Solution Implementer for WebSphere DataPower SOA Appliances and an IBM Certified System Administrator for WebSphere Application Server Network Deployment.

**Richard Kinard** is the Product Manager for WebSphere DataPower Appliances. He is a subject matter expert in business-to-business (B2B) technologies and has over 12 years of experience designing, developing, and implementing B2B solutions. He has worked on many initiatives with Internet standards organizations to promote B2B interoperability and was a Senior Product Manager of a successful B2B application prior to working for IBM.

**Ronnie Mitra** is an IBM Technical Professional operating around the world. He has worked with DataPower technology since 2004 as both a client and consultant. His areas of expertise include SOA connectivity, Java™ development, and security enforcement for messaging systems.

**Helio L. P. Mota** is a Technology Architect at IBM GTS, Brazil. He has worked in the Information Technology field since 1999. He is a graduate of Pontifícia Universidade Católica de Campinas with a degree in Information Technology and has worked with IBM since 2006, of which three years have been dedicated as a DataPower Enterprise Service Bus architect. His areas of expertise include web technologies with a strong focus on SOA and security.

**David Shute** currently coordinates channel enablement activities for the DataPower family of products. He has worked in various capacities on the DataPower development staff for the past six years and entered IBM as part of the DataPower acquisition by IBM five years ago. David has extensive experience with technical publications, technology training, and code development.

**John Walczyk** is an AABSM SWAT Solutions Architect with a focus on the IBM Tivoli® Composite Application Manager family products. John joined IBM in 1996 and is a long-time IBM developer with extensive client exposure. As a member of the Advanced Technology Group (ATG), John has traveled all over the world to help with proofs of concept, architectural solutions, briefings, and product demonstrations.

The following authors also contributed to the content and creation of this book.

**Manuel Carrizosa** is a pre-sales support IT Specialist for Latin and Central America at the IBM Software Sales Help center for IBM Business Partners. He has worked with the WebSphere Team since 2007. He holds a degree in Systems and Computer engineering from Los Andes University in Bogotá, Colombia. He is an IBM Certified SOA Solution Designer, WebSphere Application Server Advanced System Administrator, and a WebSphere DataPower Solution Implementer.

**Bruno Neves** is a Middleware Support Specialist at IBM Brazil. He has worked with IT since 2004 and has a mix of experiences in various fields. He holds a technologist degree in Data Processing Technology from FATEC and a postgraduate degree in SOA-based Software Engineering from Veris. His areas of expertise include WebSphere DataPower, WebSphere MQ, and WebSphere Application Server. He is an IBM Certified SOA Solution Designer and is always interested in SOA and business process management (BPM) subjects.

**Pablo Sanchez** is an Application Integration and Middleware Support Specialist at IBM Brazil. He has worked in IT since 2003 and with WebSphere DataPower since 2007. He holds a degree in Data Processing Technology from FATEC and a specialization in Computer Network from Unicamp. His areas of expertise include middleware and SOA-related technologies, such as WebSphere DataPower, WebSphere MQ, WebSphere Application Server, and WebSphere Message Broker. He is IBM Certified for SOA, WebSphere DataPower, and MQ V7.0 System Administrator.

**Sanako Kawaguchi** is a WebSphere Level 1 Support Specialist and subject matter expert for Edge Components. She presently works for IBM Global Technology Services in Japan.

Thanks to the following people for their contributions to this project:

Debbie Willmschen
Stephen Smith
Linda Robinson
Tamikia Barrow
Shari Deiana
International Technical Support Organization, Raleigh Center

Krithika Prakash, Software Engineer, DataPower SOA Appliances
IBM US

John Shriver, DataPower Senior Software Engineer
IBM US

John S. Graham, DataPower Senior Software Engineer
IBM US

Harley Stenzel, WebSphere DataPower Development
IBM US

James Jong, WebSphere DataPower Development
IBM US

## Now you can become a published author, too!

Here's an opportunity to spotlight your skills, grow your career, and become a published author—all at the same time! Join an ITSO residency project and help write a book in your area of expertise, while honing your experience using leading-edge technologies. Your efforts will help to increase product acceptance and customer satisfaction, as you expand your network of technical contacts and relationships. Residencies run from two to six weeks in length, and you can participate either in person or as a remote resident working from your home base.

Find out more about the residency program, browse the residency index, and apply online at:

**ibm.com**/redbooks/residencies.html

## Comments welcome

Your comments are important to us!

We want our books to be as helpful as possible. Send us your comments about this book or other IBM Redbooks publications in one of the following ways:

- Use the online **Contact us** review Redbooks form found at:

  **ibm.com**/redbooks
- Send your comments in an email to:

  redbooks@us.ibm.com
- Mail your comments to:

  IBM Corporation, International Technical Support Organization
  Dept. HYTD Mail Station P099
  2455 South Road
  Poughkeepsie, NY 12601-5400

## Stay connected to IBM Redbooks

- Find us on Facebook:

  http://www.facebook.com/IBMRedbooks
- Follow us on Twitter:

  http://twitter.com/ibmredbooks
- Look for us on LinkedIn:

  http://www.linkedin.com/groups?home=&gid=2130806
- Explore new Redbooks publications, residencies, and workshops with the IBM Redbooks weekly newsletter:

  https://www.redbooks.ibm.com/Redbooks.nsf/subscribe?OpenForm
- Stay current on recent Redbooks publications with RSS Feeds:

  http://www.redbooks.ibm.com/rss.html

1

# Securing user access

IBM WebSphere DataPower appliances are fundamentally network devices and, like other network devices, require administrative access to perform configuration, management, and monitoring tasks. However, unlike typical network infrastructure devices, DataPower appliances can be configured with complex policies that are usually implemented by middle-tier developers. In addition, those policies can undergo many enhancements or modifications based on enterprise requirements, such as new business or changed security policies. The development teams can be divided further by lines of business. With such a diverse range of individuals requiring access to the appliance, it becomes essential to limit the functional access that each group has.

The topic of access control on its own is a broad topic, especially when put in context with the diverse ways in which organizations secure data centers and lock down network infrastructures. Although this chapter cannot provide patterns for every possible scenario, it provides a strong foundational and technical understanding of how the building blocks of DataPower administrative security work.

## 1.1 Overview

DataPower appliances perform a broad range of functions and often act as the gatekeeper or governor of business critical data flowing into, out of, and within an enterprise's network. The appliance can contain not only processing policies that prepare and forward messages to other systems, but it can also contain highly guarded key material. For this reason, it is both important and essential to control access to DataPower appliances.

Organizations that deploy DataPower appliances find that the audience of users who need access frequently crosses departmental boundaries. Network administrators require access to perform network-related configuration tasks, such as IP address assignment and route definitions, while development teams require access to configure processing policies and message flows. This separation of concerns adds a level of complexity not normally encountered on simple network devices. Developers need to be prevented from accessing base appliance configuration details, while network personnel need to be restricted to only network-related functions. The DataPower Role-Based Management (RBM) subsystem handles these administrative requirements, allowing for access policies to be as broad or fine-grained as necessary.

Restricting access to functionality is only half of the equation. Network administrators typically prefer a command-line interface (CLI) for network configuration-related tasks, while developers typically prefer a graphical user interface (GUI) for configuring complex message policies. DataPower appliances meet these needs by providing a variety of administrative interfaces, each targeting a separate audience:

- The CLI is accessible through the appliance's serial port or over Secure Shell (SSH). The CLI is typically the choice of network administrators.
- The Web-based GUI (WebGUI) is accessible from a browser. The WebGUI allows for point-and-click configuration of simple to complex processing policies. The WebGUI is typically the choice of developers.
- SOAP-based XML management interface (XMI). The XMI supports a variety of XML-based protocols for programmatically monitoring and configuring DataPower appliances. The XMI (and its supported protocols) are generally used for management, monitoring, and automation tasks.

Depending on an organization's network architecture, the task of administering access to DataPower appliances can be distributed with a reliance on external authentication or policy servers. The use of such servers requires additional considerations, such as high availability and encrypted channels.

Thus, DataPower administration is a combination of any of the following configuration tasks and processes:

- Securing access to the physical device (process).
- Securing network access to the device (configuration); this task can take the form of an access control list (ACL) or network firewall.
- Defining user roles (process); roles can include administrator, monitor, developer, or even a line of business.
- Defining users and user groups (configuration). Groups can be directly associated with roles.
- Defining how users are authenticated (configuration). This authentication can be local to the appliance or remote using an authentication server, such as a Lightweight Directory Access Protocol (LDAP). It might also be desirable to rely on a single sign-on (SSO) mechanism, such as Secure Sockets Layer (SSL).
- Defining how functional permissions are obtained, whether local on the appliance or remotely (process and configuration).

## 1.2 Benefits

A well thought-out plan for securing and administering DataPower appliances can provide the following benefits:

- Prevent unauthorized access to an appliance, reducing the risk of malicious threats from both inside and outside the organization.
- Prevent accidental or malicious intentional modification to network, appliance, and policy configurations.
- Provide a clear separation of roles and responsibilities. Network administrators, developers, and lines of business can be clearly defined and administered independently.
- Assure the integrity of the network environment.

## 1.3 Device initialization considerations

When a DataPower appliance is installed and booted for the first time, it is in its most secure and restrictive state. All network interfaces are disabled, and all administrative interfaces (with the exception of the serial port) are also disabled.

During the first-time boot, the operator performs several essential key steps:

- Accept the End User License Agreement.
- Provide a password for the administrative account (`admin`).
- Decide whether to enable disaster recovery mode.
- Configure one or more of the physical Ethernet interfaces.
- Decide whether to configure the WebGUI and SSH administrative interfaces.

Most of the steps result in configuring network access and are relatively straightforward; however, two of these steps require special attention:

- Setting the administrator's password
- Deciding whether to enable disaster recovery mode

## 1.3.1 Setting up the master administrator password

During the first-time boot process, the master administrator's password must be set. It is absolutely essential that this password be safeguarded. It is not possible to recover a lost password.

After the appliance is initialized, additional privileged users can be created, providing a backup administrator in the event that the primary administrator becomes inaccessible.

Due to the hardened secure nature of the appliance, if administrator access becomes impossible as a result of misplaced passwords, the appliance must be returned to IBM for complete reinitialization.

## 1.3.2 Enabling Disaster Recovery Mode

Disaster Recovery Mode allows for the creation of a secure backup that can be used to restore all configuration settings for an appliance, including private data, such as certificates, keys, and user data. The private material is encrypted within the backup, preventing unauthorized access to its contents. The device configuration itself remains unencrypted.

**Note regarding private key material:** Private key material is encrypted within the backup and can be decrypted only by another DataPower appliance.

Disaster Recovery Mode can be set only during the first-time configuration. When set, it can be changed only by reinitializing the appliance back to its initial factory condition.

**Important:** Disaster Recovery Mode cannot be changed after the initial setup.

Because this setting determines whether private key material is exportable, it might or might not be prohibited based on an organization's security policy.

**Important:** Determine whether your organization's security policy allows for exporting private key material before the initial device setup.

## 1.4 Access control lists

An access control list (ACL) defines a list of client IP addresses that are allowed to connect to the appliance. Using an ACL is a strong and restrictive form of security and requires the knowledge of each permitted client IP address that is allowed access.

**ACLs:** ACLs control only which IP addresses can connect to the appliance; authentication and authorization of the user still occurs.

ACLs have the following properties:

- ACLs are not associated in any way with authentication or access policies. Users will still be required to provide their user name and password when connecting to the appliance (unless single sign-on is configured).
- All three management interfaces (CLI, WebGUI, and XMI) can be secured using an ACL.
- When an ACL contains no entries, it has no effect. In other words, it allows any client to connect.
- There are three pre-defined ACLs for appliance administration:

| | |
|---|---|
| `web-mgmt` | Secures the WebGUI |
| `xml-mgmt` | Secures the XML management interface |
| `ssh` | Secures the SSH CLI interface |

ACLs are set up in the associated service configuration page. For example, the `web-mgmt` ACL can be found on the Web Management Service configuration page (**Network** → **Management** → **Web Management Service**).

Take care when setting up ACLs, because it is possible to become locked out of the appliance. ACLs must not contain Dynamic Host Configuration Protocol (DHCP)-assigned IP addresses, because these addresses can change unexpectedly. In the event of an ACL lockout, access can be restored from a terminal that is connected to the serial port.

## 1.5 Authentication and credential mapping

When a user logs in to a DataPower appliance, two important steps occur:

1. The user is authenticated against a user repository. The repository can reside on the DataPower appliance or can be remote (such as an LDAP or Remote Authentication Dial-In User Service (RADIUS) server). This step is referred to as *authentication*.
2. The user's credentials are established. The credentials represent the user's privileges to access resources and configuration functions. This step is referred to as *credential mapping*.

### 1.5.1 Locally managed users

DataPower appliances contain a built-in user repository that manages *users* and *user groups*.

A *user* object defines specific information that is associated with an individual who is being given access to the DataPower administrative interface. The details are minimal, including the name, password, access level, and domain restrictions. (We discuss DataPower domains in Chapter 3, "Domains" on page 61.)

A user's *access level* determines whether access privileges are managed by the DataPower RBM subsystem. Table 1-1 shows the available access levels and their descriptions.

*Table 1-1 User access levels*

| Access level | Description |
|---|---|
| User | Grants access only to system status functions. This access level is the most limited type of user and does not use RBM. |
| Privileged | Grants access to all system functions, including status, management, and configuration. This access level does not use RBM and needs to be reserved for administrative purposes. |
| Group-defined | Assigns the user to a local *user group*. User groups define a set of access rights to resources and functions. The user inherits the rights of its assigned group, which we discuss in more detail later in this section. |

Group-defined access is the preferred and most flexible method of controlling user access. The *user* and *privileged* levels effectively grant "all or nothing" access to the device and must be used sparingly if at all. Privileged users are effectively administrators.

**Group-defined access level:** The group-defined access level is the preferred method for defining access privileges. Avoid using *user* and *privileged* access levels if possible.

## 1.5.2 Locally defined user groups

User groups provide a means of defining functional roles and their associated capabilities. DataPower user groups have little in common with user groups found on typical servers. For example, a group on a Linux® server is used to provide a group's members with access privileges for a specific resource. The group has no knowledge of the resource, rather the resource identifies the group and its privileges.

Figure 1-1 shows the relationship between a group, users, and a resource on a typical Linux server.

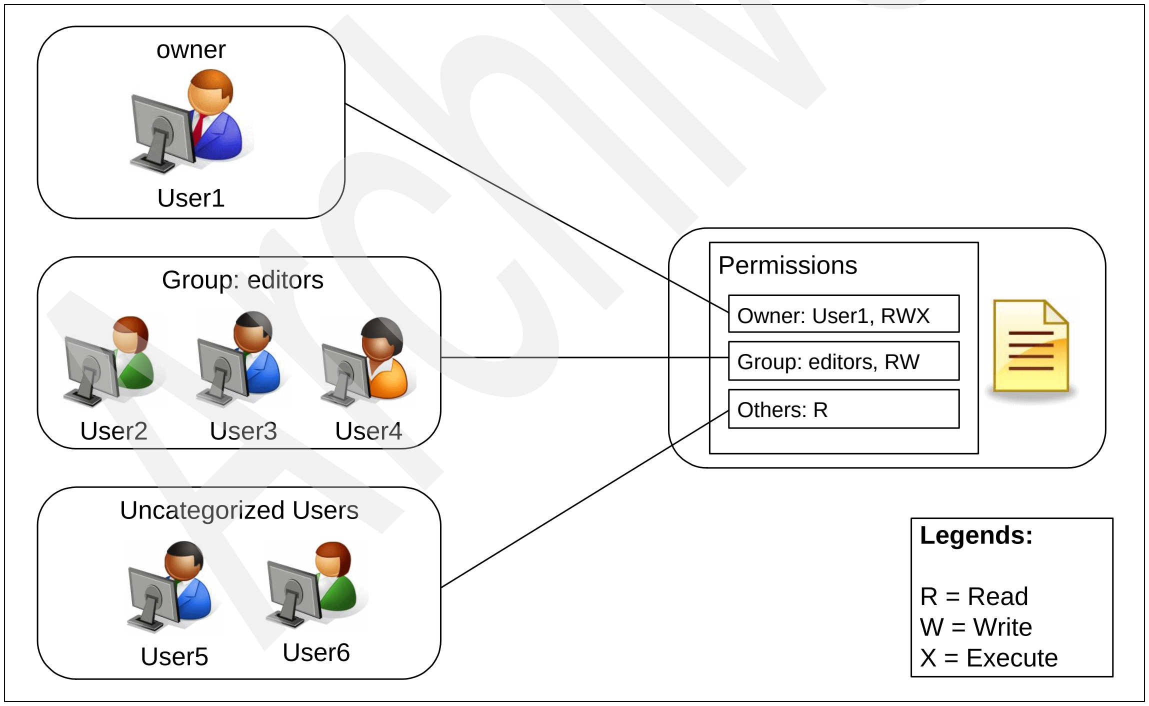


*Figure 1-1 Linux groups are used for resource permissions*

In contrast, a DataPower user group acts more like an organizational role; the group defines a set of privileges to resources and device functionality. For example, one user group can define privileges for a user administrator, while another group defines privileges for a network administrator or developer.

Figure 1-2 depicts the DataPower user and user group relationship.

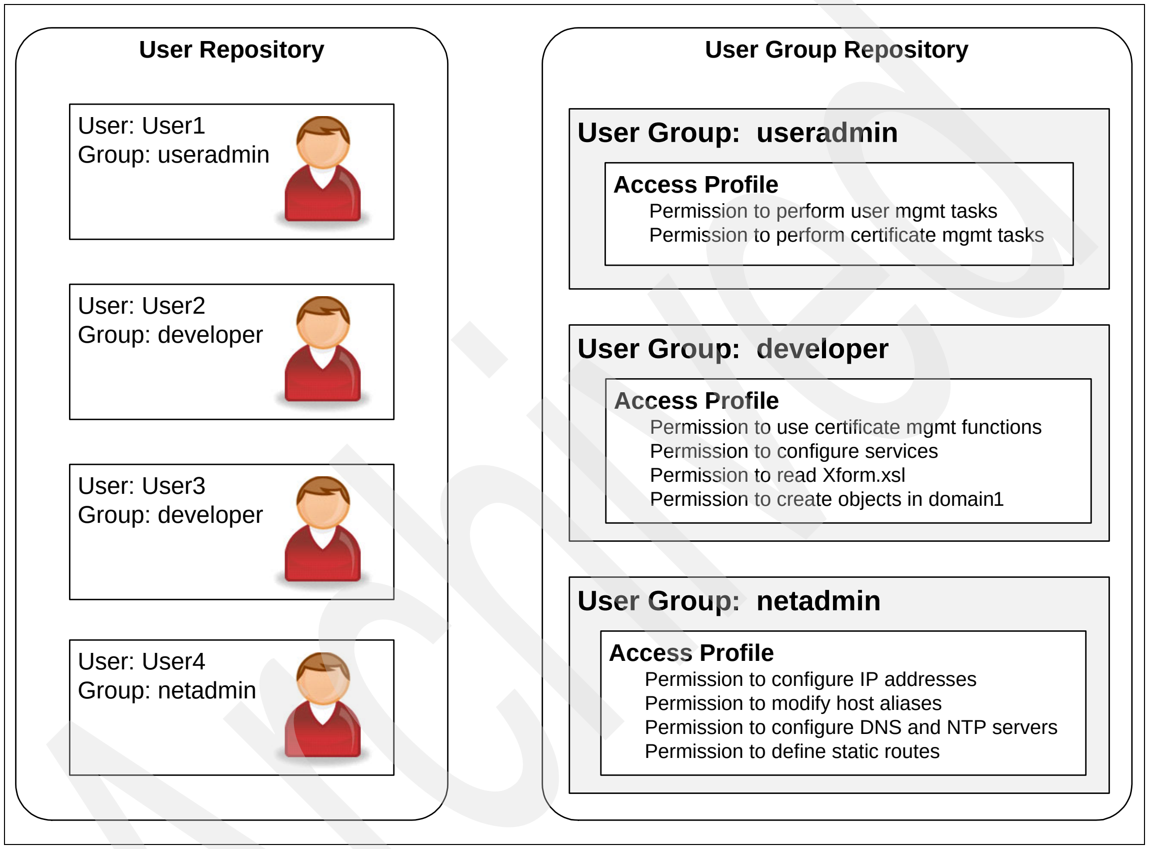

User Repository
User: User1
Group: useradmin
User: User2
Group: developer
User: User3
Group: developer
User: User4
Group: netadmin
User Group Repository
User Group: useradmin
Access Profile
Permission to perform user mgmt tasks
Permission to perform certificate mgmt tasks
User Group: developer
Access Profile
Permission to use certificate mgmt functions
Permission to configure services
Permission to read Xform.xsl
Permission to create objects in domain1
User Group: netadmin
Access Profile
Permission to configure IP addresses
Permission to modify host aliases
Permission to configure DNS and NTP servers
Permission to define static routes

*Figure 1-2 DataPower user groups are used to define administrative roles*

## Access profile

The user group defines resource access privileges using an *access profile*. After a user is authenticated, the user's credentials are determined by inspecting the access profile from the user's assigned group and mapping each permission into a credential. For example, in Figure 1-2, user `User1` has an assigned user group of `useradmin`. Therefore, after authentication, user `User1` will have credentials that grant permission to perform user and certificate management tasks.

When a user attempts to access a resource or execute a configuration task, the RBM subsystem checks the credentials to determine if the user has the required privileges. In many cases, RBM adapts the user interface to match the user's credentials, removing certain icons and enabling others. The access profile uses *access policy statements* to describe the user's privileges.

## Access policy statements

An *access policy statement* describes a permission (read, write, add, delete, and execute) for one or more resources. It is defined using a number of parameters combined into a single hierarchal formatted string, much like an XPath statement or a file path. An access policy statement can identify target resources using a Perl-compatible regular expression (PCRE), enabling it to identify a single resource or a group of resources that match the specified pattern.

An access policy statement takes the form:

```
(device-ip)/(domain)/(resource)?Access=r+w+a+d+x[&key=value]
```

Table 1-2 explains each part within the access policy.

*Table 1-2 Access policy statement parts*

| Policy part | Usage |
|---|---|
| device-ip | The device management IP address or an asterisk (*) for any. |
| domain | The resource domain or an asterisk (*) for any. |
| resource | Identifies the type of the resource to which the statement is applied. Specifying an asterisk (*) indicates that this policy applies to all resources. |
| Access | Read, write, add, delete, and execute, represented as *r*, *w*, *a*, *d*, and *x* respectively. The special keyword NONE can be used to deny access. |
| Additional fields | Depending on the resource type, additional fields can be specified using a Perl-compatible regular expression (PCRE). For example, in the case of securing a file, a Name parameter can be specified, such as `Name=Foo*`, representing all files beginning with `Foo`. |

### *Default access rights*

The default in the absence of any matching policy or for conflicting policies is to Deny.

The default is Accept if `*/*/*?Access=a+w+r+d+x` is in the access profile of the user.

Explicitly denying access to the user is through the use of the keyword NONE, such as `*/*/*/services/xmlfirewall?Access=NONE`. This statement denies any type of access to any firewall in any domain on any device.

Access is evaluated against policy with longest best-match. For example, if a user's profile contains the following two access policies, access is denied to all firewalls except for firewalls whose names start with `foo`:

```
*/*/services/xmlfirewall?Access=NONE
*/*/services/xmlfirewall?Access=r+w&Name=^foo
```

Longest best-match access policies are not order dependent.

### *Basic policy statements*

Example 1-1 defines an access policy statement that gives access to every resource in every domain using any configured IP address.

*Example 1-1 Access policy with no restrictions (defines a super admin)*

```
*/*/*?Access=r+w+a+d+x
```

In Example 1-2, a domain restriction is added to define a domain administrator.

*Example 1-2 Access policy restricted to mydomain (defines a domain admin)*

```
*/mydomain/*?Access=r+w+a+d+x
```

Example 1-3 shows how to deny access to all functionality.

*Example 1-3 Deny all access*

```
*/*/*?Access=NONE
```

Example 1-4 shows an access policy that allows read-only access to files whose names start with `Foo` within `mydomain` and that are only accessible through IP address `10.1.3.55`.

*Example 1-4 Access policy with IP, domain, and resource restrictions*

```
10.1.3.55/mydomain/file/local?Name=Foo*&Access=r
```

Host names can be used instead of IP addresses. Example 1-5 on page 11 shows an access policy that allows the user to execute the change-password function but only through the IP address that is defined as `MgmtInt`.

Example 1-5   Access policy protecting change password function using host alias

```
MgmtInt/*/access/change-password?Access=x
```

### Optional key-value pairs

The optional key-value pairs can be used to narrow down the resource instances, such as Name, LocalPort, LocalAddress, Directory, and so forth.

**Exact matches:** Each value is a PCRE. Do not forget to frame your match expression with ^ and $ if your intended match must be an exact match.

RBM controls access through both the WebGUI and SOAP Management Interface (SOMA). The login privilege to either one can be granted separately. Example 1-6 shows an access policy that grants login to `web-mgmt` only.

Example 1-6   Policy statement that grants access to the login for web-mgmt only

```
*/*/login/web-mgmt&Access=x
```

### Complex policy statements

Example 1-7 shows how to give a user explicit access to create or modify XML firewalls with names starting with *somePrefix_* and that use local addresses between 10.0.28.0 - 10.0.28.5 and with ports between 5000 - 5499 within *someDomain*.

Example 1-7   Complex policy statement using PCRE

```
*/someDomain/services/xmlfirewall?Name=^somePrefix_.*&LocalAddress=10.0
.28.[0-4]&LocalPort=5[0-4][0-9][0-9]&Access=r+w+a+d+x
```

Example 1-8 gives a user read-only access to any file within directories with prefix *someOtherPrefix_* and read/write access to any file with prefix *somePrefix_*.

Example 1-8   Policy statements that limit access to files and directories

```
*/someDomain/file/local?&Directory=^someOtherPrefix_.*&Access=r
*/someDomain/file/local?&Directory=^someOtherPrefix_.*&Filename=^somePr
efix_.*&Access=r+w
```

Every configuration option and every resource can be protected using access policy statements, such as those statements shown in these examples.

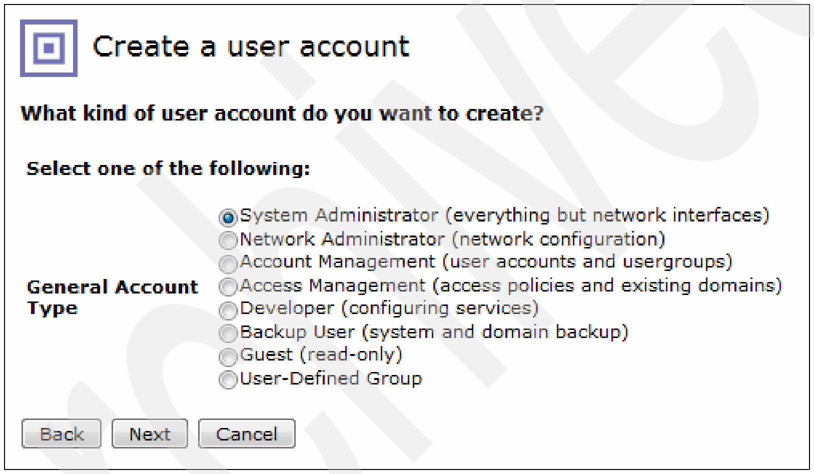
## Policy statement editor

The basic layout of a policy statement is straightforward and easy to understand; however, knowing the wide range of resource and parameter options is much more difficult to grasp. A visual policy statement editor makes this task much less daunting.

The policy statement editor is available when creating or modifying a user group. The Access Profile section has a Build button that opens the policy statement editor. The smart editor provides drop-down lists of resource types and adjusts the fields and options based on user selections.

## Predefined user groups and access policies

When an administrator adds a new local user, the administrator is given the choice of several user types (or roles), as shown in Figure 1-3.



Create a user account

**What kind of user account do you want to create?**

**Select one of the following:**

**General Account Type**

- [✓ System Administrator (everything but network interfaces)]
- Network Administrator (network configuration)
- Account Management (user accounts and usergroups)
- Access Management (access policies and existing domains)
- Developer (configuring services)
- Backup User (system and domain backup)
- Guest (read-only)
- User-Defined Group

*Figure 1-3 Predefined user types*

Depending on which account type is selected, a user group can be created and pre-populated with a number of access policy strings.

## Creating user groups with the CLI

In certain situations, it might be easier to create a script of commands that builds various user groups that are specific to your organization. Example 1-9 shows an example script that creates a single user group named `account`.

*Example 1-9 Sample CLI script to create user group*

```
top; configure terminal;
```

```
usergroup "account"
  summary "Account Management"
  access-policy */*/access/change-password?Access=x
  access-policy */*/access/usergroup?Access=rwadx
  access-policy */*/access/username?Access=rwadx
  access-policy */*/access/username?AccessLevel=privileged&Access=NONE
  access-policy */*/config/save-config?Access=x
  access-policy */*/debug/set-loglevel?Access=x
  access-policy */*/debug/set-rbmlog?Access=x
  access-policy */*/login/ssh?Access=x
  access-policy */*/login/telnet?Access=x
  access-policy */*/login/web-mgmt?Access=x
exit

exit
```

A sample script for creating the roles that are shown in Figure 1-3 on page 12 can be downloaded as part of this book and is named `createUserGroups.txt`. Refer to Appendix B, “Additional material” on page 259 for information about how to download the file. To execute a CLI script like this one, upload the file to the `local:` directory and use the CLI **`exec`** command:

```
exec local:///createUserGroups.txt
```

## 1.5.3 Using local user repository for contingency

Local users and user groups are convenient and easy to set up. However, it is common to employ the use of an external authentication server to facilitate centralized user management. Relying solely on an external authentication server can result in difficulties accessing the administrative interfaces in the event that the external authentication server becomes unresponsive or unreachable. In this case, the local user repository can be used as a backup to authenticate users. We discuss remote user repositories later in 1.5.6, “Remote authentication servers” on page 18.

## 1.5.4 Pros and cons of using the local user repository

Although the local user repository is easy to use and can accommodate nearly all authentication and authorization requirements, it is not always the most appropriate for all situations. The following list of pros and cons can help establish its acceptability in a given environment:

- Pros
  - Easy to manage users and groups through the WebGUI and CLI.

  - Visual editor for creating and updating access profiles and policy statements.
  - Built-in templates for creating commonly used groups, such as developers, network administrators, and so on.
  - Reliable and not prone to typographical errors.
  - Users and groups can be included in device backups.
  - Reduces network traffic. All authentication and permissioning occur locally on the appliance.
- Cons
  - No capability to federate local users to other DataPower appliances.
  - Users cannot be centrally managed.

## 1.5.5 RBM policy files

As an alternative to using the DataPower built-in user repository, you can use an RBM policy file to define users and their associated privileges. A Role-Based Management (RBM) policy file is an XML document that contains user authentication and credential details. You can find an example RBM policy file in the DataPower file system at `store:///RBMinfo.xml`.

### RBM policy file creation wizard

RBM policy files are XML files and, therefore, are generally created and maintained using an XML editor. However, an easy-to-use wizard can also be used to create the initial policy file. The wizard guides the user through a series of dialog boxes, ultimately resulting in a well-formed RBM policy file. The wizard is invoked by clicking the plus sign (+) next to the field where the RBM policy file name is entered.

### Using an RBM policy file for authentication

An RBM policy file defines authentication details using `<Authenticate>` elements. During authentication, RBM searches the RBM policy file for an `<Authenticate>` element that contains `<Username>` and `<Password>` values that match the user name and password that are provided by the user. If found, it saves the value from the `<OutputCredential>` element and considers the user to be authenticated. The saved value is then used as the *input credential* for the subsequent credential mapping step.

In Example 1-10 on page 15, the user name `gkaplan` is authenticated, and the credential is `useradmin`.

## Using an RBM policy file for credential mapping

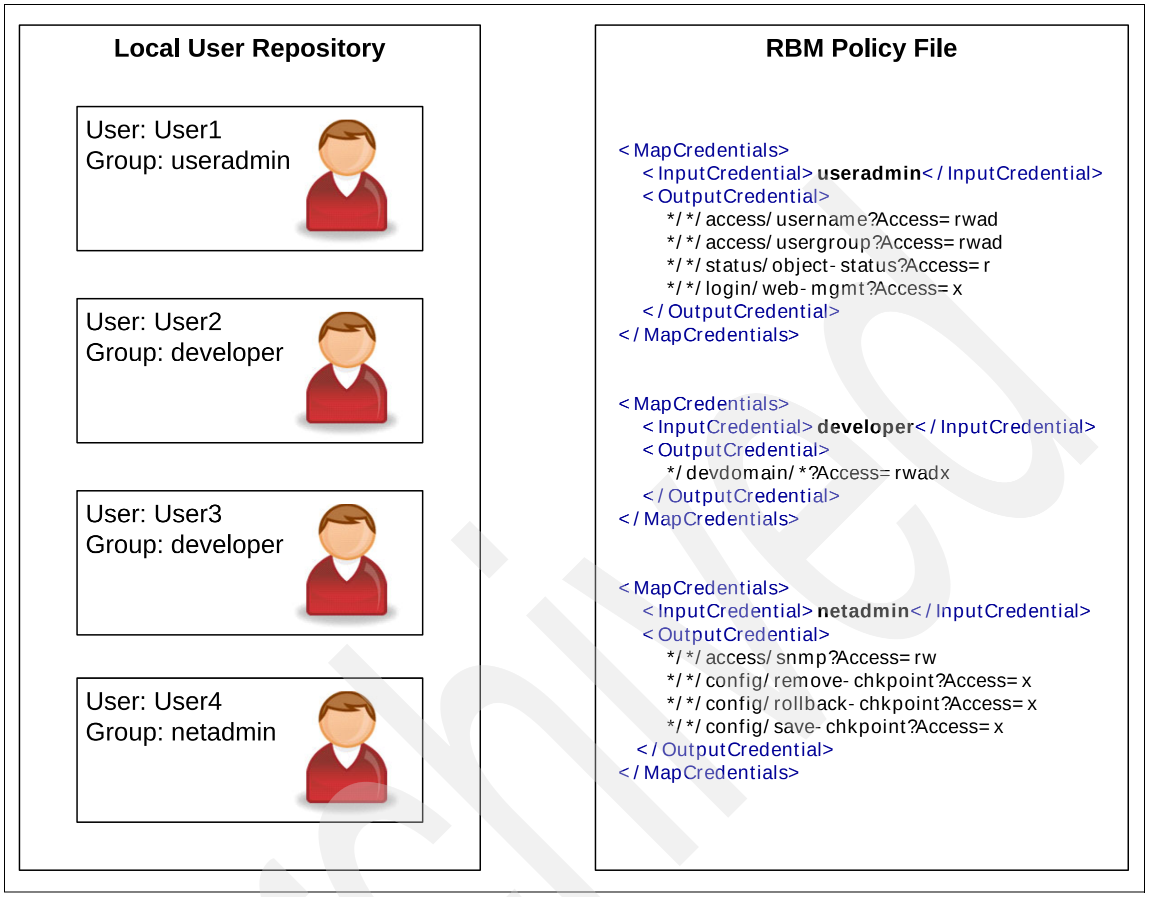
RBM policy files define credential mapping details using `<MapCredentials>` elements. RBM searches for a `<MapCredentials>` element that contains an `<InputCredential>` matching the saved input credential (from authentication). The value of the `<OutputCredential>` element becomes the new credential. In Example 1-10, the credential `useradmin` is mapped to a new set of credentials.

*Example 1-10 Sample RBM policy file for authentication and credential mapping*

```
<AAAInfo xmlns="http://www.datapower.com/AAAInfo">

   <Authenticate>
      <Username>gkaplan</Username>
      <Password>myPassw0rd</Password>
      <OutputCredential>useradmin</OutputCredential>
   </Authenticate>

   <MapCredentials>
      <InputCredential>useradmin</InputCredential>
      <OutputCredential>
         */*/access/username?Access=rwad
         */*/access/usergroup?Access=rwad
         */*/status/object-status?Access=r
         */*/login/web-mgmt?Access=x
      </OutputCredential>
   </MapCredentials>

</AAAInfo>
```

## Mixing RBM policy files and the local user repository

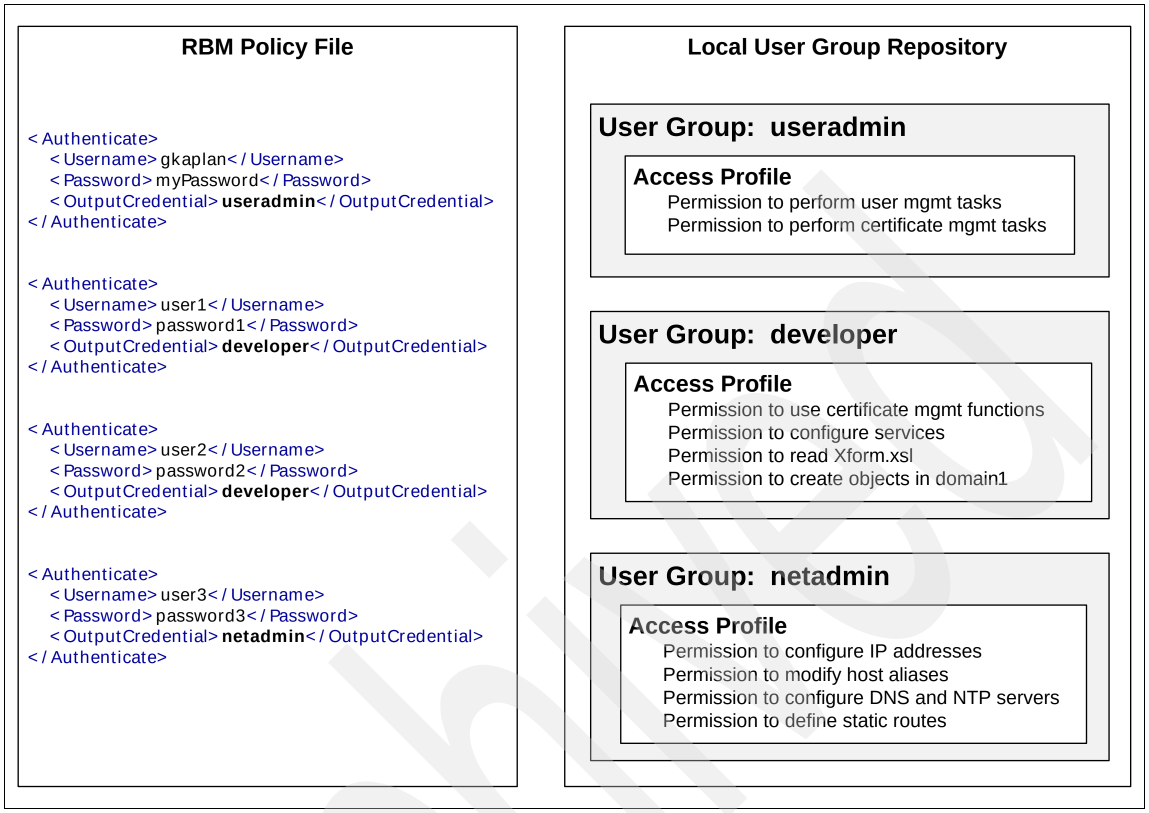
Even though an RBM policy file can be used for authentication and credential mapping, it does not have to be used for both. It is possible to use the local user repository for authentication and use an RBM policy file for credential mapping. In this case, the user's assigned group is used as the `<OutputCredential>` when performing credential mapping, as illustrated in Figure 1-4 on page 16.



```
<MapCredentials>
   <InputCredential>useradmin</InputCredential>
   <OutputCredential>
      */*/access/username?Access=rwad
      */*/access/usergroup?Access=rwad
      */*/status/object-status?Access=r
      */*/login/web-mgmt?Access=x
   </OutputCredential>
</MapCredentials>

<MapCredentials>
   <InputCredential>developer</InputCredential>
   <OutputCredential>
      */devdomain/*?Access=rwadx
   </OutputCredential>
</MapCredentials>

<MapCredentials>
   <InputCredential>netadmin</InputCredential>
   <OutputCredential>
      */*/access/snmp?Access=rw
      */*/config/remove-chkpoint?Access=x
      */*/config/rollback-chkpoint?Access=x
      */*/config/save-chkpoint?Access=x
  </OutputCredential>
</MapCredentials>
```

*Figure 1-4 Local user repository for authentication and an RBM policy file for credentials*

Similarly, it is possible to use an RBM policy file for authentication and the local group repository for credential mapping (see Figure 1-5 on page 17). The `<OutputCredential>` from the authentication is used as the group name, and RBM searches for that local group to extract the credentials from its access profile.


RBM Policy File
Local User Group Repository
User Group: useradmin
Access Profile
Permission to perform user mgmt tasks
Permission to perform certificate mgmt tasks
User Group: developer
Access Profile
Permission to use certificate mgmt functions
Permission to configure services
Permission to read Xform.xsl
Permission to create objects in domain1
User Group: netadmin
Access Profile
Permission to configure IP addresses
Permission to modify host aliases
Permission to configure DNS and NTP servers
Permission to define static routes

```
<Authenticate>
   <Username>gkaplan</Username>
   <Password>myPassword</Password>
   <OutputCredential>useradmin</OutputCredential>
</Authenticate>

<Authenticate>
   <Username>user1</Username>
   <Password>password1</Password>
   <OutputCredential>developer</OutputCredential>
</Authenticate>

<Authenticate>
   <Username>user2</Username>
   <Password>password2</Password>
   <OutputCredential>developer</OutputCredential>
</Authenticate>

<Authenticate>
   <Username>user3</Username>
   <Password>password3</Password>
   <OutputCredential>netadmin</OutputCredential>
</Authenticate>
```

*Figure 1-5 Using an RBM policy file for authentication and local groups for credentials*

### Pros of using RBM policy files

Using RBM policy files provides the following benefits:

- An RBM policy file can be published to other DataPower appliances, keeping the users and policies synchronized among the appliances.
- RBM policy files are flexible; user identities are not restricted to simple names. This flexibility is useful when an LDAP server is used for authentication and an RBM policy file is used for credential mapping. The authenticated user’s identity is expressed as a distinguished name (DN), which can be used as the user’s `<InputCredential>` in an RBM policy file.
- RBM policy files can be exported off the appliance and backed up.

### Cons of using RBM policy files

Consider the following issues when using RBM policy files:

- It can be difficult to author complex access profiles, because you must use an XML or text editor.
- Passwords can be in cleartext, which is not acceptable for authentication in certain environments.
- The policy files are not centralized. RBM files can be published from one device to another, but no real "user management" function exists to maintain users and policies within the file.

## 1.5.6 Remote authentication servers

In many organizations, user authentication is frequently carried out remotely using an LDAP server, RADIUS server, or even a mainframe. DataPower appliances support three commonly used remote authentication servers:

- LDAP server
- RADIUS servers
- System Authorization Facility (SAF)

In situations where an unsupported, in-house or proprietary authentication server must be used, a custom XSLT can be written to accommodate it.

Remote user management is a good idea but only provides half of the login processing requirements. The user's access credentials must still be determined.

There are a number of options that can be used to establish credentials for remotely authenticated users:

- A local user group
- A Role-Based Management (RBM) policy file
- A custom developed mapping solution written in Extensible Stylesheet Language (XSL)

### Remotely defined LDAP groups

Remote authentication servers generally do not return the user's group membership details. For example, after LDAP authentication, the returned credential is the user's fully qualified DN. That DN provides no insight into the groups to which the user might belong. For this reason, it might be necessary to configure a second LDAP query to determine the user's group.

**RBM:** RBM only supports a user belonging to one group. If the results of an LDAP query yield multiple groups, only the first returned group is recognized. This limitation can be overcome using a custom style sheet, as discussed in "Custom credential mapping" on page 21.

Configuring the LDAP query to retrieve the user's group is straightforward and is accomplished by enabling Search LDAP for Group Name in the RBM Credentials configuration page (**Administration** → **RBM Settings** → **Credential tab**). The following configuration scenarios provide more details about using LDAP groups.

## Local user group for credential mapping

In this scenario, a user is first authenticated using one of the supported authentication mechanisms, such as LDAP. The result of the authentication is typically the user's credential in the form of either a user name, qualified DN, or other proprietary format. The group cannot be determined by this credential and therefore needs to be further mapped to a local group. A remote LDAP server can be queried to discover of which group the user is a member.

Using an LDAP organized as in Figure 1-6 on page 20, the following events occur during LDAP authentication and credential mapping:

1. RBM authenticates the user as previously described. The result of the LDAP authentication is the user's DN:

   ```
   uid=hmota,ou=users,dc=ibm,dc=com
   ```

2. A second LDAP query is performed to discover to which group the user belongs. RBM issues an LDAP query for group membership and requests the `cn` attribute, which contains the group name. In this example, the `cn` attribute value is `developer`.
3. RBM maps the value `developer` to a local group named `developer` and obtains the user's access profile.

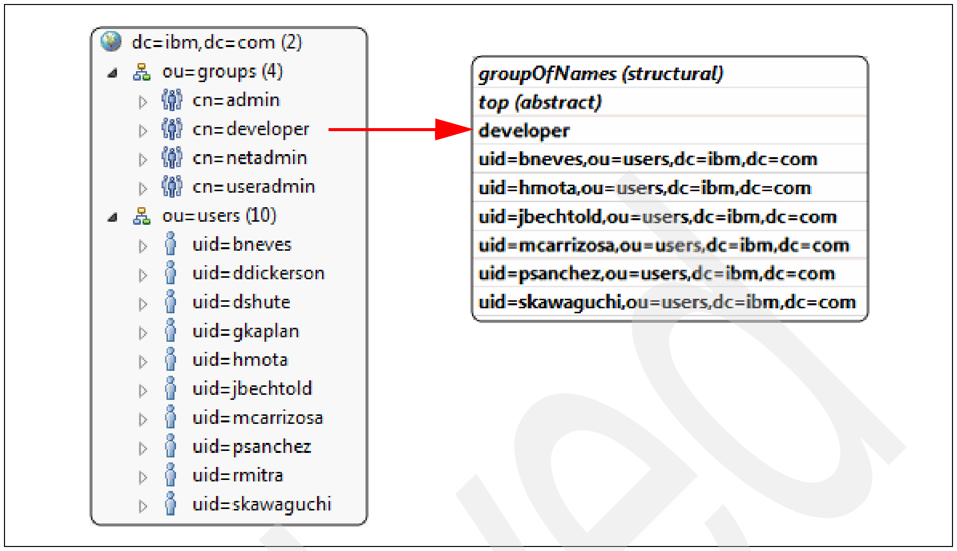

dc=ibm,dc=com (2)
ou=groups (4)
cn=admin
cn=developer
cn=netadmin
cn=useradmin
ou=users (10)
uid=bneves
uid=ddickerson
uid=dshute
uid=gkaplan
uid=hmota
uid=jbechtold
uid=mcarrizosa
uid=psanchez
uid=rmitra
uid=skawaguchi
groupOfNames (structural)
top (abstract)
developer
uid=bneves,ou=users,dc=ibm,dc=com
uid=hmota,ou=users,dc=ibm,dc=com
uid=jbechtold,ou=users,dc=ibm,dc=com
uid=mcarrizosa,ou=users,dc=ibm,dc=com
uid=psanchez,ou=users,dc=ibm,dc=com
uid=skawaguchi,ou=users,dc=ibm,dc=com

*Figure 1-6 LDAP organization for groups and users*

## RBM policy file for credential mapping

In this scenario, a user is first authenticated using one of the supported authentication mechanisms, such as LDAP. The result of the authentication is typically the user's credential in the form of either a user name, qualified DN, Kerberos principal name, or other proprietary format. The group name cannot be derived from the credential and therefore needs to be further mapped to a local group. There are two options for mapping the user's credential to an RBM group: using a local RBM policy file or using a remote LDAP server to look up the user's group membership.

### *Group mapping within the RBM policy file*

Even though RBM does not include XML elements that specifically define user groups, it is possible to define them using an additional layer of credential mapping. Example 1-11 on page 21 shows an RBM policy file that maps the credentials returned from an LDAP into an intermediary credential (`useradmin`), which is then mapped again into a set of access credentials.

*Example 1-11 Defining group credentials in an RBM policy file*

```
<AAAInfo xmlns="http://www.datapower.com/AAAInfo">

   <MapCredentials>
      <InputCredential>uid=hmota,ou=users,dc=ibm,dc=com</InputCredential>
      <OutputCredential>useradmin</OutputCredential>
   </MapCredentials>

   <MapCredentials>
      <InputCredential>uid=jbechtold,ou=users,dc=ibm,dc=com</InputCredential>
      <OutputCredential>useradmin</OutputCredential>
   </MapCredentials>

   <MapCredentials>
      <InputCredential>useradmin</InputCredential>
      <OutputCredential>
         */*/access/username?Access=rwad
         */*/access/usergroup?Access=rwad
         */*/status/object-status?Access=r
         */*/login/web-mgmt?Access=x
      </OutputCredential>
   </MapCredentials>

</AAAInfo>
```

### *LDAP group mapping*

Optionally, an LDAP server can be queried to determine group membership before attempting to establish access credentials. In this case, the following steps occur:

1. RBM authenticates the user as previously described. The results of the authentication are the user's credential.
2. A second LDAP query is performed to discover the user's group membership. The group name is returned as an LDAP attribute value.
3. The RBM policy file is then searched for an `<InputCredential>` that matches the group name from step 2. If found, the contents of the `<OutputCredential>` become the user's new credentials.

## Custom credential mapping

In this scenario, the results of the authentication step are used as the input context into an XSL transformation (see Example 1-12 on page 22). The XSL template is responsible for interpreting the credential and writing the user's access credentials to the output context. Example 1-13 on page 22 shows the basic structure of a custom XSL Transformation (XSLT) for mapping credentials.

**Custom XSLT:** A custom XSLT can use any of DataPower's extension functions, including LDAP query functions, SQL functions, and communications functions, to name a few. Practically any mapping scenario can be supported using a custom style sheet.

*Example 1-12 Input context for custom credential mapping XSLT*

```
<credentials>
   <entry>user credential goes here</entry>
</credentials>
```

*Example 1-13 Sample custom XSLT for mapping credentials*

```
<xsl:template match="/">
   <xsl:variable name="credential" select="/credentials/entry"/>
   <xsl:choose>
      <xsl:when test="$credential = 'david'">
         */*/access/username?Access=rwad
         */*/access/usergroup?Access=rwad
         */*/status/object-status?Access=r
         */*/login/web-mgmt?Access=x
      </xsl:when>
      <xsl:when test="$credential = 'bruno'">
          */*/*?Access=rwadx
      </xsl:when>
      <xsl:otherwise>
         */guestdomain/*?Access=r
      </xsl:otherwise>
   </xsl:choose>
</xsl:template>
```

## 1.5.7 Single sign-on

Single sign-on (SSO) can be configured such that a user can directly access the DataPower control panel without being challenged for a user name and password. SSO is accomplished using SSL and *User certificates*.

A crypto validation credential (valcred) is used to maintain a collection of certificates that represent permitted users. When a user navigates to the administrative console's URL, DataPower will respond by requesting the browser to forward its certificate. If the received certificate exists within the validation credential (or is signed by an accepted certificate authority (CA)), the user is considered authenticated and the DN from the certificate is used in the credential mapping phase.

Because the credential that is returned from the SSO authentication phase is the DN of the peer's certificate, it must undergo credential mapping. Credential mapping happens much in the same way as described in 1.5.6, "Remote authentication servers" on page 18:

- An LDAP can be used to look up the user's group membership, which can then be mapped to a locally defined user group (see "Local user group for credential mapping" on page 19). The local user group provides the access profile and credentials.
- An LDAP can be used to look up the user's group membership, which can then be mapped to a set of access credentials in an RBM policy file (see "LDAP group mapping" on page 21).
- An RBM policy file can be used to look up the user's access credentials (see "Group mapping within the RBM policy file" on page 20).

## 1.5.8 Login processing summary

Regardless of which management interface a user connects, the authentication and credential mapping process occurs. The process can be summarized by the following steps:

1. Authenticate the user. The actual steps depend on the selected authentication method:
   - `Local user`: A login page is displayed in order to obtain the user name and password. The appliance's local user repository is used to authenticate the user. If successful, the user's credential is determined based on the user's access level:
     - `User` access level: Credentials are predetermined by DataPower and provide the ability to view status only. A limited DataPower control panel is displayed. No further processing occurs.
     - `Privileged` access level: Credentials are predetermined by DataPower and provide access to all resources and device functions. The full DataPower control panel is displayed. No further processing occurs.
     - `Group-Defined` access level: The user's credential is the *group* name that is specified in the user's profile. Processing continues with step 2.
   - `Xmlfile`: A login page is displayed to obtain the user name and password. A local RBM policy file is used to authenticate the user. If successful, processing continues with step 2.

- `LDAP`, `RADIUS`, or `SAF`: A login page is displayed to obtain the user name and password. The provided user name and password are sent to the configured remote authentication server. If successfully authenticated, processing continues with step 2.
- `User certificate`: The peer's certificate is used as the user's identity and validated against a crypto validation credential (valcred). If the peer's certificate exists in the valcred, the user is considered to be authenticated. The user's credential is the DN from the certificate. Processing continues with step 2.
- Custom: A login page is displayed to obtain the user name and password. The user name and password are then passed into an XSL template, which will perform authentication. If successful, processing continues with step 2.

2. Map the user's credentials:
   - Local usergroup: The credential from step 1 is used as the group name. The group's access profile is inspected, and each access policy statement is mapped to a credential, resulting in the user's credentials.
   - Xmlfile: A locally hosted RBM policy file is used to map the credential from step 1 into the user's credentials.
   - Custom: An XSL template can be used to map the credential to a series of RBM access profiles.
3. DataPower control panel is displayed.

## 1.6 Audit logs

Audit logs provide a history of all administrative activities that occur on the appliance. The audit log is separate from the regular DataPower logs and can be viewed from the navigation menu under **Status** → **View Logs** → **Audit Log**.

Monitoring audit logs, which can be accomplished in several ways, is important in assuring the safety and reliability of a DataPower appliance:

- Audit event subscription where a log target can be created that subscribes to audit events
- Copying the audit log off of the appliance using either CLI or SOMA

### 1.6.1 Obtaining the audit log using CLI

The CLI can be used to copy the audit log to another location or send it to a mail recipient.

Example 1-14 shows the CLI command to copy the audit log to a new file in the `temporary:` directory.

*Example 1-14 CLI command to copy audit log to the temporary: directory*

```
copy audit:///audit-log temporary:///audit-log
```

Example 1-15 shows the CLI command to copy the audit log to an HTTP file server URL.

*Example 1-15 CLI command to copy an audit log to an HTTP file server*

```
copy audit:///audit-log <HTTP File Server-URL>
```

Example 1-16 shows the CLI command to send the audit log to a mail recipient using a Simple Mail Transfer Protocol (SMTP) server.

*Example 1-16 CLI command to send the audit log to a mail recipient*

```
send file audit:///audit-log <outgoing-mail-server> <email-address>
```

## 1.6.2 Copying the audit log using SOMA

The audit log can be retrieved using DataPower's SOAP Management Interface (SOMA). Example 1-17 shows a SOMA request that retrieves the audit log.

*Example 1-17 SOMA request to obtain the audit log*

```
<?xml version="1.0" encoding="UTF-8"?>
<soapenv:Envelope xmlns:soapenv="http://sc...omitted...envelope/">
   <soapenv:Body>
      <dp:request domain="default" xmlns:dp="ht...omitted...anagement">
       <dp:get-file name="audit:///audit-log"/>
      </dp:request>
   </soapenv:Body>
</soapenv:Envelope>
```

The SOMA response will contain the base64-encoded contents of the audit log and therefore will require decoding.

For more information about SOMA, see 10.3.3, “SOAP Management Interface (SOMA)” on page 237.

## 1.7 Preferred practices

As with any complex highly configurable device, there are certain ways of accomplishing specific tasks that are better than others. This section provides a list of tips and recommendations that have, in most circumstances, proven to be “preferred practices.” That said, they are not laws and might not be the best solutions in all situations.

- Capture audit logs. Audit logs provide a window into what administrative activities have occurred on the appliance. Audit logs can be sent to DataPower log targets for transmission to a variety of log servers. See 1.6, “Audit logs” on page 24.
- Configure an inactivity timeout for WebGUI in the navigation menu under **Network** → **Management?** → **Web Management Service**.
- Change the WebGUI port. The most commonly used port is 9090. Secure environments might consider using a port other than 9090. Make this change in the navigation menu under **Network** → **Management?** → **Web Management Service**.
- Save and protect the `admin` password. It cannot be recovered. If it becomes misplaced and no backup admin exists, the appliance must be returned to IBM for reinitialization.
- Create a second backup privileged administrative user, which provides an alternate admin (superuser) in the event that the primary one becomes inaccessible. An alternate admin user can reset the password of the primary admin if necessary.
- Use the *Group-Defined* access level instead of *User* or *Privileged* when creating local users (this suggestion does not apply when using remote authentication servers). The user access level grants the ability to view status only, and the privileged access level provides complete access to the appliance. The group-defined access level uses DataPower’s Role-Based Management functionality, which is more flexible.
- Enable `Local Login as Fallback` when configuring an appliance for non-Local RBM authentication. In the event that a remote authentication server becomes inaccessible, the local user repository can be used as a backup way of entry. It might not be necessary to replicate all users, rather only a few users for contingency purposes.
- Consider restricting administrative logon to the serial port. This suggestion is not a preferred practice, but rather a consideration point. Government agencies might require that administrative access be restricted to the serial port only.

- Use RBM for CLI access control, not CLI command groups. CLI command groups are deprecated and do not provide robust access control like RBM does.
- Do not use DHCP-assigned IP addresses in ACLs. DHCP-assigned client addresses can change, resulting in inaccessibility to the appliance.
- Adjust authentication caching to provide maximum permissible lifetime. Disabled or low caching lifetimes can result in increased network traffic.

## 1.8 Troubleshooting

Implementing administrative configurations that rely on remote authentication servers, RBM policy files, or custom development might require a certain amount of troubleshooting before all of the pieces are properly integrated. Be careful to ensure that the configuration steps do not inadvertently prevent access to the appliance.

- When testing or troubleshooting RBM, make sure to enable RBM debug logging, which is found in the Troubleshooting panel in the Logging section. Log messages might appear in either the regular system logs or the audit logs.
- Verify that remote authentication servers are reachable from DataPower. Use the Ping Remote and TCP Connection Test to assure that the servers are accessible.
- Assure that any Domain Name System (DNS) server settings are properly configured.
- Assure that the appliance's time is accurate and that any Network Time Protocol (NTP) server connections are working. Incorrect date settings can affect the validity of certain certificates.
- If a device becomes inaccessible due to access control list violations, you might be able to verify what IP addresses are in them using either the command-line interface or by inspecting a previous backup.
- Only secure one administrative interface during security configuration. In other words, if you are setting up security on the WebGUI, leave the CLI unsecured until everything has been verified. This approach allows for a "back door" in case the WebGUI becomes inaccessible.

**Enable local users:** Make sure to *always* enable local users as a fallback when making changes to the RBM and user management settings. This approach enables the users in the local repository to remain active in the event that remote authentication servers or custom style sheets fail to operate as expected.

2

# Networking

At their core, DataPower appliances are highly capable network devices and provide a wide array of networking, security, and integration tasks. Whether protecting web services, mediating security tokens, or proxying between disparate wire protocols, all activities rely on the underlying network. For this reason, it is imperative that a DataPower appliance's network configuration is compatible with its surrounding network environment. Understanding DataPower's networking capabilities and configuration nuances can help assure the maximum processing throughput.

This chapter describes the considerations and activities that are associated with IBM WebSphere DataPower service-oriented architecture (SOA) Appliance networking.

## 2.1 Overview

Due to the nature and scope of the appliance's role in the network, networking problems might be difficult to isolate and can possibly have a significant effect. Understanding how to properly deploy the appliance on the network can help prevent unexpected behavior and avoid future problems.

The information discussed in this chapter is to help augment existing documentation, attempt to help clarify any usage ambiguities, and provide suggestions from experience in the field. Figure 2-1shows an example network topology using DataPower appliances.

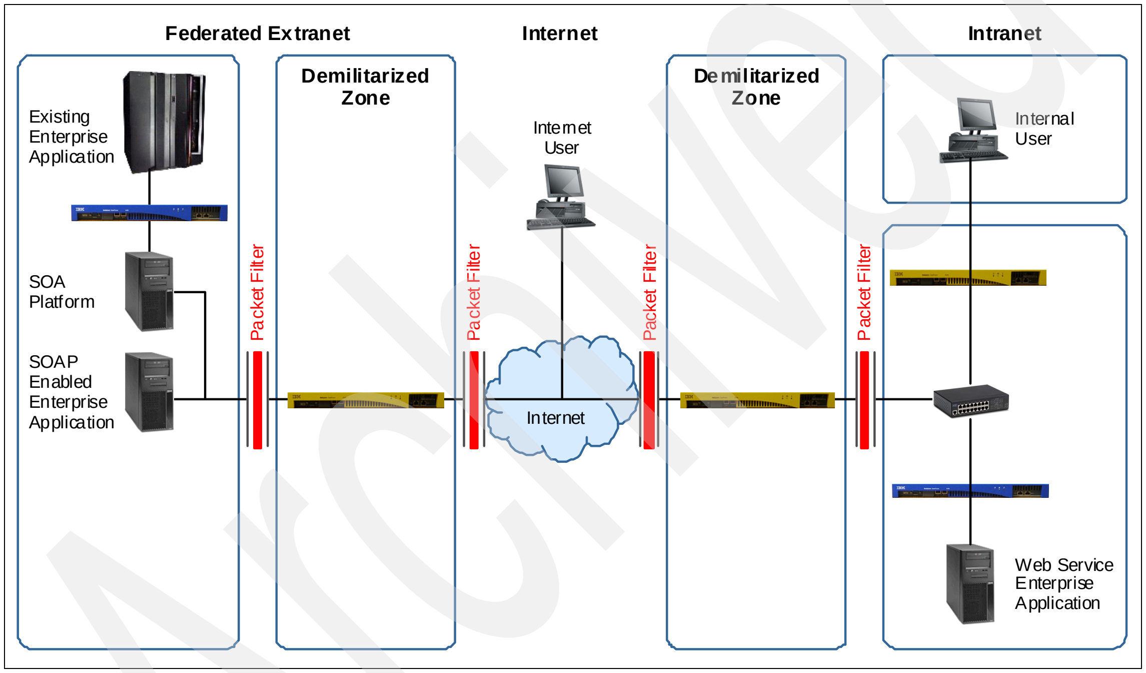


*Figure 2-1 Sample DataPower network topology*

## 2.2 Benefits

The DataPower appliance is highly configurable. The administrator can use all of its features to achieve the desired network requirements.

Consider each configuration feature as only a part of the complete network solution. Multiple components need to work together to achieve the proper deployment, including the following components and features:

- Multiple physical Ethernet interfaces
- Virtual LANs to help further segregate traffic on a physical network interface card (NIC)
- IP addresses and routes on Ethernet and virtual LAN (VLAN) interfaces
- Bind addresses on non-polling Front-Side Handlers (FSHs) and management interfaces
- Network settings
- Source and destination routing
- Interface isolation (off, strict, or relaxed)
- Reverse path filtering (on or off)
- Access control lists (ACLs)

## 2.3 Usage

This section describes the usage capabilities, configuration settings, and several of the nuances regarding networking with the DataPower appliance. It is important to correctly set the network interface configuration settings and routing behavior to integrate properly within the network topology and architecture. The main objective of this section is to help administrators make an informed decision regarding network planning, configuration, and proper deployment.

### 2.3.1 Network interface configuration and routing

IBM WebSphere DataPower SOA Appliances come with four physical network interfaces and one serial port to communicate with the external world. To start using the appliance, the initialization is done through the serial port for security reasons.

The process to initialize the device is covered in the appliance documentation. This section provides an overview of the main settings to consider when connecting the device to the network.

## Ethernet interface

The device has four network interfaces and a serial port, as shown in Figure 2-2.

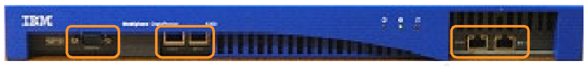


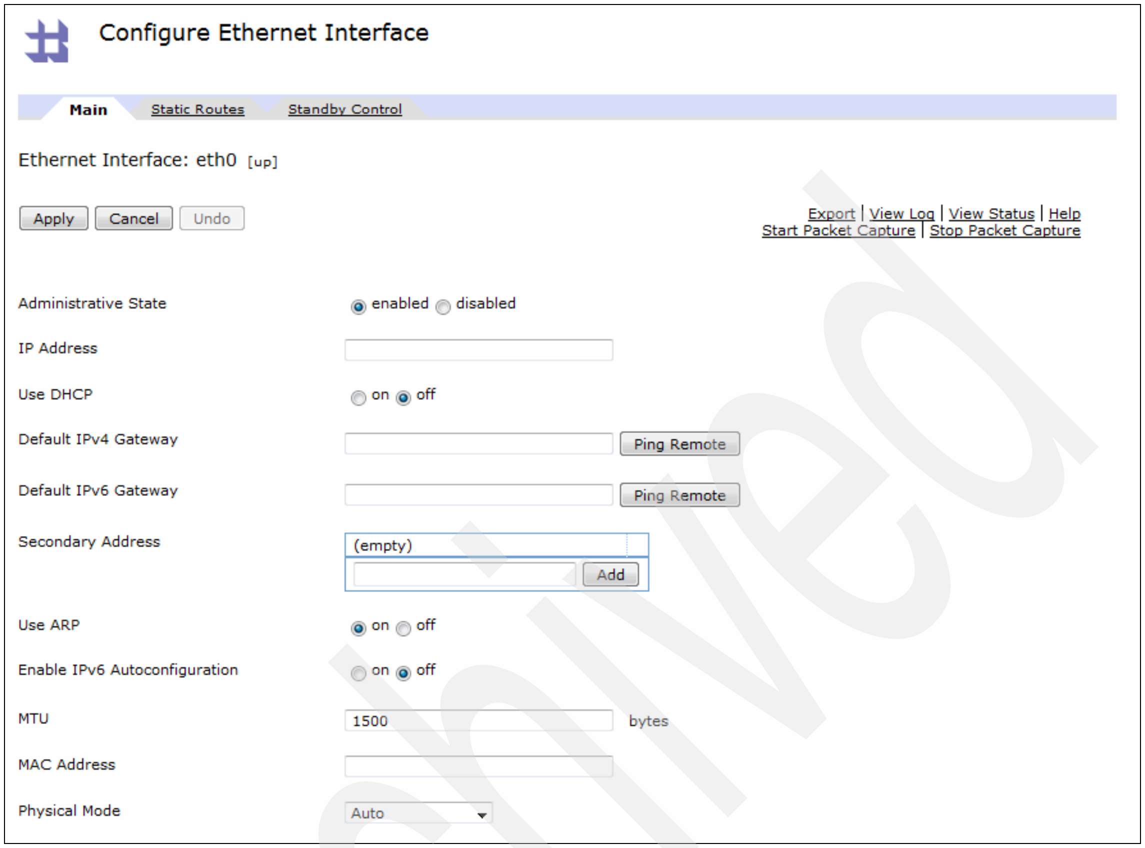
*Figure 2-2 Displaying the front of the DataPower appliance*

The Ethernet interfaces have the following tags or names:

- eth0
- eth1
- eth2
- eth4 (also called “mgt0” and usually reserved for management traffic)

**SSH service:** The Secure Shell (SSH) service attempts to bind to mgt0 if there is no interface configured for it. If the management interface is not configured, SSH will listen on all available interfaces (`0.0.0.0`).

The network interface configuration window for the DataPower appliance looks like Figure 2-3 on page 33.



Configure Ethernet Interface

Main | Static Routes | Standby Control

Ethernet Interface: eth0 [up]

Apply | Cancel | Undo

Export | View Log | View Status | Help
Start Packet Capture | Stop Packet Capture

| | |
|---|---|
| Administrative State | [✓ enabled] disabled |
| IP Address | |
| Use DHCP | on [✓ off] |
| Default IPv4 Gateway | Ping Remote |
| Default IPv6 Gateway | Ping Remote |
| Secondary Address | (empty) Add |
| Use ARP | [✓ on] off |
| Enable IPv6 Autoconfiguration | on [✓ off] |
| MTU | 1500 bytes |
| MAC Address | |
| Physical Mode | Auto |

*Figure 2-3 Ethernet Interface configuration panel*

When defining each network interface configuration, consider the following settings:

- IP address

  The subnet mask and a unique IP address must be used for each interface. Administrators can use either of the two following options to define the subnet mask:

  – Specify the network using Classless Inter-Domain Routing (CIDR) notation.

  – Use a space after the IP address, and then specify the subnet mask using the dotted notation.

    For example, both CIDR notation (`192.168.0.2/24`) and dotted decimal notation (`192.168.0.2 255.255.255.0`) are acceptable values for this field.

- Dynamic Host Configuration Protocol (DHCP)

  Whether to use DHCP depends on the network configuration and requirements. Typically, an infrastructure network node will not use DHCP because its network configuration must often remain static. However, the option to lease an IP address for the device is still available through the use of the DHCP setting.

- Default gateway

  The default gateway defines the route of last resort when the destination is not on the local subnet and no other explicitly configured static route matches.

- Secondary address

  Each interface can have additional IP addresses in addition to the primary IP address.

  **Secondary addresses:** All secondary addresses must be on the same subnet as the primary address. Many secondary addresses are not recommended. Use the HOST header to virtualize.

- Address Resolution Protocol (ARP)

  This is the option to enable or disable ARP, which broadcasts the IP address and the physical interface mapping over the network. This setting is generally not recommended to enable unless required.

- IPv6

  Configure this field only if the network uses IPv6. When enabled, it creates an IPv6 address that links to the primary interface by default.

- Stateless Address Autoconfiguration (SLAAC)

  This option is only available when IPv6 is enabled and used to enable or disable SLAAC. When enabled, the IPv6 address is obtained when connected to the network. When disabled, the interface uses the defined primary address.

- Maximum Transmission Unit (MTU)

  MTU defines the size of the media access control (MAC) layer data field that can be handled on this interface. Do not modify this configuration unless all other interfaces on this network are similarly configured. If any VLAN sub-interfaces are enabled, an extra 4 bytes are added automatically.

- MAC address

  Use this field to override the assigned MAC address that is associated with the hardware interface. This field must not be changed arbitrarily from the default.

As a side note, the configured original MAC address might not be displayed in the interface status provider when the appliance is in the Active State for Standby Control and might only display the Virtual MAC address.

- Physical Mode

  It is possible to configure the interface speed and direction of the Ethernet unshielded twisted pair physical layer. This property allows the speed and direction to be explicitly set. which is useful because certain networking equipment might not negotiate properly.

  **Important:** The switch or router that is connected to the appliance interface must have an exact port speed match.

  For example, `AUTO<->AUTO` or `100BASE-TX-FD<->100BASE-TX-FD`.

  If the port speed on the Ethernet interface is not set to the same port speed as the connected switch, the following symptoms can occur:

  – Slow performance in sending or receiving data.

  – Inability to send or receive data (most commonly unable to send or receive large amounts of data).

  – Intermittent connectivity.

  – Mismatch between full-duplex and half-duplex. The half-duplex end will experience high collision counts.

## Static routes

It is possible to define the routing path of network traffic for each interface. Define the routes carefully to avoid rule overlapping, which can cause undesired behavior.

Routes are chosen in the following manner:

- Select the matching route with the longest path.
- If more than one longest path match, select the route with the lowest metric.

If more than one possibility still exists, the route is randomly drawn.

When defining a static route, the following three fields must be set:

- Destination: Defined using either Classless Inter-Domain Routing (CIDR) or dotted decimal format
- Gateway: Needs to be the first hop on the network from the appliance
- Metric: A numeric value to determine priority (lowest value is used) when two or more routes have the same destination

**Tip:** To find the first hop on the network from the appliance, issue a `traceroute` command from the CLI interface, as depicted in Example 2-1, and select the first entry.

*Example 2-1 Sample traceroute command from the CLI*

```
xi50# traceroute 192.168.1.168
Traceroute  (192.168.1.168)
 1:   192.168.1.1  rtt= 1 ms
 2:   192.168.1.50  rtt= 1 ms
 3:   192.168.1.168  rtt= 1 ms
xi50#
```

Note that static routes, as well as the implicit interface route, are only active when the PHY link of the interface is Up. Also, note that if an interface is configured with IP address `1.2.3.4/8`, an implicit route to 1.0.0.0/8 is created via 1.2.3.4 with a metric of 0 (zero).

## 2.3.2 VLAN sub-interfaces

Use virtual LANs (VLANs) to define a set of machines that can communicate with each other as if they were attached to the same physical network. In addition to the regular interface settings, the VLAN sub-interface will need to be associated with a specific physical interface, provide a VLAN identifier, and specify an outbound priority. VLAN sub-interfaces can be defined outside the subnet of the primary interface.

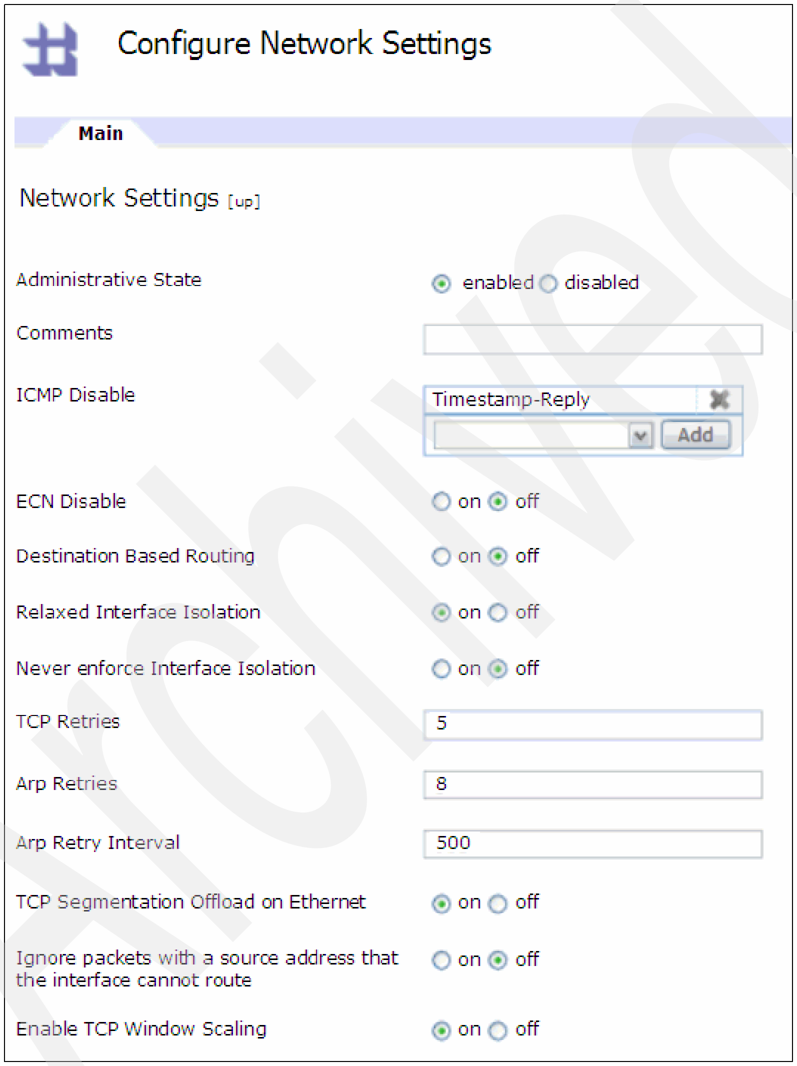
**Important:** The VLAN sub-interface can be configured to use DHCP, but then it will not allow a static route to be defined for this sub-interface. If static routes are defined within a VLAN sub-interface using DHCP, the VLAN will drop the IP address and any connectivity to that IP address will be lost.

### IPv6 default routes

In order to define an IPv6 default route in a VLAN sub-interface, it is necessary to configure the IPv4 as the primary address and the IPv6 entry as a secondary address, and then to add the IPv4 and the IPv6 default gateways. After you have completed this action, both addresses will be configured on the system and their default routes will appear as expected.

## 2.3.3 Network settings

This section provides an explanation of the appliance-wide general network settings. These settings can be configured in the Configure Network Settings configuration window that is shown in Figure 2-4.



| | |
|---|---|
| Administrative State | [✓ enabled] disabled |
| Comments | |
| ICMP Disable | Timestamp-Reply |
| ECN Disable | on [✓ off] |
| Destination Based Routing | on [✓ off] |
| Relaxed Interface Isolation | [✓ on] off |
| Never enforce Interface Isolation | on [✓ off] |
| TCP Retries | 5 |
| Arp Retries | 8 |
| Arp Retry Interval | 500 |
| TCP Segmentation Offload on Ethernet | [✓ on] off |
| Ignore packets with a source address that the interface cannot route | on [✓ off] |
| Enable TCP Window Scaling | [✓ on] off |

*Figure 2-4 Example Configure Network Settings panel*

These settings apply to all configured interfaces:

- Internet Control Message Protocol (ICMP) Disable

This setting disables the following Internet Control Message Protocol (ICMP) replies:

- Echo Reply
- Timestamp Reply

  By default, the Timestamp Reply is disabled for ICMP.
- Info Reply
- Address Mask Reply

Therefore, by default, the appliance will respond to ICMP pings, Info requests, and Address Mask queries.

- Explicit Congestion Notification (ECN) Disable

  ECN is a flag that is defined to alert about network congestion to other devices. By default, Transmission Control Protocol (TCP) sessions are ECN-enabled in the appliance. Certain network devices are incompatible with ECN. If the network is experiencing packet loss, ECN can be disabled to resolve the problem. If the problem persists, this feature needs to be enabled again.

- Destination Based Routing

  This setting controls the behavior of how the appliance routes responding packets to an incoming client request.

  The default behavior selects the interface that is bound to the service IP address. In the case of a service listening on multiple IP addresses (`0.0.0.0`), the appliance will use the interface that initially received the request (not the interface that is bound to the service that generated the response).

  When it is enabled, the interface selection uses the routing table to determine the best path to the client, irrespective of the service or receiving interface.

  **Destination-based routing:** Destination-based routing is for backward compatibility only. Only enable destination-based routing if an upgrade disrupts the existing connectivity.

- Relaxed Interface Isolation

  For security reasons, an incoming packet typically will only be accepted when the destination address matches the IP address that is configured on the Ethernet interface. The Relaxed Interface Isolation option allows less strict enforcement so that packets with the destination address within the same subnet are allowed.

  Set this option to “on” if Destination Based Routing is also on.

- TCP Segmentation Offload on Ethernet

  This setting enables an Ethernet chip feature that is intended to improve performance on large TCP writes to the network. Disable this option only if link layer resets are seen on the network or to determine if this feature is incompatible with the network traffic.

  **Important:** An appliance restart is required when modifying TCP Segmentation Offload in order for the change to take effect.

- Reverse-Path Filtering

  The option “Ignore packets with a source address that the interface cannot route” ignores packets that have a source address that the interface cannot route. By default, incoming packets with an unreachable source address will still be accepted and processed.

- Enable TCP Window Scaling

  This setting allows the negotiation of window sizes greater than 64 KB, by default. Disable this option when integrating with TCP systems that cannot handle window scaling.

## 2.3.4 Host alias, static hosts, and domain name system

This section explains the usage of host alias and static hosts. It also describes the configuration of Domain Name System (DNS) servers and the management options.

### Host alias

The host alias can be used in place of IP addresses for object configuration. It is often used to simplify the export and import of service configurations between DataPower systems.

### Static host

The static host setting manually maps a host name to the host IP address without using the DNS. This setting can be useful if the DNS is unavailable, incorrect, or incomplete. However, the device’s DNS name resolver uses a cache; therefore, static mappings will usually not result in a significant performance improvement.

### Domain Name System

In the DNS section, you configure the list of DNS servers and search domains.

If a port is not configured, the appliance uses port `53`, by default (for both User Datagram Protocol (UDP) and TCP).

Selecting the DNS Load Balancing Algorithm controls which DNS server is used when multiple DNS servers are configured.

There are two load balancing algorithms available for DNS servers:

- The *First Alive* algorithm will use the first available DNS server in the list and then will try subsequent servers in the list if the first DNS server is down. When selected in the WEBGUI, the First Alive algorithm will show a retry and timeout setting for the whole DNS group.
- The *Round Robin* algorithm will alternate through the list of configured DNS servers. Selecting the Round Robin algorithm only allows each DNS to have its own retry setting.

**Tip:** Consider using DNS aliases on a DNS server as an alternative to using secondary IP addresses directly on the appliance.

## 2.3.5 Routing

The DataPower appliance has several features that affect the network path that is selected for traffic. Packets responding to incoming traffic typically use the same interface on which they came in; however, outgoing new TCP connections use the routing table to select an outgoing interface.

The routing table shows the routing rules generated from configured static routes and default routes. It is important to understand that default routes and static routes on the DataPower appliance behave differently and have unique functionality:

- A static route forces the DataPower appliance to use a specific interface and a specific set of network hops to access a given set of destinations.
- The default route is created by setting the **Default Gateway** on one of the appliance's interfaces. The appliance uses a default route when a given destination address is unknown.

When a specific route cannot be found and multiple default routes are configured, the appliance will randomly pick which interface to use for outbound traffic. For network traffic to follow a specific route, configure a static route instead of relying on a default gateway. Consider Example 2-2 on page 41, which shows the routing table from the CLI command `show route`.

*Example 2-2   Routing table*

```
xi50# show route
Destination Device Interface Type Device InterfaceName Gateway Metric Route Type Route Protocol
----------- ------------------ -- ------------ ---- -------    ------ ---------- --------------
 0.0.0.0/0       Ethernet         eth0                 168.91.8.1 0      remote     netmgmt
 0.0.0.0/0       Ethernet         eth1                 166.91.7.1 0      remote     netmgmt
 0.0.0.0/0       Ethernet         mgt0                 11.238.77.1 0     remote     netmgmt
 11.238.77.0/24  Ethernet         mgt0                 0.0.0.0    0      local      local
 168.81.18.0/23  Ethernet         eth0                 0.0.0.0    0      local      local
 166.81.18.0/23  Ethernet         eth1                 0.0.0.0    0      local      local
```

The output shows three default gateways configured on eth0, eth1, and mgt0, which causes three default routes to be generated as indicated by the `0.0.0.0/0`. If the destination address of the service is `10.10.10.100`, the device will randomly choose any one of the default routes because no specific route is configured.

If the appliance selects the mgt0 route using gateway `11.238.77.1` and the gateway cannot route to the back-end server IP address, this situation will trigger an unexpected connection failure. This failure can be intermittent, because the appliance selects the route randomly.

If a device has any interface with a route to the entire Internet, and it is desired the entire Internet be reachable, only interfaces that can reach the entire Internet need to have default routes.

## 2.3.6 Load balancing a back-end destination

When considering how to load balance traffic that is sent from a DataPower appliance, the common scenario is to use either the built-in DataPower load balancer group or an external load balancer.

**External load balancer:** If using an external load balancer, the external load balancer needs to be transparent to the appliance as a back-end network destination endpoint.

The DataPower appliance can perform load balancing to multiple back-end destinations that are grouped logically as a single unit/server pool by one of the following methods:

- Creating a Load Balancer Group object
- Adding the Load Balancer Group object name to the service's XML Manager
- Specifying the desired configuration parameters, such as algorithm
- Specifying the Load Balancer Group object name instead of a back-end host name or IP address

The use of a load balancer group is intended for back-end service destinations and failover support for LDAP/Information Management System (IMS™) connect servers. Depending on the algorithm that makes load-balancing decisions, each load balancer group can support 64 or 512 members.

The following algorithms support 64 members:

- Least connections
- Weighted least connections
- Weighted round robin

**Important:** The Load Balancer Group objects are not intended for use in static configuration settings, such as the Web Services Description Language (WSDL) source location.

## 2.3.7 Intelligent Load Distribution

The WebSphere DataPower Option for Application Optimization adds further functionality to the standard Load Balancer Group feature set to include Intelligent Load Distribution.

Intelligent Load Distribution distributes load to back-end WebSphere Network Deployment and other non-WebSphere Application Server environments.

Information about load balancer group membership, weights, and session affinity can be retrieved from WebSphere Application Server Network Deployment cells for load distribution decisions, as shown in Figure 2-5 on page 42.

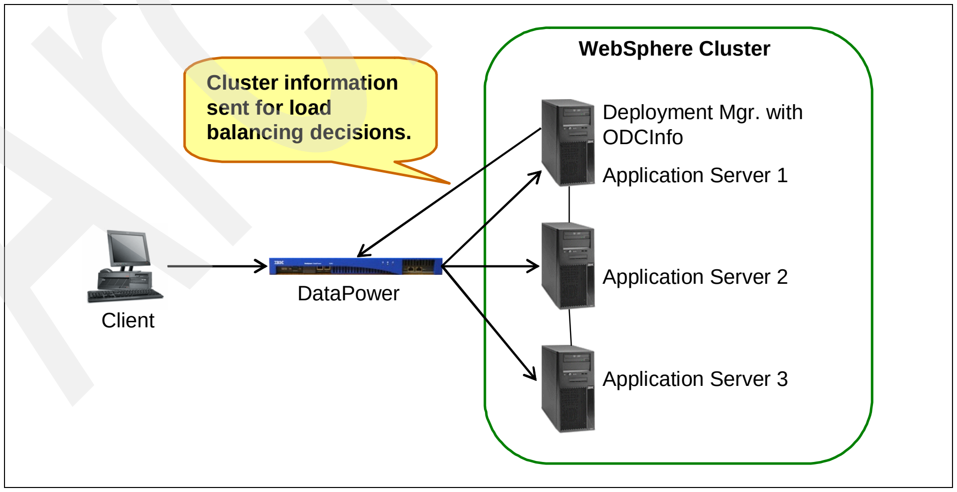


*Figure 2-5 Example of Intelligent Load Distribution of a WebSphere cluster*

Intelligent Load Distribution is designed to help use system resources more efficiently and adjust to traffic dynamically.

**WebSphere Virtual Enterprise:** Only WebSphere Virtual Enterprise dynamically changes weights and members based on runtime traffic conditions and workload.

Intelligent Load Distribution also uses these capabilities:

- Weighted Least Connection Algorithm

  Imposes weight infrastructure on top of the least connections algorithm. The larger the weight, the larger the percentage of connections that will go to a given server. The smaller the number of connections, the more likely that a server will receive the next connection.

- Session affinity

  Uses cookies to more efficiently provide the persistent (session) information to an application by forwarding every request within a session to the same server:

  – If DataPower recognizes the session ID format and can resolve the routing information, it uses the routing information to forward the request.

  – If there is no session ID, or the routing information cannot be resolved, the request is load-balanced.

When Workload Management Retrieval is enabled and the load balancer group contains explicitly defined (static) members, the following rules apply:

- If a member is part of the retrieved workload management information, its configuration settings are updated dynamically.
- If a member is not part of the retrieved workload management information, the load balancer group disables this member. Although disabled and not included in load balancing decisions, its configuration settings are not deleted from the persisted configuration. Disabling the Workload Management Retrieval feature allows you to display and update the information for these explicitly defined members.

When Workload Management Retrieval is disabled, the configuration can be changed from dynamic to static in order to debug load balancer group connectivity.

## 2.3.8 Self-Balancing services

With the WebSphere DataPower Option for Application Optimization Self-Balancing feature, two or more DataPower appliances can distribute load among themselves. This capability removes the requirement to place traditional server load balancers in front of a cluster of DataPower appliances.

When Self-Balancing is enabled, one appliance is designated as the distributor of traffic across the front of the cluster. Figure 2-6 shows the request flow of two self-balanced requests.

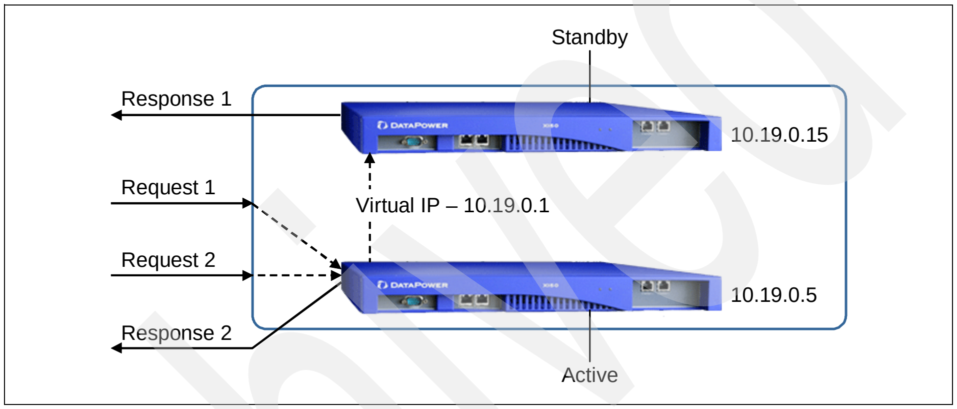


*Figure 2-6 Example of Self-Balancing*

Self-Balancing is fault-tolerant by providing high availability and is built on top of Standby Control. The virtual IP address of the Standby Control configuration is the external address that is used for Self-Balancing.

If the appliance acting as the distributor fails, another cluster member will assume the role of the distributor and take ownership of the virtual IP address. All of the DataPower appliances in the group are aware of all shared services.

Be aware of these important Self-Balancing usage considerations:

- Self-Balancing requires coordination with the network team.
- You must have the Rapid Spanning Tree enabled.
- Convergence must be less than six seconds in the event of a MAC address change.
- You must not use the same Standby Control group as any other standby group deployed on the same network.

## 2.3.9 Load balancer health checking

This section describes usage considerations of health checking to the front side and from the back side of the appliance.

You can use the following types of health checks to detect whether a service is available:

- Simple TCP check

  A simple TCP connection port check might be used as a simple “lightweight” health check, because this approach has the least overhead on the network beyond the appliance.

  However, a simple TCP connection check can only determine the TCP layer response and might mark the appliance up even though the actual HTTP/HTTPS response for a service might be wrong, empty, incomplete, or unavailable.

- Full service check

  Sending a full request to a service might be considered a more “heavyweight” health-checking method, but it can confirm that the complete service is really up.

- Service object status

  Checking the service object operational status by using a monitor or status provider can provide health check information.

- Separate health check match

  Configure the DataPower service object to match on a particular URI on the front-end request rule and generate a static response.

  For example, a DataPower service can be configured to match the `/healthcheck` part of the URL `http://datapowerservice:80/healthcheck`.

DataPower appliances have the functionality to enable health checking to back-end servers by using the Load Balancer Group object.

## 2.3.10 Standby Control and high availability

The standby capability of the DataPower appliance allows one device to serve as a failover for another device. Two Ethernet interfaces on the same appliance cannot be used as members of a standby group and cannot back each other up. Ethernet interfaces on separate appliances must be used as members of a standby group to back each other up.

Standby Control allows a collection of Ethernet interfaces on separate appliances to share responsibility for one virtual IP address (VIP).

Standby Control has these requirements:

- The two Ethernet interfaces must be on same network segment.
- The two Ethernet interfaces must be configured with the same VIP, group number, and authentication token.
- A device can have only one instance of a particular standby group number.

Standby Control offers this functionality:

- The two Ethernet interfaces operate in active/standby (active/passive) mode.
- The interface with the highest priority will be the active member.
- Standby Control allows for interface failover to another device.

## 2.4 Preferred practices

We have provided a collection of preferred practices drawn from our experience in the field.

### 2.4.1 Avoid using 0.0.0.0 as a listener

Binding a specific IP address and port to a specific service is recommended instead of using `0.0.0.0`.

Using `0.0.0.0` as a listening address is typically not a good practice, because using `0.0.0.0` as a listening address allows all interfaces to receive traffic for the assigned port. This approach might be an unnecessary exposure when services are set to listen on this address.

### 2.4.2 Separating management traffic

You can manage the DataPower appliance over the network through various methods, such as the WebGUI, SSH, Telnet, XML management interface, and SNMP. Typically, you need to separate management traffic from service traffic.

Careful construction of the routing configuration with non-overlapping routes can help isolate the front-side, back-side, and management traffic. This isolation can help prevent an attacker from directly connecting to the management interface even from the back side.

Traffic separation can be achieved by binding the management interfaces to a specific management IP address or VLAN address. A common scenario for management traffic separation is to have separate management interface routes for the back side and front side. It is not recommended to bind management interfaces to `0.0.0.0`.

If more than one IP address is required for management services, an alternative might be to use a TCP proxy listening on a second IP address, which then points to the original management IP address.

### 2.4.3 Specify port values less than 10,000

Use ports with a value of less than 10,000 when configuring services or protocol handlers. The DataPower appliance uses port values of 10,000 and greater as ephemeral ports. Using ports with a value that is higher than 10,000 can cause a port conflict and prevent the service from initializing properly.

### 2.4.4 Persistent timeout consideration

DataPower's back persistent timeout typically needs to be lower than the back-end server's timeout to prevent the reuse of a closed connection. This design can help to avoid the inherent race condition where the server side might close a connection at the same time that further data is being sent from the appliance.

### 2.4.5 Disable chained persistent connections

Services that communicate within the same appliance must have persistent connections disabled over that connection. Failure to disable persistent connections might cause undesirable results, such as connection errors or unexpected memory usage.

The connection errors are associated with the inherent race condition that might occur using an HTTP POST, which might cause the occurrence of a simultaneous POST at one endpoint and a TCP close at the other end. Additionally, memory overhead can occur for a buildup of many local long-running persistent connections.

This method needs to be consolidated and not used across too many levels whenever possible, because serialization and de-serialization will occur when passing messages from one service to another.

## 2.4.6 Configure network settings to be portable

Using host alias, static host, and externalizing end points in XSLT might help make a configuration more portable and maintainable. Using these settings is recommended instead of designating an explicit IP address in the Service configuration. Using these settings can allow easier Service migration to another appliance. Otherwise, every configuration reference to the unique IP address on one appliance will need to be modified to correspond with the new appliance's IP address.

## 2.4.7 Multiple default gateways will create multiple default routes

The appliance allows multiple default gateways to be configured and can have one on each of the four interfaces. This capability was designed to meet the requirements of having a robust appliance. The network administrator must choose the number of default gateways based on the network design.

A general recommendation is to set specific static routes and use only one default gateway that can catch all traffic that is not explicitly being directed by the static routes. This design might cause intermittent failure in connecting to other network destinations. The default routes are generated when the default gateway is configured on each interface.

**Important:** There is no explicit way to test if all default routes are working.

It is recommended to use one default gateway that is chosen to connect with other destinations and subnets outside of the network and to use static routes inside of the network. For example, use the default gateway to connect all Internet-based servers and clients, and then use a static route to the intranet servers, which can include the back-end application servers.

## 2.4.8 Standby Control preferred practices

This section describes the preferred practices for Standby Control deployment.

### Preempt

Set Preempt mode to OFF. This setting simplifies the configuration. It can help with debugging in the event that unexpected network delays cause the interfaces to start switching between the active and standby states.

## Group number

A group number is an integer that is used to identify a standby group; allowable identifiers are in the range 1 - 255. All interfaces in a given standby group must have the same group number. This value must be distinct from all group numbers that are being used by IP routers or switches in the same broadcast domain.

The active interface in the group will change its Ethernet MAC address to `00:00:0C:07:AC:XX`, where *XX* is the group number. This number must also be unique among all standby groups on a given system.

Configure the standby group number with a value higher than 20 to help avoid the accidental use of duplicate group numbers within a single network. It is common for network routers and switches to be configured with the lower standby group numbers.

Only one interface on a device can participate in a given standby group. The use of two for redundancy is not allowed. A given interface (including associated VLANs) can only have one standby configured, because the standby has only one MAC address.

## Virtual IP address

The virtual IP address is the IP address that will be used by the active member of the standby group. External clients that want to be able to contact the active member of the standby group must use this IP address. This address must be on the same IP subnet as the primary address of the interface.

## Rapid Spanning Tree

Ensure that Spanning Tree PortFast (or Rapid Spanning Tree, depending on the make and model of the switch) is enabled on all switches that are connected to the DataPower appliances. Spanning Tree PortFast or Rapid Spanning Tree must also be enabled on any other switches within the network path of the appliances. This way, you place the switch ports into a forwarding state that will allow traffic to be passed through immediately whenever the VIP moves to the currently active device. Refer to the switch operation manual to configure this setting.

Make sure that Rapid Spanning Tree is properly deployed and that the convergence time on the switch is less than the “hold” time configured on the appliance. The default “hold” time on the appliance is 10 seconds. This setting helps allow the proper amount of time to complete a failover and helps prevent unnecessary failovers caused by misconfiguration.

If the Rapid Spanning Tree is properly deployed and the convergence time requires longer than 10 seconds, the “hello” and “hold” time intervals on the appliance to accommodate the switch can be changed by using the **standby** CLI command.

**Timer values:** It is not recommended changing the intervals on the appliance for the rare instances that require the timer values to be larger than the default setting. Also, remember that larger timers mean longer periods to detect when a failover needs to occur.

For example, issue the command that is shown in Example 2-3 from the CLI, where `100` is the group number, `5` is the hello time, and `15` is the hold time.

*Example 2-3 Using config command for changing intervals*

```
config
int eth0
standby 100 timers 5 15
```

### 2.4.9 Management interface and default route

Because all network interfaces that are available in DataPower devices are the same and one of the interfaces is named `mgmt` only to help distinguish it from others, any interface can be used as a management port. And, one or more DataPower network interfaces can be used to route network traffic to and from the device.

As a general rule, the management interface must not have the default gateway set, because it is generally recommended to restrict the connections that can be made through that interface.

### 2.4.10 Enabling “No Delay Ack” to avoid latency with other systems

If you observe slow performance and a delayed ACK response from an application replying back to the DataPower appliance, a latency issue might be the cause. For example, this situation has been observed using applications, such as WebSphere MQ or Tivoli Access Manager running on AIX®.

By default, AIX has a feature called “delayed acknowledgement” enabled to improve performance for certain network traffic, such as large chunks of data. Although this situation has been mainly observed on AIX, this delay might occur on any operating system that employs a delayed acknowledgment setting. This feature is controlled by the AIX setting `tcp_nodelayack`, which is set to 0 by default:

```
tcp_nodelayack=0
```

However, this AIX default setting can slow down performance communicating between DataPower and certain applications, such as WebSphere MQ or Tivoli Access Manager. Changing the default `tcp_nodelayack` option to enabled (set `tcp_nodelayack=1`) prompts TCP to send an immediate acknowledgement, rather than the default 200 millisecond (ms) delay.

Sending an immediate acknowledgement might cause a few more ACKs on the network, but in cases with WebSphere MQ, Tivoli Access Manager, or generally when sending small messages back and forth, it might greatly improve performance.

Use the following suggestions to diagnose the problem:

- Turn the `tcp_nodelayack` option on and test the performance.
- Review packet traces from DataPower to see if there is a delay between the packet sent to AIX and the ACK response coming back from AIX.

For example, in Wireshark/Ethereal, look for the "Time delta from previous packet" entry for the ACK packet to determine the amount of time elapsed waiting for the ACK.

To resolve this problem, disable the default ACK delay on AIX by changing the setting to:

```
tcp_nodelayack=1
```

For example, to see what the current setting is:

```
/usr/sbin/no -o tcp_nodelayack
```

To test the option:

```
/usr/sbin/no -o tcp_nodelayack=1
```

To make the change persistent across reboots:

```
/usr/sbin/no -p -o tcp_nodelayack=1
```

**Delayed acknowledgement:** Although delayed acknowledgement might adversely affect applications on AIX, such as WebSphere MQ or Tivoli Access Manager communications with DataPower, it can improve performance for other network connections.

Therefore, do not change the default `tcp_nodelayack` value unless slow communication with a DataPower appliance is occurring. Consult with the AIX system administrator for further considerations about the effect that this setting might have on the system and for further details.

### 2.4.11 Streaming large messages and flow control

*Streaming* allows a message to start flowing to the back end before the whole message is read from the sending client.

When streaming large messages through a DataPower Multi-Protocol Gateway, it is recommended to utilize the flow control feature to help prevent memory from building up in the case of a slow back-end server.

In order to effectively use flow control, it is recommended to verify that a processing policy does not prevent streaming, which is discussed further in the *Optimizing Through Streaming* product documentation that is available in the DataPower Information Center:

http://www-01.ibm.com/software/integration/datapower/library/documentat ion/

Also, verify that the **XML Manager** → **XML Parser** → **XML Bytes Scanned** value that is used by the service is large enough to handle the desired large file size.

## 2.5 Examples

This section provides examples of various configuration and troubleshooting techniques.

### 2.5.1 Externalizing endpoints in a metadata document

XSLT often uses environment-specific information. Externalizing endpoints in a metadata document can help remove the environment-specific information from within the XSLT to allow better reusability. Each environment can then contain its own metadata document.

Example 2-4 is a routing example that shows how to externalize endpoints in a metadata document.

*Example 2-4 Routing example for externalizing endpoints*

```
<routingDestinations>
   <destinations subjectCN="CN=companylocation1">
      <host>10.10.10.2</host>
      <port>5000</port>
      <sslid/>
   </destinations>
   <destinations subjectCN="CN=companylocation2">
      <host>10.10.10.3</host>
      <port>5001</port>
      <sslid/>
   </destinations>
</routingDestinations>
```

XSL will reference the previous metadata document as shown in Example 2-5.

*Example 2-5 XSL reference to externalized endpoints*

```
<xsl:variablename="endPoints"
select="document('local:///identityDocument.xml')//identityDocument/ser
vice[@name='bookService']/endPoints"/>

<!--Set routing for Purchases -->

<dp:xset-target host="$endPoints/BookServiceHost1/ip/text()"
port="$endPoints/BookServiceHost1/port/text()" ssl="false()"/>
```

## 2.5.2 Disabling chained persistent connections for points of a service

Persistent connections can be used at various points of a service object, including these points:

- Front side
- Back side
- Processing policy

### Disabling persistent connections for front side

If the service is using a Front-Side Handler (FSH), persistent connections can be enabled or disabled explicitly in this FSH. This approach is particularly useful if the FSH is listening on a local host or the `127.0.0.1` IP address.

### Disabling persistent connections for back side

If the service points to a local chained service as a back end, use the Advanced tab to disable persistent connections going to this local chained service.

### Disabling persistent connections in the processing policy

If traffic is sent out during a processing policy (url-open), the User-Agent will dictate the type of connection used. Use the User-Agent to “Restrict to HTTP 1.0” to prevent persistent connections for the processing policy traffic with a match.

Another possibility is to add the “Connection: close” header to the url-open to prevent persistent connection reuse. See the following website for more information:

http://www.w3.org/Protocols/rfc2616/rfc2616-sec14.html#sec14.10

## 2.5.3 Port speed mismatch

If the Ethernet interface port speed is configured as auto, the interface setting must be matched by auto on the switch to ensure reliability. Network collisions can be caused by incompatible interface settings on the DataPower device® and the switch.

In particular, check to make sure an interface is not configured with a fixed speed, but the remote switch is set to Auto. This configuration can result in one end running full-duplex and the other end running half-duplex.

## 2.5.4 Sample DNS workaround using static host

Each DNS query response from the DNS server typically contains an IP address along with a time-to-live (TTL) with an IP address/host name mapping. DataPower will try Host Alias to honor and respect the TTL that is specified in the DNS server response.

In order to shorten the time that the DNS cache exists from the DataPower side, configure the DNS servers with the desired time-to-live. It is recommended that these settings are consistent across all of the DNS servers that are configured for usage with DataPower.

**Workaround:** If this configuration affects Production Traffic, enter a static host for the IP/host name mapping in the DNS configuration section of DataPower. This static host will serve as a temporary workaround so that there is not an outage.

## 2.5.5 Sample CLI commands to capture DNS server responses

To obtain DNS server information, determine the route that will be used to query the configured DNS server by examining the routing table and the IP address of the DNS server.

When the interface that handles the DNS traffic has been determined, the following commands will get DNS information and a packet capture of the DNS traffic:

- `co`
- `show dns`
- `show dns-cache`
- `show ip hosts`
- `clear dns-cache`
- `show dns-cache`
- `show ip hosts`
- `int eth<interface number>`
- `packet-capture temporary:///DNStrace.pcap -1 5000`
- `exit`
- `show clock`
- `ping <hostname of failing DNS entry>`
- `<Wait for the console to return before continuing>`
- `show dns-cache`
- `show ip hosts`
- `show clock`
- `ping <IP Address of failing DNS entry>`
- `<Wait for the console to return before continuing>`
- `show dns-cache`
- `show ip hosts`
- `show clock`
- `int eth<interface number>`
- `no packet-capture temporary:///DNStrace.pcap`
- `exit`

### 2.5.6 Verifying that Rapid Spanning Tree deployed properly for DataPower Standby Control

If Rapid Spanning Tree is not deployed correctly on the network, the Standby Control appliances might not be able to communicate properly. If the convergence time is more than 6 seconds, the network has not successfully deployed Rapid Spanning Tree and you need to contact the network administrator. Use the following procedure to determine if Rapid Spanning Tree is deployed:

1. Record the current Standby Control configuration settings, disable Standby Control on both appliances, and then save the updated configuration by using one of these methods:
   - Using the WebGUI:
     i. Navigate to **Network** → **Interface** → **Ethernet Interface** → **eth<number>**.
     ii. Click the **Standby Control** tab to view and record the settings.

iii. Click the **X** next to the Standby Control configuration entry to remove the Standby Control configuration.

iv. Click **Apply** → **Save Config**.

– Using the CLI:

*Example 2-6 Using the CLI*

```
#show standby
#co
#int eth<number>
#no standby
#exit
#write memory
#y
```

2. Reboot both appliances.
3. After the appliances have completed the reboot, check that both appliances have their original MAC addresses, by using one of these methods:

> **Tip:** This MAC address must *not* be the Virtual MAC Address: `00:00:0c:07:ac:<groupnumber>`.

– Using the WebGUI:

Navigate to **Status** → **IP-Network** → **Ethernet Interfaces** to view the MAC addresses.

– Using the CLI:

```
#show int mode
```

Be sure to record the original MAC addresses for later use.

The next several steps describe how to measure the spanning tree convergence time:

1. Start a continuous ping to one of the DataPower interfaces from another remote host on the network and verify that the continuous pings are successful:

– Using UNIX®:

```
ping <DataPower IP>
```

– Using the Windows® command prompt:

```
ping -t <DataPower IP>
```

2. Change the MAC address on the appliance interface to any MAC address that is currently not in use on the network by using one of the following methods. This change causes the continuous pings from the remote host to start failing.

   – Using the WebGUI:

     i. Navigate to **Network** → **Interface** → **Ethernet Interface** → **eth<*number*>**.

     ii. Update the MAC address field and click **Apply**.

   – Using the CLI:

```
#co
#int eth<number>
#mac-address <mac-address>
#exit
```

3. From the appliance, ping a remote address by using one of the following methods:

   – Using the WebGUI:

     Navigate to **Control Panel** → **Troubleshooting** → **Ping Remote**.

   – Using the CLI:

```
#ping <ip-address>
```

4. Immediately time how long it takes for the continuous pings to become successful again from the remote host.

**Rapid Spanning Tree:** If the network has correctly deployed Rapid Spanning Tree, the ping will resume successfully within 6 seconds.

Return the MAC address to the original MAC address that was recorded from step 3. Add the Standby Control configuration back after Rapid Spanning Tree has been deployed properly.

## 2.5.7 Example of deleting routes

A deleted static route setting of an Ethernet interface causes connection loss to DataPower using WebGUI or SSH. Static routes can be deleted using either of these methods:

- Using the WebGUI:

  a. Navigate to **Network** → **Interface** → **Ethernet Interface**.

  b. Choose the interface with the static route to be modified.

  c. Select the **Static Routes** tab.

d. Delete the static route setting that is not used anymore.

- Use the CLI in Example 2-7 (we used eth0 in this example):

*Example 2-7 Deleting static routes using the CLI*

```
xi50# co
Global configuration mode
xi50(config)# inter eth0
Interface configuration mode (eth0 )
xi50(config-if[eth0])# clear route
xi50(config-if[eth0])#
```

If connectivity is lost after removing a static route, check to see if the serial console is working. If so, you might need to define a particular route or default route. Use the serial console to set a default route/gateway to recover the network connectivity.

**Sequence:** Be sure to set the default route/gateway before deleting the static routes on the connected Ethernet interface.

## 2.5.8 Sample XSLT for adding DataPower transaction ID to an HTTP header for outgoing traffic

It is often necessary to correlate a transaction between the logs and a packet capture in order to debug. This correlation can be especially difficult in environments with large numbers of transactions. Use the style sheet in Example 2-8 in a transform action to insert the transaction ID into the HTTP headers.

*Example 2-8 Insert the transaction ID into HTTP headers*

```
<?xml version="1.0" encoding="UTF-8"?>
<xsl:stylesheet version="1.0"
   xmlns:xsl="[<code>http://www.w3.org/1999/XSL/Transform</code>]"
   xmlns:dp="[<code>http://www.datapower.com/extensions</code>]"
   extension-element-prefixes="dp"
   exclude-result-prefixes="dp">

   <xsl:template match="/">
      <xsl:variable name="tid"
         select="dp:variable('var://service/transaction-id')"/>

         <!-- can be used for request/response/both -->
      <dp:set-response-header name="'TransactionID'" value="$tid"/>

      <xsl:message dp:priority="info">
         <xsl:text>Transaction ID: </xsl:text>
         <xsl:value-of select="$tid"/>
      </xsl:message>

   </xsl:template>
</xsl:stylesheet>
```

Now, you can view the transaction ID in the packet capture and search the logs for corresponding events quickly and easily. Do not change the configuration of the interface supporting Telnet or SSH sessions, because the change might disrupt the session.

Similarly, do not alter the configuration of the interface supporting the WebGUI by using the WebGUI. The WebGUI makes changes by first clearing any existing configuration, necessarily ending the WebGUI session.

3

# Domains

From a cost perspective, one of the benefits of using DataPower appliances is the ability to use the same physical device to support a variety of projects and implementations. To support this level of versatility, DataPower appliances provide management functions for the separation of a single physical appliance into one or more logical instances called *domains*.

This chapter discusses the various benefits, uses, configuration, and preferred practices that are associated with DataPower domains.

## 3.1 Application domains

An *application domain* is similar to a private workspace. It isolates object configurations and files in one domain from those in other domains. Application domains provide an easy way to logically partition a single DataPower appliance for use by multiple developers, applications, or lines of business (LOBs).

IT professionals will find that application domains are similar to virtualization solutions and logical partitions (LPARs), which allow a single physical machine to be divided into several virtual systems for distinct usage. There are indeed similarities; however, unlike a true virtualized system, all DataPower domains share the same system-level resources. Memory, CPU, and network interfaces are shared throughout the entire appliance. This shared resource model means that administrators must be careful in how they reuse a single appliance.

As an example, it is unwise to have a single appliance that has one domain that processes high volume web service traffic and another domain that processes medium volume, extremely large (perhaps 1 GB) files. The memory consumption of the large files might impede not only available memory (especially if cryptographic functionality is required) but also network capacity.

### 3.1.1 The default domain

A special administrative domain, which is named *default*, contains the device's global configuration. Network setup, user administration, and other device configuration tasks can be performed only from within the default domain. In addition, application domains can be created and deleted only by administrators who are logged in to the default domain.

**Development within the default domain:** Do not perform application-related development within the default domain.

### 3.1.2 Domain use and benefits

Application domains provide a convenient and flexible way of dividing a single appliance into multiple workspaces. Domains are atomic in nature and are managed as a unit. An application domain can be exported easily from one appliance and imported into another one.

How a DataPower appliance is divided depends largely on its role within the enterprise. For example, a *development* appliance might contain the following domains:

- Individual developer domains

  In this case, each developer has a domain so that activities do not disrupt the activities of other developers. This design provides each developer with a "sandbox" or test environment for learning, testing, and troubleshooting.

- Shared project domains

  In this case, the domain can represent a single project (or application). Developers might build components in their own development domains and copy these components into this domain for integration with pieces created by other developers. This domain ultimately is promoted to test and production appliances.

Test and production appliances generally contain domains for specific applications or lines of business and rarely, if ever, contain developer domains.

The DataPower appliance domain model provides a number of benefits:

- Logical segregation:
  - Workspace segregation

    Developers are segregated from each other. Role-Based Management (RBM) access policies can easily restrict developers from accessing each other's domains.

  - Message segregation

    Messages from one domain are not visible within other domains (except the default domain).

  - Application segregation

    A single domain can contain a set of services or configuration objects that are used by a single enterprise application. This type of segregation facilitates easy promotion between appliances and easy overall management and policy enforcement at the domain level.

  - Line of business (LOB) segregation

    A single domain can contain all services for a specific LOB.

- Easy backup and restore (import/export)

  With only a few actions, an entire domain can be exported or imported, making migration relatively easy. Import and export can also be automated using the CLI (scripting) or the XML management interface (XMI). Deployment policies further enhance this process by allowing specific elements within a configuration to be modified during an import operation. For example, the test environment can use a host name of `wsgatewaytst` as a back-end service, but in production it must be changed to `wsgateway`.

- Access control

  Using role-based management, domains are easily protected and secured by unauthorized access.

- Version control

  Domains can be exported as a compressed file or as an XML file and saved within any popular source code management solution.

- Easy rollback

  Using either backup and restore functionality or the built-in configuration checkpoints facility, domains can be easily rolled back to a configuration from a previous point in time.

### 3.1.3 Segregating projects and LOBs

Application domains provide a useful way of supporting many projects from a variety of business and technology teams within the same physical appliance. The segregation of configuration helps to provide assurance to business stakeholders that their implementations will not be affected when another business' configuration is deployed to the production environment.

However, it is important to remember that the same physical system resources are shared across the device. Project teams and LOBs must be made aware of this sharing and must be willing to accept the risk that the over-utilization of processing or memory resources by one domain might affect their application.

If this risk is deemed unacceptable by the stakeholders, it might be necessary to purchase additional devices and physically separate usage. Alternatively, a DataPower team can use a process of capacity planning with negotiation of service-level agreements and DataPower service-level monitors (SLM) to greatly reduce the risk that a single application domain will consume an inordinate amount of system resources. See the Service Level Monitoring topic in the DataPower Information Center for more details about SLM functionality (the URL is in 3.6, "Further reading" on page 78).

### 3.1.4 Number of domains on an appliance

Although there is no set limit on the number of application domains that can be configured on a single appliance, there are several environmental considerations worth assessing to safeguard against the exhaustion of DataPower system resources. For example, having one application domain with 20 complex services will impose a larger strain on system resources than 10 application domains with 10 simple services.

**Consideration:** There is no limit to the number of domains that can be created on a single DataPower appliance. However, because all domains share system resources, it is prudent to evaluate whether introducing a new domain on an existing appliance will negatively affect other domains.

### 3.1.5 Domain resource consumption

The existence of a domain requires a negligible amount of system memory and is not generally a consideration in overall capacity planning. A new (or empty) domain's private flash file system also consumes minimal resources with the exception of the domain's default logs.

When a domain is created, it includes a single log target that is configured to send log messages to a flash-based file in the `logtemp:` directory. The file has an upper size limit of 500 KB; however, the log target is configured for three rotations. Thus, when the default log file becomes full, it is archived up to three times, which results in 2 MB of space in the flash file system. Depending on the amount of flash memory resident in the appliance, this space consumption might be worthy of consideration.

**Space considerations:** Although a domain consumes minimal system resources, its default logs require at least 2 MB on the flash file system.

## 3.2 Domain structure

All domains contain the same fundamental structure and capabilities:

- A domain-specific *file system* is used to organize and persist various details about the domain, such as configuration, Extensible Stylesheet Language (XSL) templates, cryptographic certificates, and so forth. We discuss the file system in 3.2.1, "Local flash-based file system" on page 66.
- A domain-specific *configuration file* includes configuration details that pertain to all objects that are created within the domain. We discuss configuration files in 3.2.2, "Domain configuration files" on page 68.
- A domain-specific *logging system* is isolated from logged output that is generated in other domains. We discuss domain logging further in 3.2.3, "Domain logging" on page 68.

- All domains have access to shared system resources, such as CPU, memory, and network interfaces.

## 3.2.1 Local flash-based file system

When an application domain is created, a set of dedicated directories in the flash-based file system is also created. The directories listed in Table 3-1 are specific to that domain, and the directories listed in Table 3-2 on page 67 are shared across all application domains. There are also several domains that are administrative in nature and are accessible only through the CLI within the default domain (as listed in Table 3-3 on page 67).

*Table 3-1 Domain directories that exist in every domain*

| Directory | Usage |
|---|---|
| `export:` | Contains the exported configurations that are created with the Export Configuration utility. Each application domain contains one `export:` directory. This directory is not shared across domains. |
| `cert:` | Contains keys and certificates for application development. Keys and certificates in this folder are specific to an application domain and are not accessible from any application domain. You must be in the specific application domain to create or upload keys and certificates to this folder. |
| `chkpoints:` | Contains the configuration checkpoint files for the appliance. Each application domain contains one `chkpoints:` directory. This directory is not shared across domains. |
| `config:` | Contains the domain's configuration file. |
| `local:` | Contains miscellaneous files that are used by the services within the domain, such as XSL, XML Schema Definition (XSD), and Web Services Description Language (WSDL) files. Each application domain contains one `local:` directory. This directory can be made visible to other domains. |
| `logstore:` | Contains log files that are stored for future reference. Typically, the logging targets use the `logtemp:` directory for active logs. You can move log files to the `logstore:` directory. Each application domain contains one `logstore:` directory. This directory is not shared across domains. |
| `logtemp:` | This directory is the default location of log files. Each application domain contains one `logtemp:` directory. This directory is not shared across domains. |

| Directory | Usage |
|---|---|
| `temporary:` | Used as temporary disk space by processing rules. Each application domain contains one `temporary:` directory. This directory is not shared across domains. During an upgrade, domain restart, reset, or device restart, the contents of this directory are deleted. |

*Table 3-2 Domain directories that are shared across all domains*

| Directory | Usage |
|---|---|
| `pubcert:` | Contains certificates that are commonly used by web browsers. Certificates in this folder are accessible from any application domain. However, you must be in the default domain to upload public certificates to this folder. |
| `sharedcert:` | Contains keys and certificates for application development. Keys and certificates in this folder are accessible from any application domain. However, you must be in the default domain to create or upload keys and certificates to this folder. |
| `store:` | This directory contains example style sheets, default style sheets, and schemas that are used by the appliance. Do not modify the files in this directory. Each appliance contains only one `store:` directory. By default, this directory is visible to all domains. The `store:` directory has the following subdirectories:<br>`meta:` Files used by the appliance itself<br>`msgcat:` Message catalogs<br>`policies:` Predefined WS-Policy definition files<br>`profiles:` Style sheets used by DataPower services<br>`schemas:` Schemas used by DataPower services<br>`dp:` Encrypted, internal-use files<br>`pubcerts:` Used internally by the appliance |

*Table 3-3 Directories accessible from the CLI only in the default domain*

| Directory | Usage |
|---|---|
| `audit:` | Contains the audit logs. Each appliance contains only one `audit:` directory. This directory is available from the command line in the default domain only and is not visible from the WebGUI. |
| `dpcert:` | This encrypted directory contains files that the appliance itself uses. This directory is available from the command line in the default domain only and is not visible from the WebGUI. |

| Directory | Usage |
|---|---|
| `image:` | Contains the firmware images for the appliance. This directory is where firmware images are stored during an upload or fetch operation. Each appliance contains only one `image:` directory. This directory is available in the default domain only. |
| `tasktemplates:` | Contains the XSL files that define the display of specialized WebGUI windows. Each appliance contains only one `tasktemplates:` directory. This directory is visible to the default domain only. |

## 3.2.2 Domain configuration files

Every application domain includes at least one configuration file, which is kept in the `config:` directory. The domain configuration file contains a script of CLI commands that are executed to initialize all of the service and configuration objects within the domain.

At device startup, the default domain's configuration file is executed first, initializing the network, administrative interfaces, and other device-wide settings. It also includes a number of commands that create all of the user-defined application domains. As each domain is initialized, its configuration script is executed, building all of the services and configuration objects for that domain.

The configuration script for the default domain is named `autoconfig.cfg`. The configuration script in each application domain is named the same as the domain with a `.cfg` extension. For example, the configuration file for a domain named `wsgateway` is `wsgateway.cfg` and is found in that domain's `config:` directory.

## 3.2.3 Domain logging

Every application domain includes its own isolated logging subsystem, which operates only on log messages that are generated by service objects defined within the same domain. Log messages do not cross domain boundaries, with the exception of the default domain, which is capable of receiving messages from all domains. When a new application domain is created, a log target named `default-log` is created.

As you might expect, each domain can control the level (or severity) of log messages that are generated within the domain. Log levels range from emergency to debug, with the latter generating the most log messages. Setting the log level in one domain has no effect on logging in other domains. You can determine the log level for a specific domain by clicking the Troubleshooting Panel icon from within the main Control Panel.

We describe logging capabilities in more detail in Chapter 6, “Logging” on page 163.

### 3.2.4 Domain monitoring

Domains can provide monitoring systems with metrics that pertain to service activity. When a domain is created, this functionality is initially disabled, but you can enable it using **Administration** → **Device** → **Statistic Settings**.

We discuss device monitoring in more detail in Chapter 4, “Simple Network Management Protocol monitoring” on page 81.

### 3.2.5 Shared resources

Although application domains provide a convenient mechanism for logically partitioning a DataPower device, they do not provide any segmentation of global system resources. System resources, such as a processor, memory, network cards, and storage are shared across all domains on a single physical device and cannot be partitioned. Thus, if a configuration running on a single application domain experiences heavy use, it can consume the majority of system resources and leave little resources for other configurations running on the same appliance. Although there is limited support for the prioritization of services, using global system resources cannot be restricted to a specific application domain.

In addition to physical system resource considerations, be aware that a DataPower device can run only a single firmware image at a time. For application domains, the effect is that all domains must operate with the same firmware version, which might be a consideration when planning the number of devices per user for development, testing, and production environments.

## 3.3 Domain persistence

When an administrator creates a new application domain, the following actions occur:

- System memory (RAM) is allocated for the domain.
- The domain’s directory structure is allocated in the file system.
- A configuration file is created in the `config:` directory.
- The logging and monitoring subsystems are initialized for the domain, along with any preconfigured log targets.

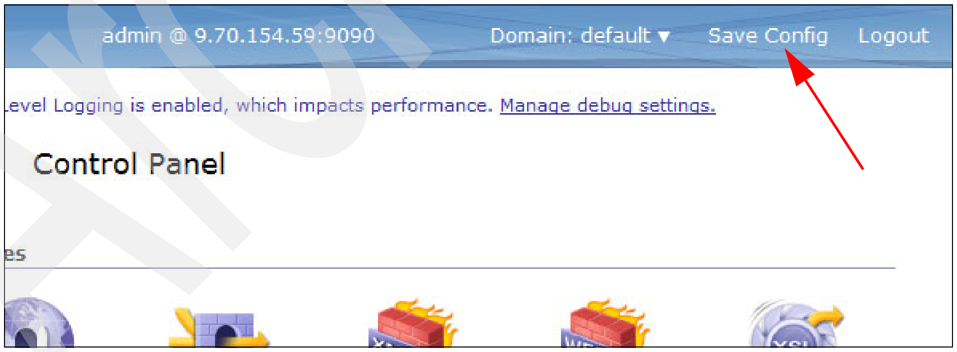
## 3.3.1 Saving configuration changes

When these actions complete, the domain is active *in memory* and ready for administrative or development activities. From this point forward, any configuration actions that are performed within the domain, such as creating a new Web Service Proxy or defining an MQ Connection Manager, result in the immediate creation of memory-resident objects.

These newly created objects are alive and functional and can perform work tasks, but they are not yet part of the domain's saved configuration. In other words, these newly defined objects are not yet written into the domain's configuration file. After you save the configuration (by either clicking the **Save Config** link or by executing the **`write memory`** CLI command), the newly created objects are added to the domain's configuration file. (See Figure 3-1 for the location of the Save Config link.) If the domain is restarted or the appliance is rebooted before the configuration is saved, the newly created objects will be lost.

**Configuration note:** Configuration changes are not saved into the domain's configuration file until you click the Save Config link.

This same rule is true when modifying pre-existing objects. For example, if a developer modifies a request processing rule to include a new XSL transform action, the functionality becomes immediately available to any messages that pass through the service. However, the domain's configuration file does not reflect this new action until the developer clicks the Save Config link to persist the modifications.



.evel Logging is enabled, which impacts performance. Manage debug settings.

Control Panel

*Figure 3-1 The Save Config link is located toward the top of the WebGUI*

Consequently, an application domain is also a configuration object that is created in and owned by the default domain. To ensure that the newly created domain becomes part of the default domain's saved configuration, it is important to remember to click the Save Config link.

**Important to save changes:** Application domains are configuration objects that are owned by the default domain. Thus, it is important to save the default domain's configuration after creating any new domains.

### 3.3.2 Imported domain configurations

By default, when a domain is created, its configuration is stored locally, as described in 3.2.2, "Domain configuration files" on page 68. It is also possible to create a domain that, when started, imports its configuration from a remote location. Both local and imported domains have specific usage scenarios and considerations.

#### Local domains

Domains that are purposed for development are always defined as *local*. As developers modify the objects within the domain, they save the active configuration to the local configuration file. If the domain or appliance is restarted, the saved configuration is used to reconstitute the domain.

#### Imported domains

Imported domains fetch their configuration from a remote location. This type of domain is read-only. After a domain is initialized, any changes that occur to the running configuration cannot be saved, which disqualifies imported domains for development use. However, imported domains are ideally suited for test and production environments.

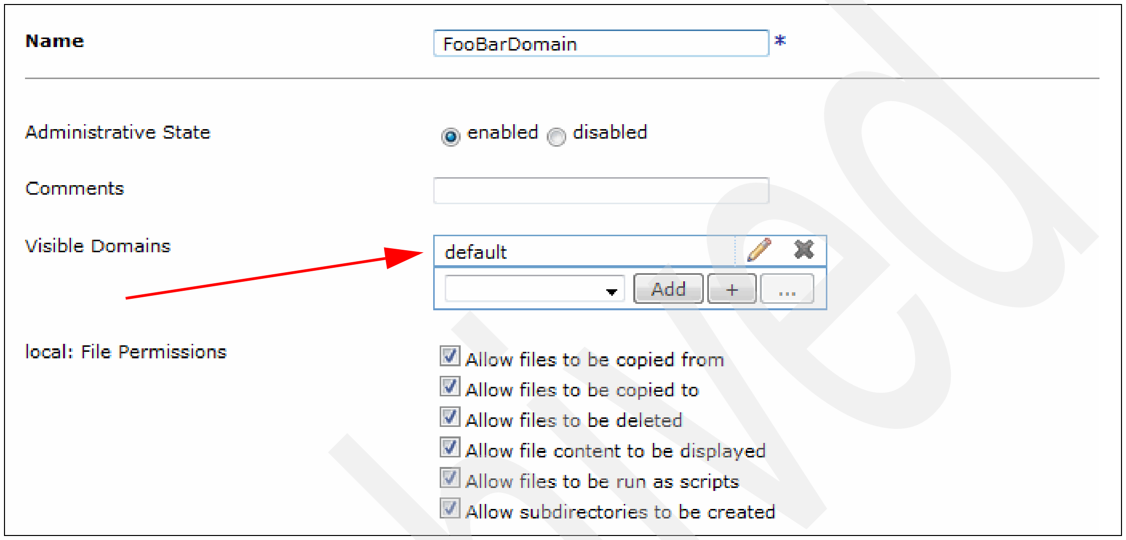
**Modifying imported domains:** An imported domain's running configuration can be modified, but the modifications cannot be saved. When the appliance is rebooted or the domain is restarted, those changes are lost. Changes can be made only to local domains.

## 3.4 Usage considerations

Domains provide a powerful and convenient way to segment a single DataPower appliance. Creating and using domains is simple and intuitive. This section provides additional guidance when configuring or using domains.

## 3.4.1 Cross-domain file visibility

An application domain can be provided with read-only access to any other domain's `local:` directory. By default, all domains are created with visibility into the default domain. Domain visibility is added (or removed) during domain creation or modification (see Figure 3-2).



| | |
|---|---|
| **Name** | FooBarDomain * |
| Administrative State | [✓ enabled] disabled |
| Comments | |
| Visible Domains | default |
| local: File Permissions | ✓ Allow files to be copied from<br>✓ Allow files to be copied to<br>✓ Allow files to be deleted<br>✓ Allow file content to be displayed<br>✓ Allow files to be run as scripts<br>✓ Allow subdirectories to be created |

*Figure 3-2 Adding or removing visible domains*

Domain visibility is useful for viewing or copying file resources that are located in another domain's `local:` directory. For example, a team can create a single domain to hold XSL templates that are modified frequently for various applications. This domain can then be visible from developer domains, allowing developers to copy the files into their `local:` directories.

Do not confuse domain visibility with domain *sharing*. Files or artifacts that are located within a visible domain's `local:` directory cannot be directly referenced by configuration objects. For example, an XSL template located in domain1's `local:` directory cannot be used in a transform action within domain2. The XSL template first must be copied from domain1's `local:` directory into domain2's `local:` directory before it can be referenced by a transform action.

## 3.4.2 Domain names

There is no strict rule about how to assign domain names. Every organization generally has its own set of naming standards.

Remember the following points when naming a domain:

- Domain names must be alphanumeric and cannot contain spaces or special characters.
- Domain names cannot be longer than 128 characters; however, it is recommended to keep names shorter than 80 characters (see 3.5, "Preferred practices" on page 77).
- Domain names cannot be changed after the domain has been created.

Although it is not possible to rename a domain, you can migrate an existing domain easily to a domain with the desired name.

**Renaming a domain:** The methods that we describe provide an alternate means of renaming a domain by copying its contents to a new domain and then removing the original domain. Take care to ensure that all artifacts in the source domain's `local:` and `cert:` directories are reproduced in the new destination domain.

### Exporting and importing

The contents of a source domain can be exported and then imported into a newly created domain. This method has the advantage of exporting the domain's `local:` directory. It might be necessary to re-import private key material into the `cert:` directory, because keys are generally not included in domain exports.

Follow these steps to export and then import a domain:

1. Export the source domain, and download the exported compressed file, which is used as the import into step 3 but also as a backup of the original domain if it is necessary to undo these actions.
2. Create a new domain with the desired name.
3. Import the compressed file into the new domain.
4. Optional: Upload any private key material into the domain's `cert:` directory.
5. Disable the source domain.
6. Test the new domain.
7. Delete the source domain.

### Copying the configuration file using the CLI

If there is little or no dependence on the `local:` directory, it might be easier to create a new domain and then copy the configuration file from the original domain into the newly created domain.

Copying the configuration file does not automatically include any artifacts that exist in the source domain's `local:` directory; therefore, it might be necessary to copy the contents of the source domain's `local:` directory to the new domain as well. It might also be necessary to upload any dependent private key material.

**Maintaining required artifacts:** Maintaining required artifacts on an external server avoids the need to copy them from one domain to another. This benefit also applies to private key material, which might be kept in the `sharedcert:` directory.

Example 3-1 shows the CLI commands to copy a domain to a new domain.

*Example 3-1 Copying one domain to another*

```
configure terminal
domain SourceDomain; admin-state disabled; exit
domain DestDomain; exit
copy -f config:/SrcDomain/SrcDomain.cfg config:/DestDomain/DesetDomain.cfg
restart domain DestDomain
exit;
```

The commands in this example accomplish the following tasks:

1. Disable the source domain (`SourceDomain`).
2. Create a new domain named `DestDomain`.
3. Copy the configuration file from the `SourceDomain` to `DestDomain`. Notice that the new file is renamed to the domain's name. The **`-f`** parameter overwrites the existing file.
4. Restart the new domain. Restarting a domain rebuilds the domain based on the new configuration file.

Note that no files from the `local:` directory are copied to the new domain. If you need to copy files from the `local:` directory, use the CLI copy command or the WebGUI.

## 3.4.3 Restarting and resetting domains

There is a significant difference between *restarting* and *resetting* a domain. This section explains those differences and when to use each of these actions.

### Restarting

It is possible to restart an application domain, including the default domain, without restarting the entire appliance. The application domain is reconstituted using the currently saved configuration for the domain. In the event that the saved configuration differs from the running configuration, a notice displays that prompts the user to save the configuration before restarting.

There is no effect on the contents of the domain's flash file system. Restarting a domain is an immediate action and does not wait for in-flight transactions to complete. If you need to wait for in-flight transactions to complete, quiesce the domain before restarting (see 3.4.4, "Quiescing" on page 76).

### Resetting

Resetting a domain has the effect of deleting all configuration objects from the running configuration but *not* from the saved configuration. In-flight transactions are abandoned. If in-flight transactions must complete first, quiesce the domain prior to resetting it (see 3.4.4, "Quiescing" on page 76).

Clicking the "Save Config" link after resetting a domain causes the new empty running configuration to be saved to the domain's configuration file and permanently removes all service objects.

To illustrate the effects of saving the configuration, assume that a domain contains several service objects that are saved in the configuration. Consider the following sequence of events:

1. A domain is reset; all running objects are purged from memory.
2. The domain is then restarted (or the appliance is rebooted); the domain is restored back to its original state.

The following sequence of events illustrates what happens if the configuration is saved after resetting the domain:

1. A domain is reset; all running objects are purged from memory.
2. The Save Config link is clicked. The empty running configuration is now saved to the configuration file.
3. The domain is restarted (or the appliance is rebooted). The domain exists but is empty and has no service objects.

**Resetting is not the same as deleting:** Resetting a domain differs from deleting and recreating a domain:

- *Resetting* a domain deletes all configured objects in the domain but retains the configuration of the domain and retains all files in the `local:` directory.
- *Deleting* a domain deletes all configured objects in the domain, deletes all files in the domain, and deletes the configuration of the domain itself.

## 3.4.4 Quiescing

DataPower firmware version 3.8.1 introduces the quiesce function that allows an administrator to bring down a domain (or any service object) in a controlled manner. *Quiescing* causes the domain objects to stop accepting new transactions while continuing to finish processing any existing activities. In production environments, quiescing helps to guarantee that any in-flight transactions will complete before the domain is brought down.

## 3.4.5 Cleaning up orphaned objects

During the process of developing service objects, it is common for configuration objects to become unassociated with a service. For example, a developer might place a decrypt action within a processing rule and then later remove the action from the rule. The decrypt processing action still exists within the configuration but is no longer being referenced. The unused processing action is referred to as an *orphaned object*.

An orphaned object's existence has an extremely minimal effect on the system memory and no effect at all to the overall performance. The object is still accessible and can be used if necessary, but in most cases, it is forgotten and remains orphaned.

You can clean up orphaned objects in various ways:

- When exporting, select only the top-level service objects that are required. Assure that the "Include all objects required by selected objects" option is selected, which causes only referenced objects to be exported. When later imported, the orphaned objects will not exist.
- Using either the WebGUI or the CLI, manually delete orphaned objects.
- Manually edit the domain's configuration file to remove the commands that create the orphaned objects.

## 3.4.6 Isolating the domain network interface

There is no global mechanism within the DataPower appliance to isolate application domains to a specific Ethernet interface; however, there is a brute-force approach that can be applied in accomplishing similar results. For example, assume that there are two application domains called `AppDomA` and `AppDomB`. In addition, the Ethernet interfaces are defined, as shown in Table 3-4 on page 77.

*Table 3-4 Ethernet interface definition*

| Interface | IP Address |
|---|---|
| Ethernet 0 | 9.33.83.100 |
| Ethernet 1 | 9.33.83.101 |

The services within the application domains can be forced to have their inbound and outbound traffic isolated to a specific interface. If `AppDomA` has an XML Firewall (with a static back end) and a Multi-Protocol Gateway and if all traffic must go over Ethernet 0, you associate the inbound traffic on the service by specifying the IP address `9.33.83.100` on both the XML Firewall and the HTTP Front-Side Handler (FSH) for the Multi-Protocol Gateway. Static routes are then defined on Ethernet 0 for the destination addresses of the XML Firewall and the Multi-Protocol Gateway.

In this simple example, the services that are associated to `AppDomA` have all of their inbound traffic restricted to Ethernet 0. After the XML Firewall or Multi-Protocol Gateway opens an outbound connection, it goes out Ethernet 0 following the static route.

Unfortunately, this brute-force approach cannot be applied to FTP poller FSHs, because there is no way to isolate FTP server traffic to come into a Multi-Protocol Gateway on a specific Ethernet interface.

### 3.4.7 Deleting domains

Domain deletion is an asynchronous process. DataPower locks objects that are currently in use until any open transactions complete. This lock guarantees that transactions in flight are processed successfully before any dependent service objects are deleted.

## 3.5 Preferred practices

As with any complex highly-configurable device, there are ways of accomplishing certain tasks that are simply better than others. This section provides a list of tips and recommendations that have, in most circumstances, proven to be “preferred practices.” That said, these tips are not laws and might not be the best in all situations.

Consider the following preferred practices:

- Avoid creating service objects in the default domain. Restrict the default domain to network-related configuration and any other appliance-wide settings. Using the default domain for other purposes makes migrating and upgrading difficult.
- Do not restore the default domain from a separate appliance. See *Backing up, exporting, and importing the configuration of an IBM WebSphere DataPower SOA Appliance* at this website:

  `http://www-01.ibm.com/support/docview.wss?uid=swg21416135`
- Although domain names can be as long as 128 characters, try to keep them as short as possible. In addition to helping facilitate easy viewing when the domain name appears in a list in the WebGUI, external systems that monitor DataPower might have difficulty with long names.
- Secure the `default` domain. Use RBM to define access policies that restrict access from non-administrative personnel.
- Quiesce production domains before performing configuration activities to assure that any in-flight transactions complete.
- Keep development, test, integration, and production domains on separate devices to facilitate easy migration between environments.
- Remove unused ancillary configuration objects.
- Configure high availability for external domain repositories to ensure that a domain's configuration is always available if the appliance is restarted.
- Monitor for remote domain configuration error messages.
- Do not migrate domains to older firmware levels. In the event that this type of migration becomes necessary, perform ample regression testing.

## 3.6 Further reading

For more information, see the following additional resources:

- *IBM WebSphere DataPower Version 3.8.2 Information Center:*

  `http://publib.boulder.ibm.com/infocenter/wsdatap/v3r8m2`
- *Managing IBM WebSphere DataPower Device configurations for high availability, consistency, and control, Part 1*:

  `http://www.ibm.com/developerworks/websphere/library/techarticles/0801_rasmussen/0801_rasmussen.html`
- *Managing IBM WebSphere DataPower Device configurations for high availability, consistency, and control, Part 2: Application promotion strategies:*

http://www.ibm.com/developerworks/websphere/library/techarticles/0904_rasmussen/0904_rasmussen.html

- *Backing up, exporting and importing the configuration of an IBM WebSphere DataPower SOA Appliance*:

  http://www-01.ibm.com/support/docview.wss?uid=swg21416135

# Simple Network Management Protocol monitoring

Understanding a network's composition and complexity and having the ability to be informed of how individual network components are performing at any given time are key success factors in maintaining the performance and integrity of the network. A clear perspective into the overall health of a network is critical to its operational efficiency.

A DataPower appliance relies on a variety of mechanisms to communicate its overall condition. For example, an onboard Simple Network Management Protocol (SNMP) agent monitors vital statistics and provides an interface for SNMP-based monitoring solutions to both query the device, as well as receive alerts when abnormal conditions arise.

This chapter discusses DataPower monitoring and presents strategies and preferred practices for using it:

- Enabling monitoring of DataPower from SNMP tools
- Producing SNMP alerts from within DataPower
- Configuring log targets to produce alerts that are based on system events
- Event subscriptions
- Monitoring preferred practices

## 4.1 Appliance monitoring

Monitoring the health and capacity of DataPower appliances ensures that they are ready to perform the functions for which they are configured. Monitoring not only notifies administrators of exceptions, it also provides trending analysis for managing the appliances and their capacity utilization over time. Monitoring, therefore, enables the organization to maximize its return-on-investment and receive warnings of increases in network volumes and potential capacity issues.

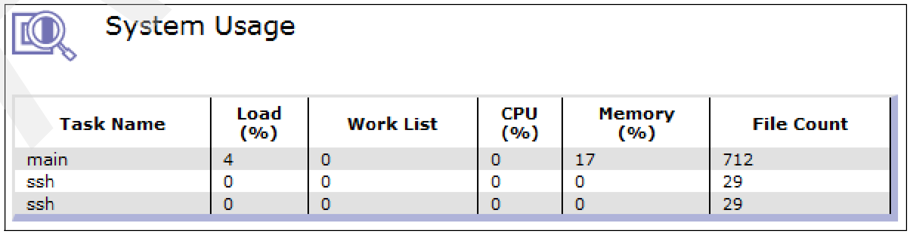
DataPower appliances rely on a wide array of hardware components when processing network traffic. These components generally include RJ-45 Ethernet interfaces, a DB-9 serial port, redundant power supplies and fans, batteries, memory, CPUs, compact flash, hard drives, and hardware security modules. The integrity of each of these components assures that DataPower can handle the traffic that it receives. Knowing the health of individual components is germane to avoiding potential downtime and maintaining maximum throughput.

## 4.2 DataPower monitoring fundamentals

Like most networking components, DataPower monitors its general system health, services, and resource consumption and exposes the various monitored metrics through various interfaces. Physical device parameters include CPU thermal details, memory and file system utilization, interface utilization, and voltage reading. In addition, DataPower also provides various formulaic indicators, such as System Usage, which is a calculation of system capacity based on various factors.

DataPower exposes monitoring metrics in several ways:

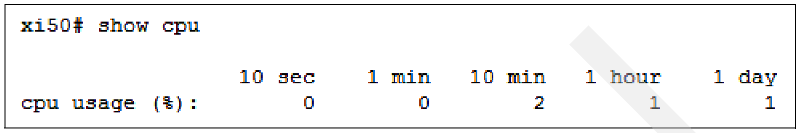
- WebGUI: A browser-based user interface for managing, configuring, and administering DataPower appliances. Status metrics are available under the Status navigation menu. For example, to view system usage, select: **Status** → **System** → **System Usage** (see Figure 4-1).


System Usage

| Task Name | Load (%) | Work List | CPU (%) | Memory (%) | File Count |
|---|---|---|---|---|---|
| main | 4 | 0 | 0 | 17 | 712 |
| ssh | 0 | 0 | 0 | 0 | 29 |
| ssh | 0 | 0 | 0 | 0 | 29 |

*Figure 4-1 System Usage as displayed in WebGUI*

- Command-line interface (CLI): Accessed via Secure Shell (SSH) or the appliance’s serial interface; provides network administrators with a familiar command-line environment for the initial device setup and configuration (see Figure 4-2).



```
xi50# show cpu

                  10 sec    1 min   10 min   1 hour    1 day
cpu usage (%):         0        0        2        1        1
```

*Figure 4-2 Output from CLI show CPU command*

- XML management interface (XMI): A SOAP-based interface for programmatic access to appliance management and administration. We discuss XMI in more detail throughout this chapter and in Chapter 3, “Domains” on page 61.
- Simple Network Management Protocol (SNMP): An onboard SNMP agent provides status information in response to SNMP operations, and it supports the creation of alerts via the SNMP notification mechanism.

Unlike SNMP, which focuses exclusively on device monitoring, the WebGUI, CLI, and XMI can provide access to every aspect of a DataPower appliance, including configuration, administration, and monitoring.

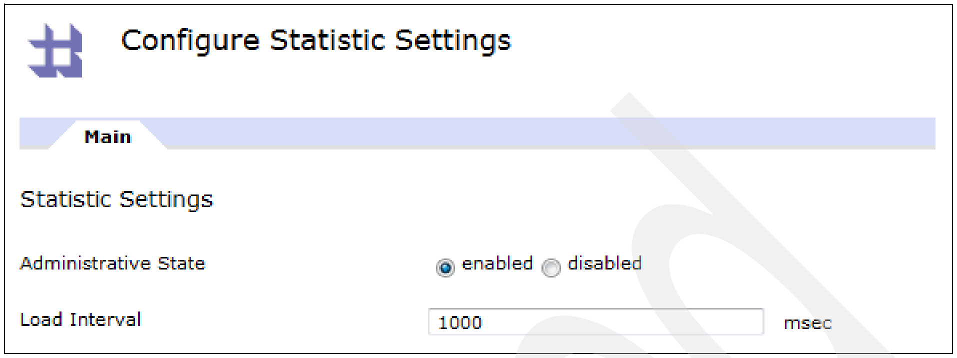
## 4.3 Enabling statistics

Specific status data, such as fan speeds and CPU utilization, is specific to the appliance as a whole, whereas other status data, such as transaction rates, is segmented by application domain and accumulated only if Statistic Settings are enabled. Enabling statistics has an extremely small impact on system utilization. The effect can further be reduced by increasing the load interval (frequency of SNMP polling).

To enable statistics, select **Administration** → **Device** → **Statistic Settings**.

After it is enabled, an SNMP manager can monitor application-related statistics in the specified domain. Figure 4-3 on page 84 shows an example of the Statistic Settings configuration form. Depending on the configuration, specific metrics can be polled to provide data on the health or throughput of the application.

These application-related table entries differ from system-level metrics in that they are dynamic and are based on the key fields of these tables. For example, the dpStatusHTTPTransactions2Table table contains the transaction rates for all services in a domain over various time intervals. Metrics in this table are based upon the service class, such as XMLFirewallService, as well as the service name.



Statistic Settings

Administrative State [✓ enabled] disabled

Load Interval 1000 msec

Figure 4-3 Configure Statistic Settings

## 4.4 SNMP monitoring

Most organizations query the health and capacity of network-attached devices using the SNMP protocol in conjunction with tools, such as those in the IBM Tivoli Monitoring and Tivoli Composite Application Manager product families. These tools use SNMP over User Datagram Protocol (UDP) to query an SNMP agent for device and application metrics, as well as receive notifications of conditions that warrant administrative attention.

SNMP is based on the manager/agent model consisting of an SNMP manager, an SNMP agent, a database of management information, managed SNMP devices, and the network protocol. SNMP agents expose management data in the form of variables on the managed devices. These variables can then be queried by the SNMP manager. SNMP itself does not define which information, or variables, a managed system needs to offer. Rather, the available information is defined within management information bases (MIBs). MIBs are text files that describe the structure of the device's management data using a hierarchical namespace containing object identifiers (OIDs). Each OID identifies a specific metric that can be queried (or sometimes set) via SNMP. Certain metrics are scalar objects describing a single data point, such as the current firmware version. And other metrics can be tabular, such as the CPU status that is provided in Figure 4-1 on page 82 and Figure 4-2 on page 83.

## 4.4.1 SNMP protocol messages

The SNMP protocol includes five major messages for communications between the manager and the agent:

- GET and GET-NEXT: Used by the manager to query the agent for specific variable values. The agent returns the requested value in the GET-RESPONSE message.
- GET-RESPONSE: Used by the agent to respond to various queries.
- SET: Sent by the manager to the agent to modify the value of a variable on the monitored device.
- TRAP: Initiated by the agent to alert the manager of an event or condition on the monitored device.

## 4.4.2 Management information base (MIB) structure

SNMP managers rely on MIBs to define the specific details that are related to the devices that are being managed. Each object (or characteristic) has a unique OID consisting of a series of numbers separated by decimal points. For example, `1.3.6.1.4.1.14685.3.1.52.2` refers to the dpStatusSystemUsageLoad metric. OIDs are hierarchical, with each number representing a separate branch or leaf of the tree. See Figure 4-1 on page 82.

*Example 4-1 OID hierarchy for dpStatusSystemUsageLoad*

```
root
   ccitt (0)
   joint ccitt (3)
   iso (1)
      org (3)
         dod (6)
            internet (1)
               directory (1)
               mgmt (2)
               experimental (3)
               private (4)
                  enterprise (1)
                     datapower (14685)
                        modules (2)
                        management (3)
                           status (1)
                              ...
                              tcp table (39)
                              system usage (52)
            load (2) ¬ 1.3.6.1.4.1.14685.3.1.52.2
            work list (3)
         http transactions (53)
         ...
      config (2)
      notifications (3)
```

When the SNMP manager wants to know the value of an object or characteristic, such as DataPower's current system load, it assembles a GET packet that includes the dpStatusSystemUsageLoad OID. If the agent understands the OID, the agent creates a response packet and returns the value; otherwise, a special error response is returned. Similarly, when an agent wants to send a TRAP to the manager, the agent creates a TRAP packet and includes the OID and value information to advise of the event.

## 4.4.3 SNMP traps

Although querying DataPower for status values is a relatively straightforward endeavor, alerting is done using several DataPower objects. Four built-in notification alerts are available:

- authenticationFailure: Sent when a failed attempt to access the device occurs
- linkDown: Sent when an interface becomes disabled
- coldStart: Sent when the device restarts
- linkUp: Sent when an interface becomes enabled

In addition to these built-in alerts, custom alerts can be generated by subscribing to a list of error conditions or in conjunction with the logging system that is described in Chapter 6, "Logging" on page 163.

**Preferred practice:** Reliance on alerts alone is *not* a sufficient monitoring strategy. The device might become unable to transmit alerts; therefore, it is prudent to rely on both subscription-based alerts, as well as device polling to provide a robust monitoring strategy.

## 4.4.4 DataPower status providers

DataPower appliances rely on multiple status providers to maintain status data. Certain providers handle data that is specific to the device, such as environmental components, fans, temperatures, or battery health, and are always enabled and associated with the default domain. Other status providers are application domain-specific, such as those status providers that measure service transaction rates. These status providers can be further segmented by XML-Manager or DataPower service.

Although the device-level data is automatically enabled, transaction data, such as transaction rates or transaction times, must be explicitly enabled (it is disabled by default). There are exceptions to this generalization, for example, CPU status requires statistic enablement, and System Load status does not. Each domain must have its individual Statistics setting enabled to provide domain-specific status.

## 4.4.5 SNMP security

SNMP, which was originally developed in the late 80s, has undergone several redevelopments with a focus on performance and security improvements. A weak authentication and access control model has been a key factor in the continual evolution of SNMP. This section discusses the various SNMP versions and their security model.

### SNMP security history

SNMP Version 1 (SNMPv1), which is the initial implementation of SNMP, required the authentication of clients by using a simple “community string”. This community string acted effectively as a password that was transmitted between the manager and the agent in cleartext. For read-only communities, the name `public` is often used. So long as the manager provided a community name of `public`, the manager had complete access to monitoring data. The community name of `private` was often used for read-write access. This weak form of security required a watertight management network infrastructure to prevent unauthorized access, especially to the read-write communities.

SNMP Version 2 (SNMPv2) enhanced Version 1 by adding improvements in the areas of performance, security, confidentiality, and manager-to-manager communications. However, the *party-based* security enhancements in Version 2 were viewed by many as overly complex and were not widely accepted.

Community-Based Simple Network Management Protocol Version 2 (SNMPv2c) was based on the enhanced SNMPv2 but without the controversial security model. Rather, it reintroduced the simple community-based security model that was in SNMPv1. Officially only a “Draft Standard”, this security model is widely considered the actual SNMP V2 standard. Like SNMPv1, this version depends on a secure management network infrastructure.

SNMP Version 3 (SNMPv3) added new security and remote configuration functionality, including password authentication, packet signing, and encryption/decryption. The Internet Engineering Task Force (IETF) recognizes

SNMPv3 as the current standard version and has designated it as a full Internet Standard. The IETF considers the earlier versions to be obsolete.

### Community-based security (SNMPv1 and SNMPv2c)

An SNMP *community* is the name of the group to which devices and managers belong. It is not necessarily unique among devices, nor does a device have to belong to a single community. The community name is used to identify the group. An SNMP agent will not respond to requests from managers that do not belong to one of its communities. Communities are further designated as read only or read write. It is important to realize that community names are transmitted in cleartext; therefore, they are considered weak forms of security and offer little in the form of protection. Packets are neither signed nor encrypted.

### Authenticated and private security (SNMPv3)

SNMPv3 security resolves the lack of security in earlier versions by adding support for authenticating the manager, digitally signing transmitted packets, and optionally encrypting the packets transmitted between the agent and the manager.

In SNMPv3, authentication actually represents both authentication of the manager accessing the agent as well as the creation of a *digest* (digital signature) for each packet that is transmitted between the manager and the agent. Handshaking during the initial contact between the manager and the agent includes authenticating the user and then exchanging a secret authentication key. This secret authentication key is then used during subsequent message digest creation and packet encryption/decryption.

A message digest is created for each packet using a combination of the Keyed Hashing for Message Authentication (HMAC) algorithm, and either the Message Digest 5 (MD5) or the Secure Hash Algorithm 1 (SHA-1). When either the manager or agent receives a message, the manager or agent calculates a message digest and compares it with the received message digest. If the message digest does not match, the packet is not authenticated and it is dropped. If privacy is configured, packets are encrypted using the Cipher Block Chaining mode to the Data Encryption Standard (CBC-DES) algorithm.

#### *SNMPv3 security models*

SNMPv3 offers three security models:

- No Authentication, No Privacy: Essentially unsecured.
- Authentication, No Privacy: The user is authenticated and a secret key is used to generate a message digest (signature) for each SNMP packet. Packets are not encrypted.

- Authentication, Privacy: The user is authenticated and a secret key is used to generate a message digest (signature) for each SNMP packet. The packets are then encrypted.

## 4.4.6 Configuring SNMP using the WebGUI

SNMP settings must first be configured within the default domain. Using the left navigation menu, select these SNMP settings: **Administration** → **Access** → **SNMP Settings**.

### *Main tab configuration*

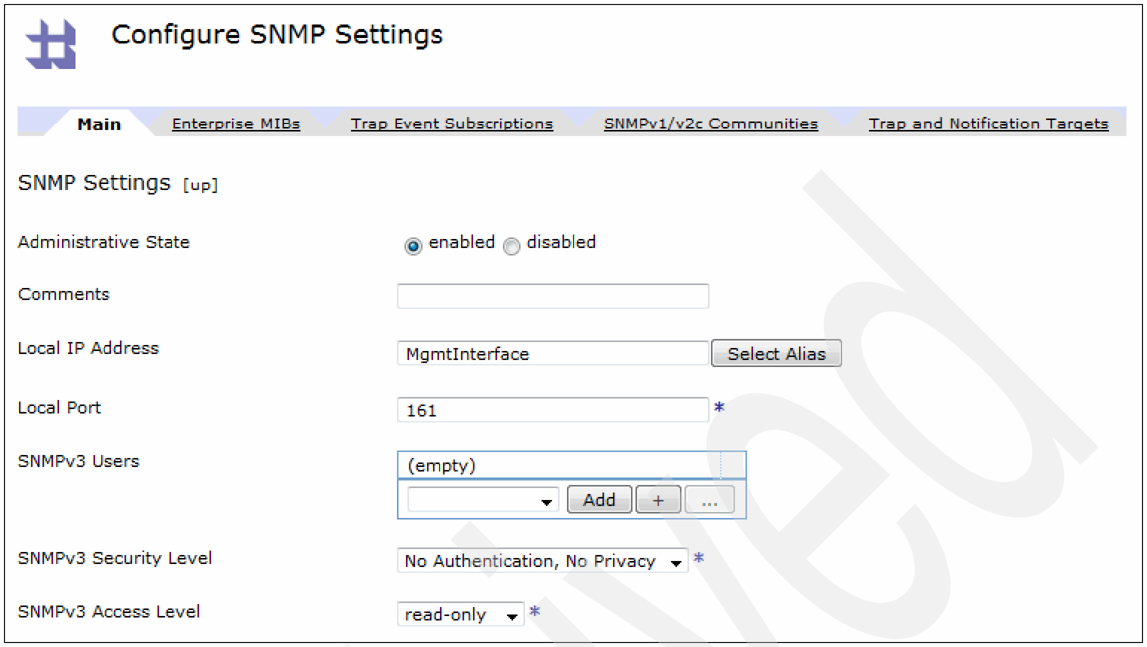
Use the guidelines in Table 4-1 to complete the Main tab, as shown in Figure 4-4 on page 90. This example assumes that polling will occur on MgmtInterface (host alias to mgt0) on port 161, and outbound responses and alerts will be sent out using any appliance interface that has the appropriate routing.

If it is necessary to restrict outbound traffic to the same management interface, a static route can be added to the management interface's (mgt0) configuration.

*Table 4-1 DataPower versus SNMP manager matching options*

| DataPower option | SNMP manager option |
|---|---|
| Administrative State | N/A |
| Local IP Address: The IP address on which DataPower will expect incoming SNMP connections. Typically, the local IP address is set to a host alias that maps to the management interface IP (mgt0). This option restricts SNMP polling requests to this IP address only, and prevents any SNMP requests from being received over client traffic interfaces (eth0, eth1, or eth2). | In the manager, this address is referred to as *Remote IP Address* or *Agent IP Address*. |
| Local Port: Used for inbound SNMP polling requests. | This value must match the agent's port when setting up the manager. |
| SNMPv3 Fields: These fields are discussed later in "Configuring for SNMPv3 security" on page 90. | N/A |

**Preferred practice:** Define a host alias (in the default domain) and use it instead of an actual IP address.



Configure SNMP Settings

SNMP Settings [up]

| | |
|---|---|
| Administrative State | [✓ enabled] disabled |
| Comments | |
| Local IP Address | MgmtInterface |
| Local Port | 161 * |
| SNMPv3 Users | (empty) |
| SNMPv3 Security Level | No Authentication, No Privacy * |
| SNMPv3 Access Level | read-only * |

*Figure 4-4 Enabling SNMP and providing an IP address*

### *Configuring for SNMPv3 security*

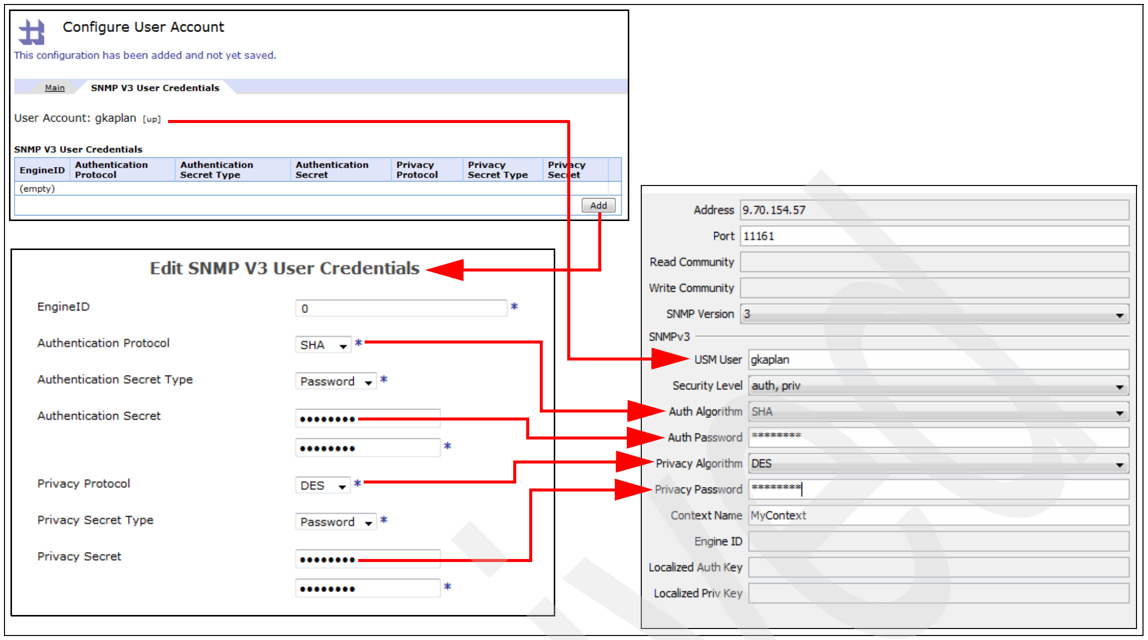
When configuring for SNMPv3 security, a pre-existing DataPower user will need to be identified and configured for the purposes of SNMPv3 authentication and subsequent cryptographic activity. Follow these steps:

1. In the SNMPv3 Users drop-down list, select an existing DataPower user (or create a new user by clicking +). The DataPower user does not need any special permissions.
2. Toward the top of the Configure User Account form, select the **SNMP V3 User Credentials** tab.
3. On the SNMP V3 User Credentials tab, click **Add** to add a new credential for the selected DataPower user:
   a. Refer to Table 4-2 on page 91 for a description of the various configuration options and how they need to match in the SNMP manager. Figure 4-5 on page 92 shows a graphical representation of the parameter relationships.
   b. Save the SNMPv3 user credential information and apply the user settings.
4. With the user selected in the drop-down list, click **Add** to add this user to the list of SNMPv3 users.

5. In the SNMPv3 Security Level field, select the minimum security level that is required for incoming SNMPv3 Get/Set requests.
6. In the SNMPv3 Access Level field, select **read-only**.
7. Click **Apply** to activate the SNMP configuration settings.

*Table 4-2 SNMPv3 User Credential configuration*

| Option | Description |
|---|---|
| EngineID: Leave this field “0” and let DataPower provide it. | This unique value is used at various times through the SNMPv3 authentication and encryption process.<br><br>The manager generally fetches this value during initial contact with the agent. |
| Authentication Protocol<br>None, MD5, or SHA | Select which algorithm to use for authentication and digest creation. This value must match the algorithm selected in the SNMP manager’s authentication settings. Selecting none will disable authentication. |
| Authentication Secret Type<br>Password or Key | For password, the authentication secret (next parameter) is a text password that will be converted to an intermediate key with a standardized algorithm, and then localized against the engine ID value. After saving, this value will change to “key”.<br><br>For key, the authentication secret is a fully localized key. Specifying a fully localized key is useful when the key was initially created on another system. |
| Authentication Secret | If authentication type is password, provide a text password (at least eight characters). If authentication type is MD5, provide a 16-byte hexadecimal key. For SHA, provide a 20-byte hexadecimal key.<br><br>This value must match the provided secret in the SNMP manager. |
| Privacy Protocol<br>None, DES, or AES | Select which algorithm to use for encryption/decryption. This value must match the algorithm selected in the SNMP manager’s privacy settings. Selecting “none” will disable privacy. |
| Privacy Secret Type | Same as Authentication Secret Type. |
| Privacy Secret | Similar to Authentication secret, except using DES or AES. This secret must match at the SNMP manager. |


Configure User Account

This configuration has been added and not yet saved.

User Account: gkaplan [up]

SNMP V3 User Credentials

| EngineID | Authentication Protocol | Authentication Secret Type | Authentication Secret | Privacy Protocol | Privacy Secret Type | Privacy Secret |
|---|---|---|---|---|---|---|
| (empty) | | | | | | |

Edit SNMP V3 User Credentials

| | |
|---|---|
| EngineID | 0 * |
| Authentication Protocol | SHA * |
| Authentication Secret Type | Password * |
| Authentication Secret | •••••••• / •••••••• * |
| Privacy Protocol | DES * |
| Privacy Secret Type | Password * |
| Privacy Secret | •••••••• / •••••••• * |

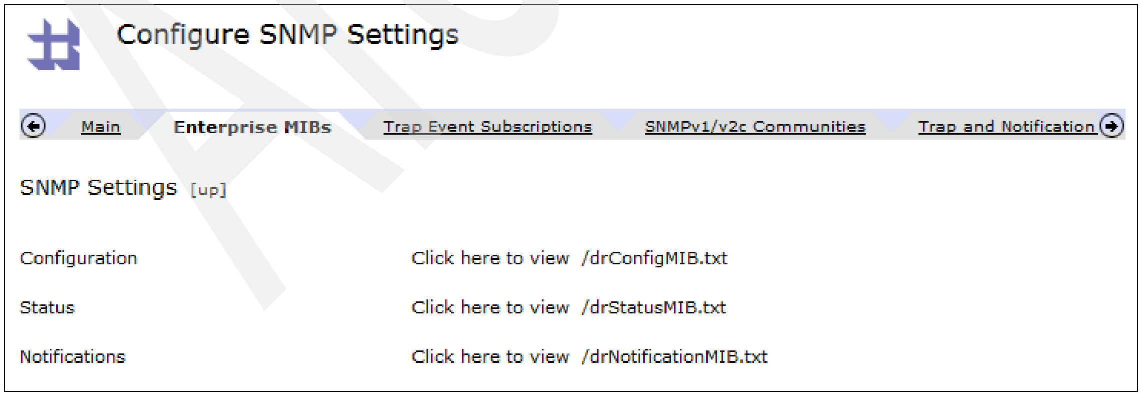
| | |
|---|---|
| Address | 9.70.154.57 |
| Port | 11161 |
| Read Community | |
| Write Community | |
| SNMP Version | 3 |
| SNMPv3 | |
| USM User | gkaplan |
| Security Level | auth, priv |
| Auth Algorithm | SHA |
| Auth Password | ******** |
| Privacy Algorithm | DES |
| Privacy Password | ******** |
| Context Name | MyContext |
| Engine ID | |
| Localized Auth Key | |
| Localized Priv Key | |

*Figure 4-5 SNMPv3 parameter relationships for DataPower and SNMP manager*

## DataPower Enterprise MIBs

DataPower MIBs define all of the status values that can be queried by an SNMP manager. On the SNMP settings page, select the **Enterprise MIBs** tab.

The Enterprise MIBs tab, which is shown in Figure 4-6, lists three DataPower MIBs that can be downloaded and imported into any SNMP manager. There is a MIB for configuration, a MIB for status, and a MIB for notifications.


Configure SNMP Settings

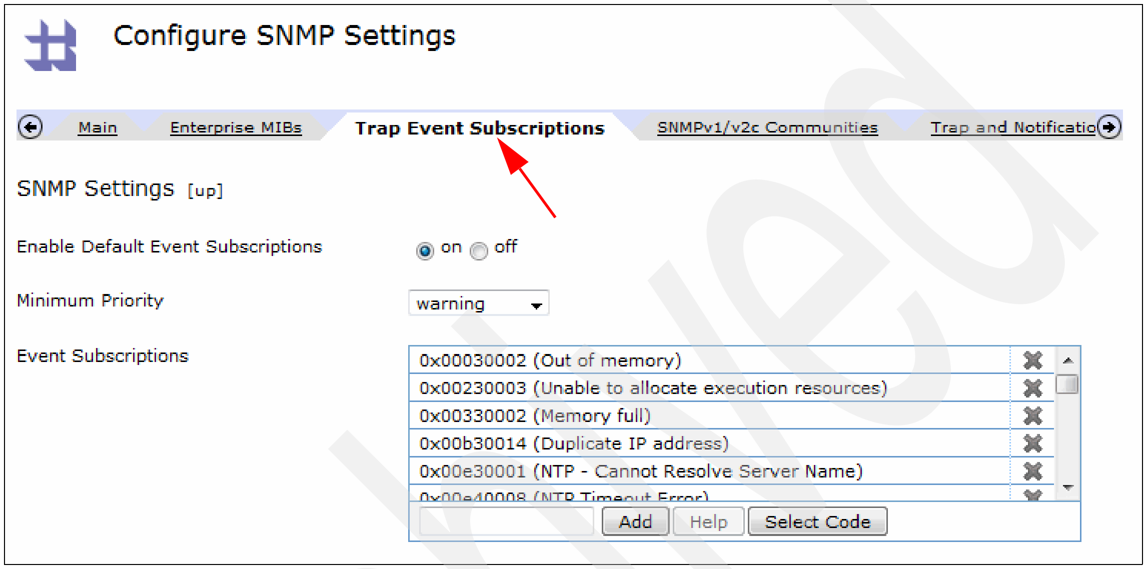
SNMP Settings [up]

| | |
|---|---|
| Configuration | Click here to view /drConfigMIB.txt |
| Status | Click here to view /drStatusMIB.txt |
| Notifications | Click here to view /drNotificationMIB.txt |

*Figure 4-6 Accessing DataPower's Enterprise MIBs*

## Trap subscriptions

The Trap Event Subscriptions tab enables the selection of which DataPower event codes will be sent to the management console as alerts. Figure 4-7 shows the Trap Event Subscription tab. Additional event codes can be added as needed by clicking **Select Code**. If a specific code is not shown in the list, it can be added manually.



Enable Default Event Subscriptions [✓ on] off

Minimum Priority warning

Event Subscriptions
0x00030002 (Out of memory)
0x00230003 (Unable to allocate execution resources)
0x00330002 (Memory full)
0x00b30014 (Duplicate IP address)
0x00e30001 (NTP - Cannot Resolve Server Name)
0x00e40008 (NTP Timeout Error)

*Figure 4-7 Trap Event Subscriptions tab*

Figure 4-8 lists the pre-configured event code subscriptions.

```
0x00030002 (Out of memory)
0x00230003 (Unable to allocate execution resources)
0x00330002 (Memory full)
0x00b30014 (Duplicate IP address)
0x00e30001 (NTP - Cannot Resolve Server Name)
0x00f30008 (File is expired)
0x01530001 (Time zone config mismatch.)
0x01a2000e (Installed battery is nearing end of life.)
0x01a40001 (Throttling connections due to low memory)
0x01a40005 (Throttling connections due to low temporary file space)
0x01a40008 (Throttling connections due to low number of free ports)
0x01b10006 (Microcode load failed)
0x01b10009 (uncertified HSM firmware detected)
0x01b20002 (HSM is uninitialized)
0x01b20004 (HSM PED login failed)
0x01b20008 (HSM password login failed)
0x02220001 (Power supply failure.)
0x02220003 (Internal cooling fan has stopped.)
0x02240002 (Internal cooling fan has slowed)
```

*Figure 4-8 Pre-loaded event code subscriptions*

You can obtain a complete list of reference codes in the *IBM WebSphere DataPower SOA Appliances Message Reference*.

### SNMP communities

SNMP communities are used by SNMPv1 and SNMPv2c to establish trust between managers and agents. Community names are essentially used as credentials to access SNMP data on the appliance. There are three types of communities:

- Read-only: Allows only reading of data values. A commonly used name for read-only access is `public`.
- Read-write: Allows reading and modifying data values.
- Trap: Allows the receipt of asynchronous notifications (traps) from the agent.

**Preferred practice:** Because community strings are essentially passwords that allow access to the SNMP agent, community strings need to adhere to the same creation rules (mixed case, must contain a number, and so on) as passwords.

**Preferred practice:** Unless it is necessary for the SNMP manager to set values from MIB-II and other IETF MIBs, it is recommended that all communities that are defined on DataPower are read only. There are no read-write values that are defined within the DataPower MIBs.

Community strings are sent from monitoring software to the agent in cleartext. For this reason, it is important to ensure that firewalls are properly configured to protect the SNMP infrastructure. SNMPv3 addresses this problem by establishing secure authentication and communication between SNMP devices.

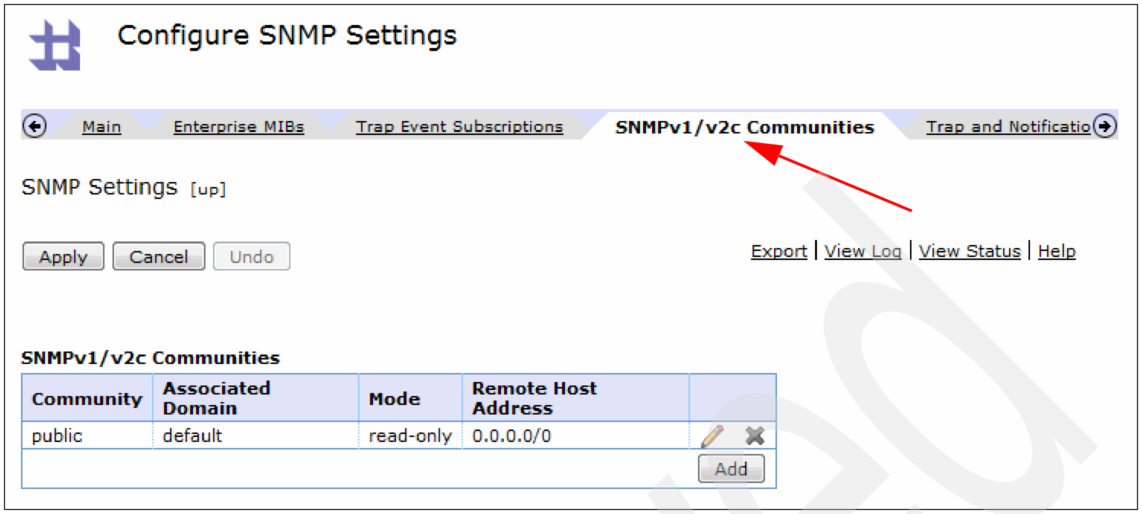
### *SNMP communities and DataPower domains*

SNMP communities on DataPower are associated with an application domain. This association allows for a specific community to have access to domain-specific (or application-specific) metrics, such as transaction rates, queue manager status, and so on. If application-specific data is not required, the community needs to be associated with the default domain. Specifying an application domain (other than default) does not prevent the management software from polling device-level metrics, such as the device load, CPU utilization, and so on.

**Preferred practice:** If application-specific or domain-specific data is not required, associate the community with the default domain.

### *Associating communities to specific managers*

A community can be further restricted to allow requests from a range of IP addresses, thus further securing access to SNMP data. By default, the IP address is set to 0.0.0.0/0, which allows any SNMP manager to access the community. Figure 4-9 on page 96 shows a single read-only community named `public` that is associated with domain `SA_W004_R01_Kaplan` and not restricted to any specific IP addresses.



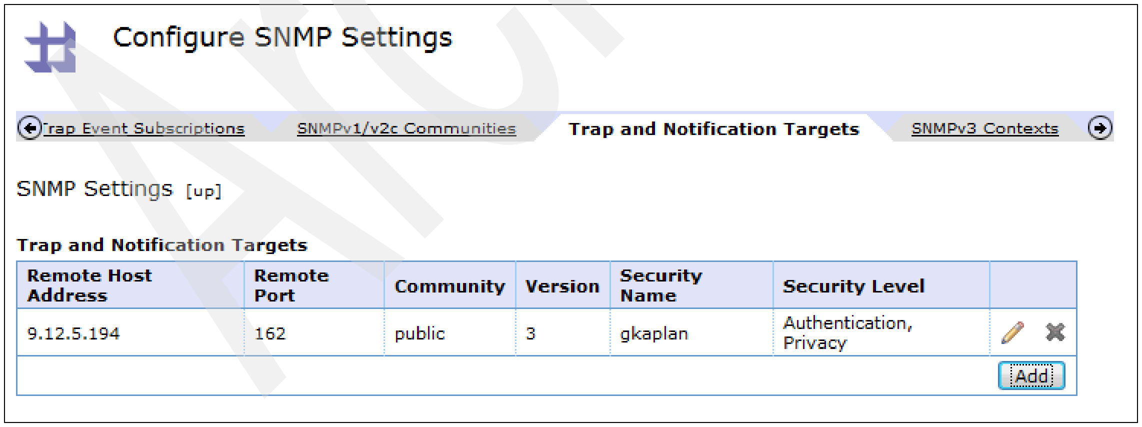
SNMPv1/v2c Communities

| Community | Associated Domain | Mode | Remote Host Address |
|---|---|---|---|
| public | default | read-only | 0.0.0.0/0 |

Figure 4-9 SNMPv1/v2c Communities tab

## SNMP trap and notification targets

SNMP managers that need to receive event (trap) notifications can be specified on the Trap and Notification Targets tab. The manager is identified by an IP and port combination, along with the community. Targets can be configured for either SNMPv1, SNMPv2c, or SNMPv3. If SNMPv3 is selected, you might need to specify additional security-related parameters, depending on which security model is selected. Figure 4-10 shows SNMP configured for SNMPv3 traps with authentication and privacy enabled.



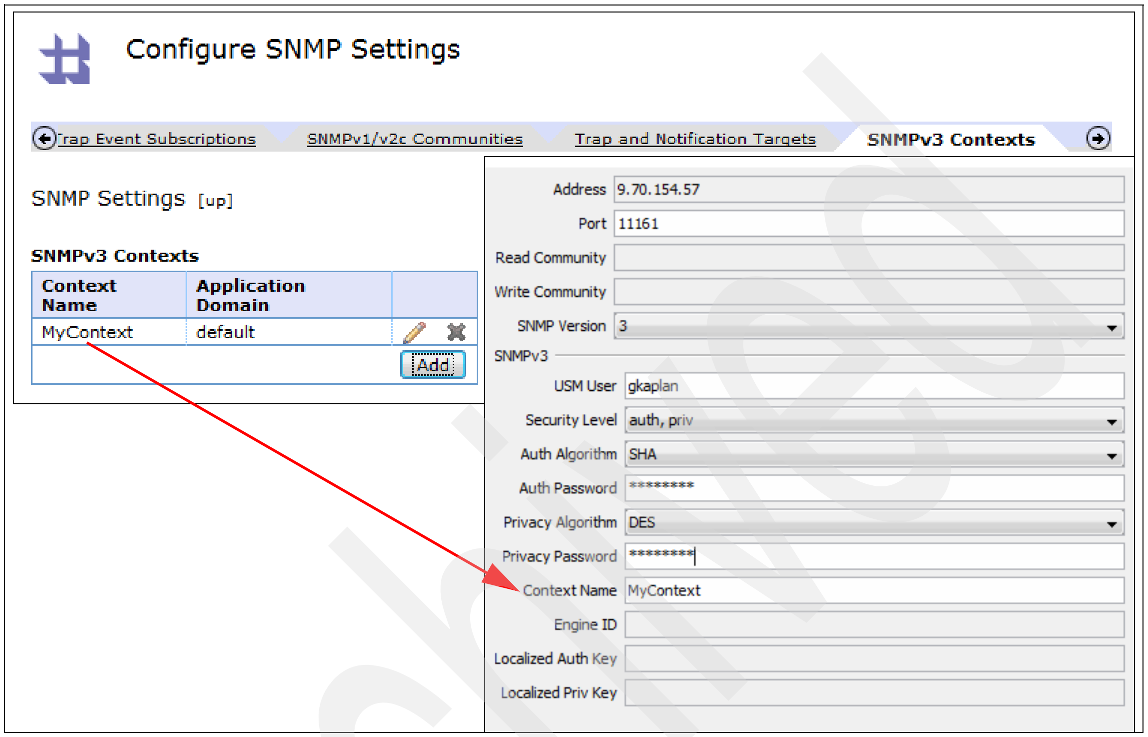
Trap and Notification Targets

| Remote Host Address | Remote Port | Community | Version | Security Name | Security Level |
|---|---|---|---|---|---|
| 9.12.5.194 | 162 | public | 3 | gkaplan | Authentication, Privacy |

Figure 4-10 DataPower configured for SNMPv3 trap notification

## SNMPv3 contexts

Setting up the SNMPv3 context allows SNMP managers to gain access to non-default application domains. See Figure 4-11.



SNMPv3 Contexts

| Context Name | Application Domain |
|---|---|
| MyContext | default |

| | |
|---|---|
| Address | 9.70.154.57 |
| Port | 11161 |
| Read Community | |
| Write Community | |
| SNMP Version | 3 |
| SNMPv3 | |
| USM User | gkaplan |
| Security Level | auth, priv |
| Auth Algorithm | SHA |
| Auth Password | ********* |
| Privacy Algorithm | DES |
| Privacy Password | ********* |
| Context Name | MyContext |
| Engine ID | |
| Localized Auth Key | |
| Localized Priv Key | |

*Figure 4-11 SNMPv3 context configuration*

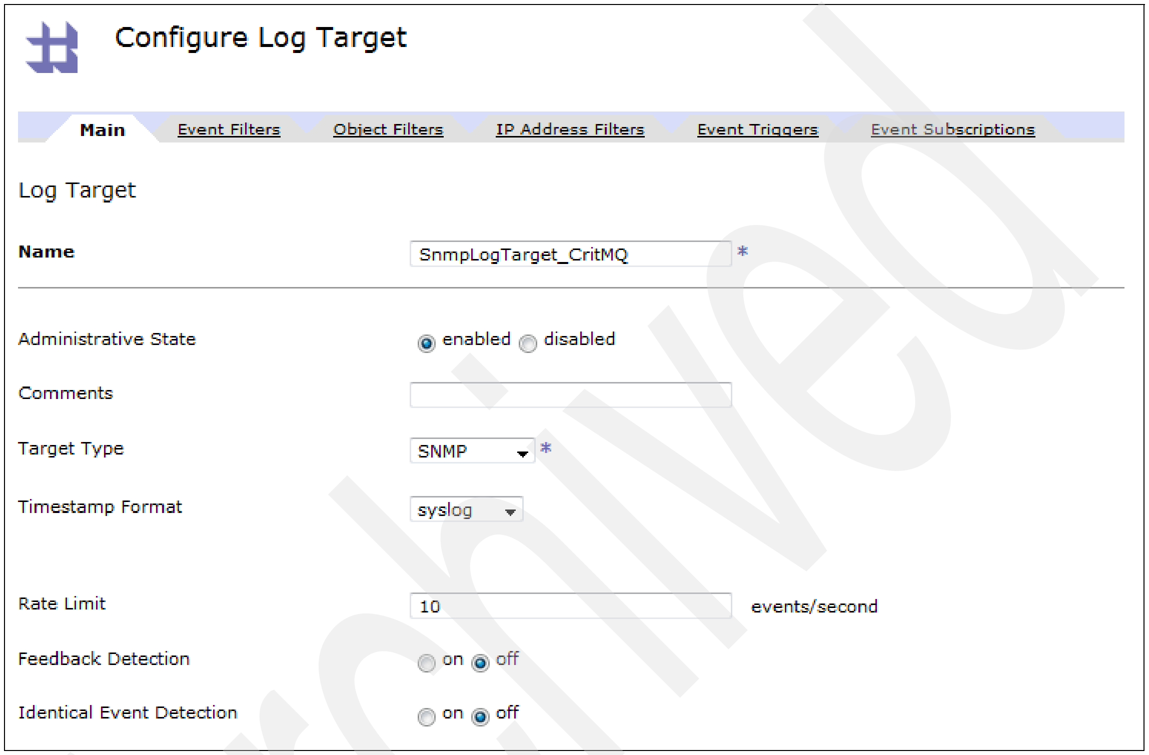
## 4.4.7 Generating traps with SNMP log targets

In addition to the event subscriptions that can be specified in the SNMP settings, DataPower log targets can be configured to produce SNMP events from general runtime log messages. For example, an SNMP log target can be created that lists only log messages with a log category of MQ. Whenever an MQ message is received by the log target, the log target converts the log entry into an SNMP trap and forwards it to the subscribed manager.

Creating an SNMP log target is straightforward. Within the desired domain, select Log Target from the left navigation menu by selecting **Objects** → **Logging Configuration** → **Log Target**.

Follow these steps to create a log target that subscribes to critical MQ events:

1. On the Main tab, specify a meaningful name for the log target (see Figure 4-12).
2. For the Target Type, select **SNMP**.

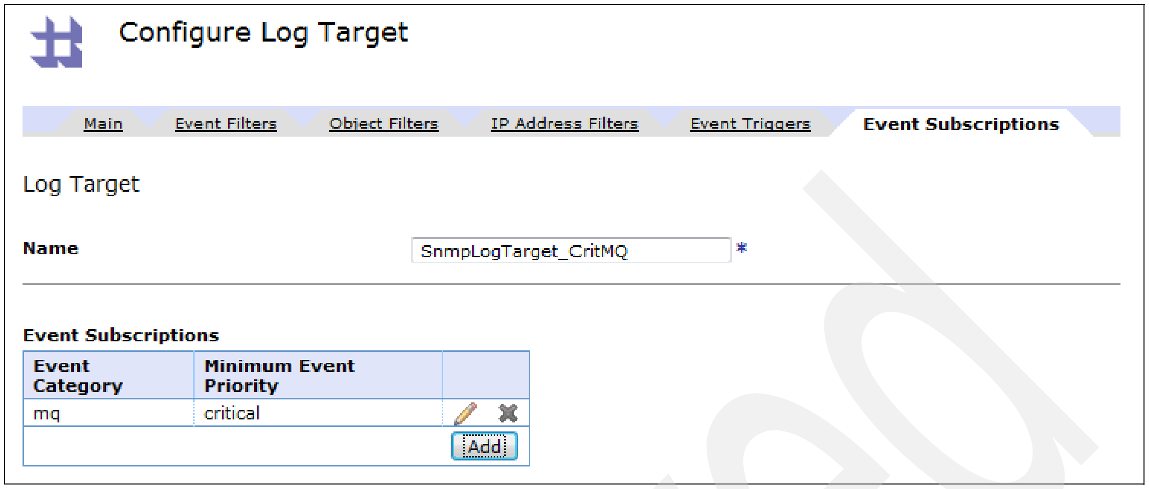

Configure Log Target

Log Target

| | |
|---|---|
| **Name** | SnmpLogTarget_CritMQ * |
| Administrative State | [✓ enabled] disabled |
| Comments | |
| Target Type | SNMP * |
| Timestamp Format | syslog |
| Rate Limit | 10 events/second |
| Feedback Detection | on [✓ off] |
| Identical Event Detection | on [✓ off] |

*Figure 4-12 SNMP log target configuration*

3. Select the **Event Subscriptions** tab, and then click **Add** to add a new event subscription.
4. For the Event Category value, select **mq**.
5. For the Minimum Event Priority field, select **critical**.
6. Click **Apply** to save the subscription (See Figure 4-13 on page 99).
7. Click **Apply** to save the log target.



Log Target

**Name** SnmpLogTarget_CritMQ *

**Event Subscriptions**

| Event Category | Minimum Event Priority |
|---|---|
| mq | critical |

*Figure 4-13 Critical MQ event subscription for SNMP log target*

Whenever a critical MQ message is logged within the domain, the log message will be used as the basis for an SNMP trap. Any managers subscribing for traps will receive the notification.

## 4.5 Monitoring via the XML management interface

While SNMP provides a standards-based approach to monitoring, and the WebGUI and CLI are convenient tools to fetch status information interactively, the XML management interface (XMI) can be used to programmatically monitor and configure DataPower. For example, an application can request status information from DataPower by issuing a **`dp:get-status`** SOAP request to the XMI, and it can perform an operation or configuration modification based on the value in the SOAP response.

The XMI exposes several endpoints, which are accessible via URI. One endpoint is the SOAP Management Interface (SOMA), a service that provides a set of operations for both monitoring and configuring DataPower appliances. You can obtain the Web Services Description Language (WSDL) and XML Schema Definitions (XSDs) for SOMA in DataPower's `store:` directory.

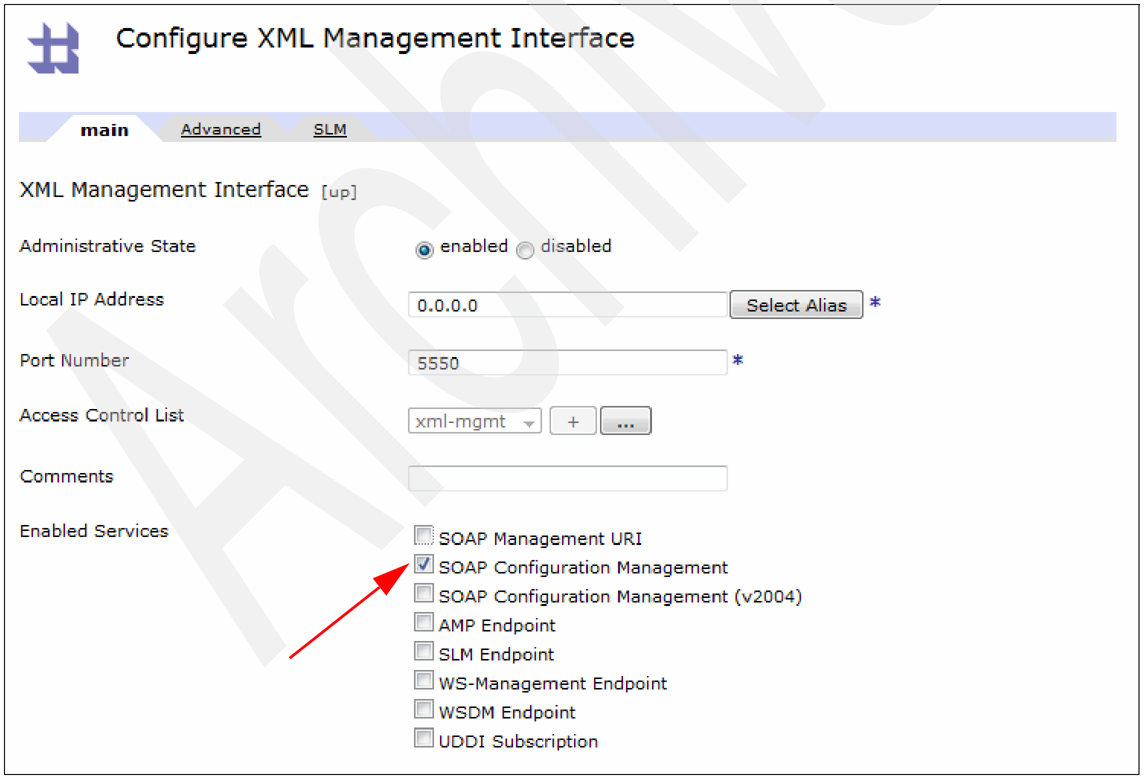
*Table 4-3 SOMA-related WSDL and XSDs found in the store: directory*

| File name | Description |
|---|---|
| store:///xml-mgmt.wsdl | SOMA WSDL |
| store:///xml-mgmt-ops.xsd | Schema describing various operations and types |
| store:///xml-mgmt.xsd | Schema describing elements and options |

### Enabling the XML management interface

In order to issue requests against the XML management interface, you must enable and configure it for the appropriate request types. You can obtain the XMI configuration options in the left navigation menu. Select **Network** → **Management** → **XML Management Interface**.

After you select the XML management interface, you can enable the XMI and customize the network-related settings as necessary (see Figure 4-14). Table 4-4 on page 101 explains the various configuration options that are available.



XML Management Interface [up]

| | |
|---|---|
| Administrative State | [✓ enabled] disabled |
| Local IP Address | 0.0.0.0 * |
| Port Number | 5550 * |
| Access Control List | xml-mgmt |
| Comments | |
| Enabled Services | SOAP Management URI |
| | [✓ SOAP Configuration Management] |
| | SOAP Configuration Management (v2004) |
| | AMP Endpoint |
| | SLM Endpoint |
| | WS-Management Endpoint |
| | WSDM Endpoint |
| | UDDI Subscription |

*Figure 4-14 Enabling SOAP Configuration Management*

**Preferred practice:** Use a host alias when specifying the IP address for the XML management interface, especially in production environments. Leaving the IP address as 0.0.0.0 allows requests to be received on any IP address that is defined on the appliance. Generally speaking, the management interface is used for XMI traffic (mgt0 or eth4).

*Table 4-4 XML management interface settings*

| Option | Value |
|---|---|
| Administrative State | Enabled |
| Local IP Address | Specifies the IP address that exposes the XMI. It is a preferred practice to specify a previously defined host alias, which maps to the management interface. Specifying 0.0.0.0 allows access to the XMI from any active Ethernet interface and is especially not recommended in production environments.<br><br>Use **Network** → **Interface** → **Host Alias** to assign a host alias to the management interface. |
| Access Control List | Allows access to the XMI from only specified IP addresses. Usage depends on organizational security requirements. |
| Enabled Services | Check boxes enable the various services that can be accessed through the XMI. Clicking the **Enabled Services** link displays a help window explaining the various options. This chapter focuses on using the SOAP Management Interface (SOMA) service; therefore, **SOAP Configuration Management** needs to be checked. |

## 4.5.1 Requesting device status and metrics

The SOAP Configuration Management service exposes the **`get-status`** operation for the purpose of obtaining device status and metrics. Example 4-2 on page 102 shows a SOAP request to obtain the device's current CPU usage, and Example 4-3 on page 102 shows the response that is generated by the DataPower appliance.

*Example 4-2 SOMA request for obtaining device status*

```
<soapenv:Envelope
   xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
   xmlns:man="http://www.datapower.com/schemas/management">
   <soapenv:Header/>
   <soapenv:Body>
      <man:request domain="default">
         <man:get-status class="CPUUsage"/>
      </man:request>
   </soapenv:Body>
</soapenv:Envelope>
```

*Example 4-3 SOMA response to request in Example 4-2*

```
<env:Envelope xmlns:env="http://schemas.xmlsoap.org/soap/envelope/">
   <env:Body>
      <dp:response xmlns:dp="http:..[omitted]..schemas/management">
         <dp:timestamp>2010-07-13T13:31:20-04:00</dp:timestamp>
         <dp:status>
            <CPUUsage xmlns:env="http://www..[omitted]..envelope">
               <tenSeconds>0</tenSeconds>
               <oneMinute>9</oneMinute>
               <tenMinutes>1</tenMinutes>
               <oneHour>0</oneHour>
               <oneDay>1</oneDay>
            </CPUUsage>
         </dp:status>
      </dp:response>
   </env:Body>
</env:Envelope>
```

## Posting SOAP requests to the XMI

SOMA requests are posted to the XMI using HTTPS and are secured using HTTP Basic Authentication. The following URI is used for SOMA. You can obtain this URI in the `xml-mgmt.wsdl` file:

```
https://datapower:port/service/mgmt/current
```

For a complete list of class attributes that can be used in the SOMA **`get-status`** request, see the `store:/xml-mgmt.xsd` schema and search for the text “`StatusEnum`”.

## 4.6 Appliance monitoring values

Whether through the WebGUI, SNMP, or the XML management interface, you must vigilantly monitor the overall condition of DataPower and its configured services to mitigate potential loss of service due to hardware or environmental failures. DataPower's unique ability to perform complex message processing leads to three generalized types of monitoring:

- General health can be ascertained by monitoring environmental status information, such as temperatures, fan speeds, and power supply health.
- System load can be gauged by monitoring various system metrics, such as system usage, CPU utilization, memory, and file system utilization.
- Processing throughput can be determined by analyzing network interface consumption and transaction statistics.

DataPower appliances expose a wealth of information that can be used to support monitoring these topics and assess the overall health of DataPower and its configuration. The remainder of this section describes several of the key status values that need to be monitored. For each monitored value described, we present a table that shows the four primary ways of obtaining the status values. The table shows the following information:

- The access path using the left navigation menu in DataPower's WebGUI
- The CLI command to enter into a command window (SSH or serial interface)
- The XMI status class, describing which values to use for the **`class`** attribute in a SOMA request
- The name of the MIB variable in the Status MIB document, which contains the associated value

**Examples:** The XML examples showing the SOMA responses have been slightly simplified for the purpose of brevity. Specifically, the SOAP Body and Envelope elements have been removed, large repeating elements have been removed (and noted), and several namespaces have been shortened. The XML examples are provided for reference so that you can see exactly what data is returned on the request.

Requests are not shown but a fully functional SOMA request can be seen in Example 4-2 on page 102. Replacing the `CPUUsage` class with the class specified in this section will yield the desired status values.

## 4.6.1 General device health and activity monitors

General health and activity monitors ensure that a DataPower appliance is operating within predefined system parameters. The monitoring values in this section are all related to general device health.

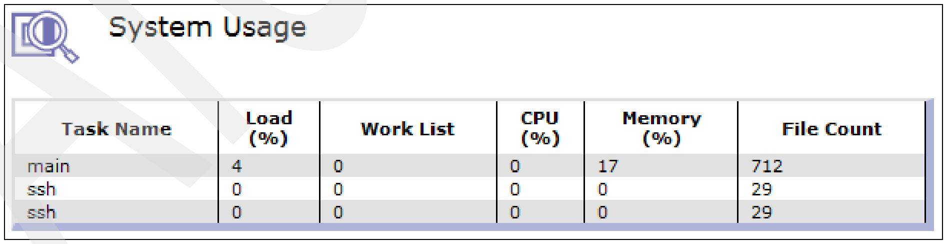
### System usage

*System Usage* is a measurement of the device's ability to accept additional work. It is a formulaic calculation that is based on various components of system load, including CPU, memory, and file system utilization. System usage is typically considered the best single indicator of overall system capacity. Although it might sometimes spike to 100%, typical values are less than 75%. The secondary work list value is a calculation of internally queued tasks, and it is of lesser interest in typical monitoring situations.

Table 4-5 shows the various ways for obtaining the system usage metrics. Figure 4-15 shows system usage, as displayed in the WebGUI. And Example 4-4 and Example 4-5 on page 105 show the SOAP response from the XMI request for SystemUsageTable and SystemUsage.

*Table 4-5 Obtaining system usage metrics*

| Access method | Menu location, command, or variable |
|---|---|
| WebGUI | **Status → System → System Usage** |
| CLI | show load |
| XMI Status Class | SystemUsage; SystemUsageTable |
| Status MIB | dpStatusSystemUsageLoad |


System Usage

| Task Name | Load (%) | Work List | CPU (%) | Memory (%) | File Count |
|---|---|---|---|---|---|
| main | 4 | 0 | 0 | 17 | 712 |
| ssh | 0 | 0 | 0 | 0 | 29 |
| ssh | 0 | 0 | 0 | 0 | 29 |

*Figure 4-15 System usage as depicted by the WebGUI*

*Example 4-4 Response from XMI get-status, class: SystemUsageTable*

```
<dp:response xmlns:dp="http://www.datapower.com/schemas/management">
   <dp:timestamp>2010-07-19T14:03:40-04:00</dp:timestamp>
   <dp:status>
      <SystemUsageTable xmlns:env="http://www.w3..[omitted]...velope">
         <TaskName>main</TaskName>
         <Load>13</Load>
         <WorkList>0</WorkList>
         <CPU>0</CPU>
         <Memory>22</Memory>
         <FileCount>109</FileCount>
      </SystemUsageTable>
      <SystemUsageTable xmlns:env="http://www.w3..[omitted]...velope">
         <TaskName>ssh</TaskName>
         <Load>0</Load>
         <WorkList>0</WorkList>
         <CPU>0</CPU>
         <Memory>0</Memory>
         <FileCount>29</FileCount>
      </SystemUsageTable>
   </dp:status>
</dp:response>
```

*Example 4-5 Response from XMI get-status, class: SystemUsage*

```
<dp:response xmlns:dp="http://www.datapower.com/schemas/management">
   <dp:timestamp>2010-07-19T13:49:44-04:00</dp:timestamp>
   <dp:status>
      <SystemUsage xmlns:env="http://www.w3.org/2003/05/soap-envelope">
         <Interval>1000</Interval>
         <Load>20</Load>
         <WorkList>0</WorkList>
      </SystemUsage>
   </dp:status>
</dp:response>
```

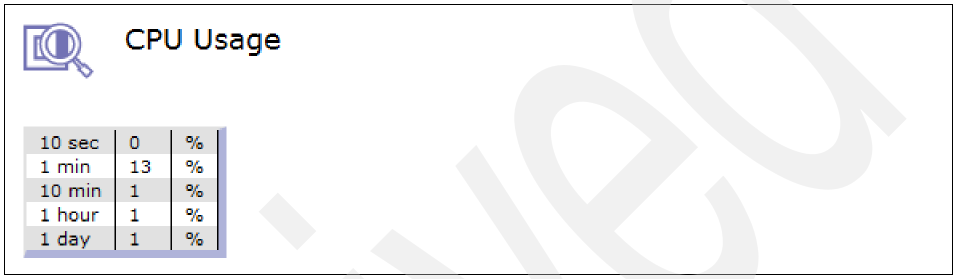
## CPU usage

CPU Usage statistics are provided over five time intervals. CPU utilization is not as reliable as the system usage metrics in determining device capacity. DataPower is self-optimizing, and spikes in CPU that are not associated with traffic levels might occur as the device performs background activities. Spikes as high as 100% are not unusual. Do not be concerned unless a 100% spike is sustained over numerous consecutive polls.

Table 4-6 on page 106 shows the various ways for obtaining CPU usage metrics. Figure 4-16 on page 106 shows CPU usage, as displayed in the WebGUI. And, Example 4-6 shows the SOAP response from the XMI request for CPUUsage.

*Table 4-6 Obtaining CPU usage*

| Access method | Menu location, command, or variable |
|---|---|
| WebGUI | **Status → System → CPU Usage** |
| CLI | show cpu |
| XMI Status Class | CPUUsage |
| Status MIB | dpStatusCPUUsage |



| | | |
|---|---|---|
| 10 sec | 0 | % |
| 1 min | 13 | % |
| 10 min | 1 | % |
| 1 hour | 1 | % |
| 1 day | 1 | % |

*Figure 4-16 CPU usage as depicted by the WebGUI*

*Example 4-6 Response from XMI get-status, class: CPUUsage*

```
<dp:response xmlns:dp="http://www.datapower.com/schemas/management">
   <dp:timestamp>2010-07-19T15:18:38-04:00</dp:timestamp>
   <dp:status>
      <CPUUsage xmlns:env="http://www.w3.org/2003/05/soap-envelope">
         <tenSeconds>1</tenSeconds>
         <oneMinute>0</oneMinute>
         <tenMinutes>0</tenMinutes>
         <oneHour>0</oneHour>
         <oneDay>1</oneDay>
      </CPUUsage>
   </dp:status>
</dp:response>
```

## Memory usage

Memory Usage statistics are provided for various classifications of the appliance's flash memory. Statistics include a percentage of total memory utilized; bytes of total, used, and free memory; and of lesser interest in typical monitoring, reque3st, XG4, and held memory. The percentage of used memory depends on the application, the size of request and response messages, and the volume and latency of requests. Typical utilization runs are less than 80%, and statistics beyond this threshold are of concern. You can use the device's Throttle Settings to temporarily slow down request processing or to perform a warm restart, which recaptures memory in this situation.

Figure 4-17 shows system error codes that are associated with these sensors and can be used to trigger alerts from the SNMP Trap Event Subscription configuration.

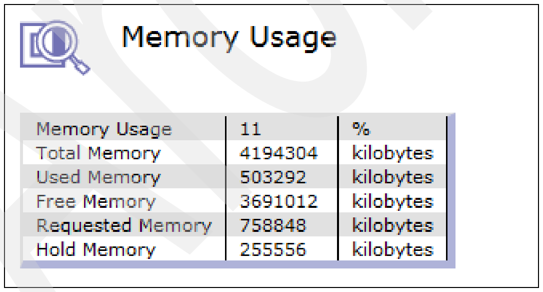
```
0x01a40001 Throttling connections due to low memory
0x01a30002 Restart due to low memory
0x01a30003 Memory usage recovered above threshold
```

*Figure 4-17 Error codes associated with memory usage*

Table 4-7 shows the various ways for obtaining memory usage metrics. Figure 4-18 shows memory usage as displayed in the WebGUI, and Example 4-7 on page 108 shows the SOAP response from the XMI request for MemoryStatus.

*Table 4-7 Obtaining memory usage*

| **Access method** | **Menu location, command, or variable** |
|---|---|
| WebGUI | **Status** → **System** → **Memory Usage** |
| CLI | show memory |
| XMI Status Class | MemoryStatus |
| Status MIB | dpStatusMemoryStatus |


Memory Usage

| | | |
|---|---|---|
| Memory Usage | 11 | % |
| Total Memory | 4194304 | kilobytes |
| Used Memory | 503292 | kilobytes |
| Free Memory | 3691012 | kilobytes |
| Requested Memory | 758848 | kilobytes |
| Hold Memory | 255556 | kilobytes |

*Figure 4-18 Memory Usage as shown in the WebGUI*

*Example 4-7 Response from XMI get-status, class: MemoryStatus*

```
<dp:response xmlns:dp="http://www.datapower.com/schemas/management">
   <dp:timestamp>2010-07-19T15:20:43-04:00</dp:timestamp>
   <dp:status>
      <MemoryStatus xmlns:env="http://www.w3...[omitted]...elope">
         <Usage>14</Usage>
         <TotalMemory>4148536</TotalMemory>
         <UsedMemory>587969</UsedMemory>
         <FreeMemory>3560567</FreeMemory>
         <ReqMemory>884132</ReqMemory>
         <HoldMemory>296163</HoldMemory>
      </MemoryStatus>
   </dp:status>
</dp:response>
```

### File system usage

File system statistics are provided for the free space and total space of the encrypted, temporary, and internal file system. Monitor all free space metrics; levels beneath 20% of the total space are a concern. You can use the device's Throttle Settings to temporarily slow down request processing or to perform a warm restart, which recaptures file system space in situations of reduced free space.

Figure 4-19 shows the system error codes that are associated with these sensors and that can be used to trigger alerts from the SNMP Trap Event Subscription configuration.

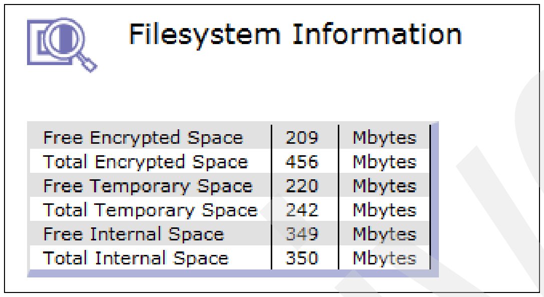
```
0x01a40005 Throttling connections due to low temporary file space
0x01a30006 Restart due to low temporary file space
0x01a50007 Temporary file space recovered above threshold
```

*Figure 4-19 Error codes associated with filesystem status*

Table 4-8 on page 109 shows the various ways for obtaining file system usage metrics. Figure 4-20 on page 109 shows file system status as displayed in the WebGUI, and Example 4-8 on page 109 shows the SOAP response from the XMI request for FilesystemStatus.

*Table 4-8 Obtaining file system information*

| Access method | Menu location, command, or variable |
|---|---|
| WebGUI | **Status → System → Filesystem Information** |
| CLI | show filesystem |
| XMI Status Class | FilesystemStatus |
| Status MIB | dpStatusFilesystemStatus |


Filesystem Information

| | | |
|---|---|---|
| Free Encrypted Space | 209 | Mbytes |
| Total Encrypted Space | 456 | Mbytes |
| Free Temporary Space | 220 | Mbytes |
| Total Temporary Space | 242 | Mbytes |
| Free Internal Space | 349 | Mbytes |
| Total Internal Space | 350 | Mbytes |

*Figure 4-20 Filesystem Information as shown in the WebGUI*

*Example 4-8 Response from XMI get-status, class: FilesystemStatus*

```
<dp:response xmlns:dp="http://www.datapower.com/schemas/management">
   <dp:timestamp>2010-07-19T15:22:59-04:00</dp:timestamp>
   <dp:status>
      <FilesystemStatus xmlns:env="http://www...[omitted]...nvelope">
         <FreeEncrypted>207</FreeEncrypted>
         <TotalEncrypted>475</TotalEncrypted>
         <FreeTemporary>204</FreeTemporary>
         <TotalTemporary>242</TotalTemporary>
         <FreeInternal>224</FreeInternal>
         <TotalInternal>350</TotalInternal>
      </FilesystemStatus>
   </dp:status>
</dp:response>
```

## System uptime

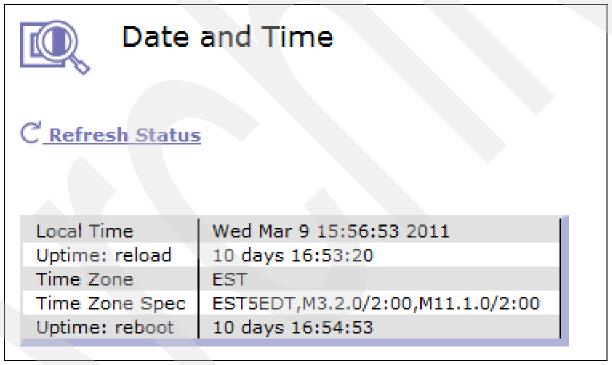
System uptime indicates the elapsed time since the device was last restarted, including controlled firmware reloads and any unexpected device restarts. DataPower appliances restart themselves automatically in conjunction with throttle configurations, such as memory or file system constraints.

Even though SNMP notifications are sent in the event of a restart, it is possible that message delivery fails due to the conditions that might have caused the restart in the first place. For this reason, it is prudent to rely on both SNMP traps and SNMP polling to assure that any notification delivery failure will not obscure the fact that the machine was restarted. Uptime is an ideal metric for determining the last time that an appliance restarted.

Table 4-9 shows the various ways for obtaining system time metrics (including uptime). Figure 4-21 shows date and time status, as displayed in the WebGUI. Example 4-9 on page 111 shows the SOAP response from the XMI request for DateTimeStatus.

*Table 4-9 Obtaining system uptime*

| Access method | Menu location, command, or variable |
|---|---|
| WebGUI | **Status → Main → Date and Time** |
| CLI | show time |
| XMI Status Class | DateTimeStatus |
| Status MIB | dpStatusDateTimeStatusuptime |



| | |
|---|---|
| Local Time | Wed Mar 9 15:56:53 2011 |
| Uptime: reload | 10 days 16:53:20 |
| Time Zone | EST |
| Time Zone Spec | EST5EDT,M3.2.0/2:00,M11.1.0/2:00 |
| Uptime: reboot | 10 days 16:54:53 |

*Figure 4-21 Date and Time status as shown in the WebGUI*

*Example 4-9 Response from XMI get-status, class: DateTimeStatus*

```
<dp:response xmlns:dp="http://www.datapower.com/schemas/management">
   <dp:timestamp>2010-07-19T15:24:45-04:00</dp:timestamp>
   <dp:status>
      <DateTimeStatus xmlns:env="http://www...[omitted]...nvelope">
         <time>Mon Jul 19 15:24:45 2010</time>
         <uptime>2 days 23:50:23</uptime>
         <timezone>EDT</timezone>
         <tzspec>EST5EDT,M3.2.0/2:00,M11.1.0/2:00</tzspec>
         <bootuptime>2 days 23:52:42</bootuptime>
      </DateTimeStatus>
   </dp:status>
</dp:response>
```

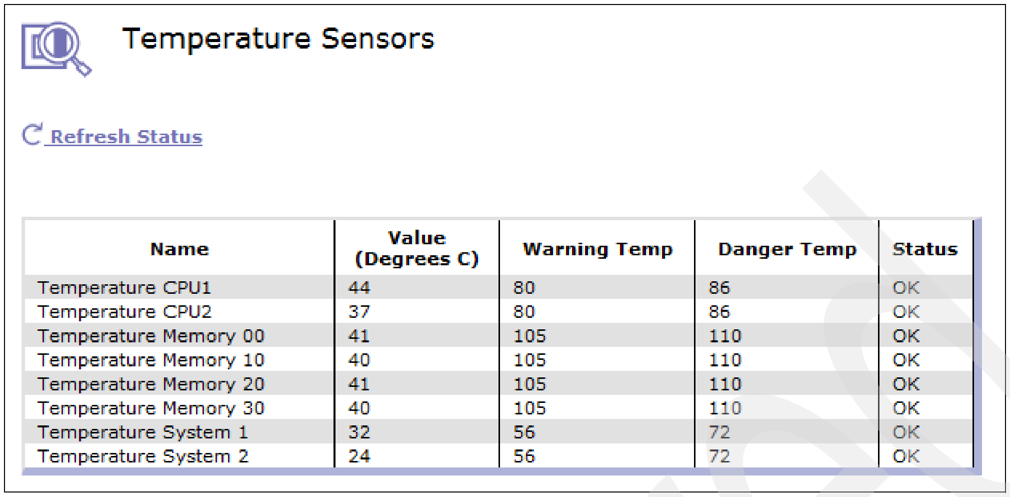
## Temperature sensors

Sensors for obtaining CPU, memory, and system temperatures can be queried to ascertain whether the components are operating within acceptable temperature ranges. Each component has a warning and danger temperature associated with it and a status value of OK or FAIL. High temperatures might be the result of ambient temperature or fan failures.

Table 4-10 shows the various ways for obtaining temperature sensor metrics. Figure 4-22 on page 112 shows temperature sensor status, as displayed in the WebGUI. Example 4-10 on page 112 shows the SOAP response from the XMI request for TemperatureSensors.

*Table 4-10 Obtaining temperature sensor status*

| Access method | Menu location, command, or variable |
|---|---|
| WebGUI | **Status → System → Temperature Sensors** |
| CLI | show sensors-temperature |
| XMI Status Class | TemperatureSensors |
| Status MIB | dpStatusTemperatureSensorsTable |


Temperature Sensors

Refresh Status

| Name | Value (Degrees C) | Warning Temp | Danger Temp | Status |
|---|---|---|---|---|
| Temperature CPU1 | 44 | 80 | 86 | OK |
| Temperature CPU2 | 37 | 80 | 86 | OK |
| Temperature Memory 00 | 41 | 105 | 110 | OK |
| Temperature Memory 10 | 40 | 105 | 110 | OK |
| Temperature Memory 20 | 41 | 105 | 110 | OK |
| Temperature Memory 30 | 40 | 105 | 110 | OK |
| Temperature System 1 | 32 | 56 | 72 | OK |
| Temperature System 2 | 24 | 56 | 72 | OK |

*Figure 4-22 Temperature sensor information as shown in the WebGUI*

*Example 4-10 Response from XMI get-status, class: TemperatureSensors*

```
<dp:response xmlns:dp="http://www.datapower.com/schemas/management">
   <dp:timestamp>2010-07-19T15:26:15-04:00</dp:timestamp>
   <dp:status>
      <TemperatureSensors
xmlns:env="http://www.w3.org/2003/05/soap-envelope">
         <Name>Temperature CPU1</Name>
         <Value>32</Value>
         <UpperNonCriticalThreshold>76</UpperNonCriticalThreshold>

<UpperNonRecoverableThreshold>86</UpperNonRecoverableThreshold>
         <ReadingStatus>ok</ReadingStatus>
      </TemperatureSensors>
      <TemperatureSensors
xmlns:env="http://www.w3.org/2003/05/soap-envelope">
         <Name>Temperature CPU2</Name>
         <Value>32</Value>
         <UpperNonCriticalThreshold>76</UpperNonCriticalThreshold>

<UpperNonRecoverableThreshold>86</UpperNonRecoverableThreshold>
         <ReadingStatus>ok</ReadingStatus>
      </TemperatureSensors>
      <TemperatureSensors
xmlns:env="http://www.w3.org/2003/05/soap-envelope">
         <Name>Temperature System 1</Name>
         <Value>26</Value>
```

```
        <UpperNonCriticalThreshold>56</UpperNonCriticalThreshold>

<UpperNonRecoverableThreshold>72</UpperNonRecoverableThreshold>
        <ReadingStatus>ok</ReadingStatus>
     </TemperatureSensors>
  </dp:status>
</dp:response>
```

## Fan sensors

Proper fan operation assures that DataPower appliances can operate safely within normal ambient conditions. The number of fans within the case can vary depending on installed options. Fan malfunctions potentially can lead to device overheating and malfunction; therefore, it is important to proactively monitor the condition of the fans.

Figure 4-23 shows system error codes that are associated with these sensors and can be used to trigger alerts from the SNMP Trap Event Subscription configuration.

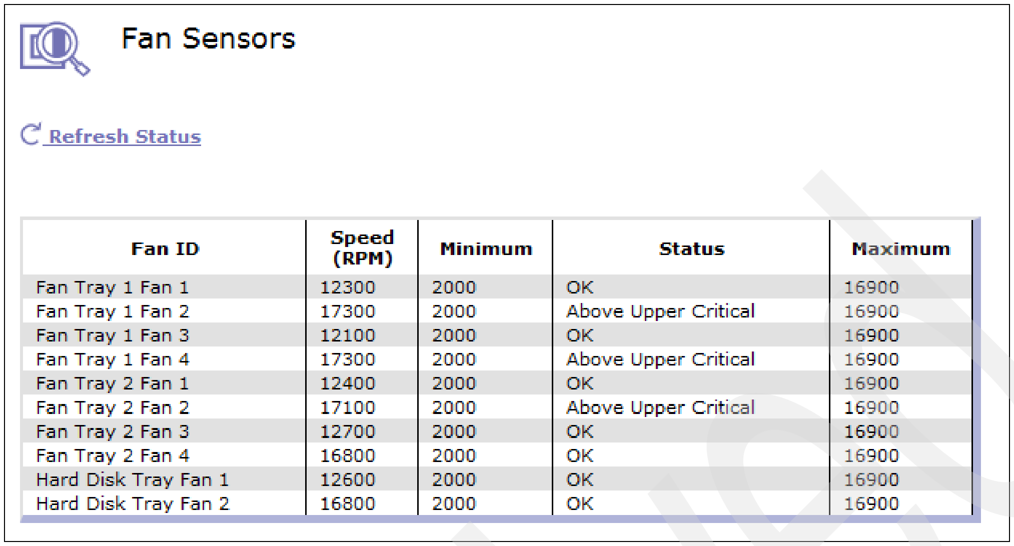
```
0x02240002 Internal cooling fan has slowed
0x02220003 Internal cooling fan has stopped
```

*Figure 4-23 Error codes associated with fan status*

Table 4-11 shows the various ways for obtaining temperature sensor metrics. Figure 4-24 on page 114 shows temperature sensor status, as displayed in the WebGUI. Example 4-11 on page 114 shows the SOAP response from the XMI request for EnvironmentalFanSensors.

*Table 4-11 Obtaining fan sensor information*

| Access method | Menu location, command, or variable |
|---|---|
| WebGUI | **Status → System → Fan Sensors** |
| CLI | show sensors-fan |
| XMI Status Class | EnvironmentalFanSensors |
| Status MIB | dpStatusEnvironmentalFanSensorsTable |



| Fan ID | Speed (RPM) | Minimum | Status | Maximum |
|---|---|---|---|---|
| Fan Tray 1 Fan 1 | 12300 | 2000 | OK | 16900 |
| Fan Tray 1 Fan 2 | 17300 | 2000 | Above Upper Critical | 16900 |
| Fan Tray 1 Fan 3 | 12100 | 2000 | OK | 16900 |
| Fan Tray 1 Fan 4 | 17300 | 2000 | Above Upper Critical | 16900 |
| Fan Tray 2 Fan 1 | 12400 | 2000 | OK | 16900 |
| Fan Tray 2 Fan 2 | 17100 | 2000 | Above Upper Critical | 16900 |
| Fan Tray 2 Fan 3 | 12700 | 2000 | OK | 16900 |
| Fan Tray 2 Fan 4 | 16800 | 2000 | OK | 16900 |
| Hard Disk Tray Fan 1 | 12600 | 2000 | OK | 16900 |
| Hard Disk Tray Fan 2 | 16800 | 2000 | OK | 16900 |

*Figure 4-24 Fan sensor status as shown in the WebGUI*

*Example 4-11 Response from XMI get-status, class: EnvironmentalFanSensors*

```
<dp:response xmlns:dp="http://www.datapower.com/schemas/management">
   <dp:timestamp>2010-07-19T15:39:03-04:00</dp:timestamp>
   <dp:status>
      <EnvironmentalFanSensors xmlns:env="http://www..[omitted]..lope">
         <FanID>chassis-1</FanID>
         <FanSpeed>7336</FanSpeed>
         <LowerCriticalThreshold>2000</LowerCriticalThreshold>
         <ReadingStatus>ok</ReadingStatus>
      </EnvironmentalFanSensors>
      <EnvironmentalFanSensors xmlns:env="http://www..[omitted]..lope">
         <FanID>chassis-2</FanID>
            .
            . [repeated for various installed fans]
            .
      /EnvironmentalFanSensors>
   </dp:status>
</dp:response>
```

### Other sensors

Sensors that are more specific to DataPower appliances are grouped into the Other Sensors category, including intrusion detection, battery, hard disk, and power supply indicators.

Figure 4-25 shows system error codes that are associated with these sensors and that can be used to trigger alerts from the SNMP Trap Event Subscription configuration.

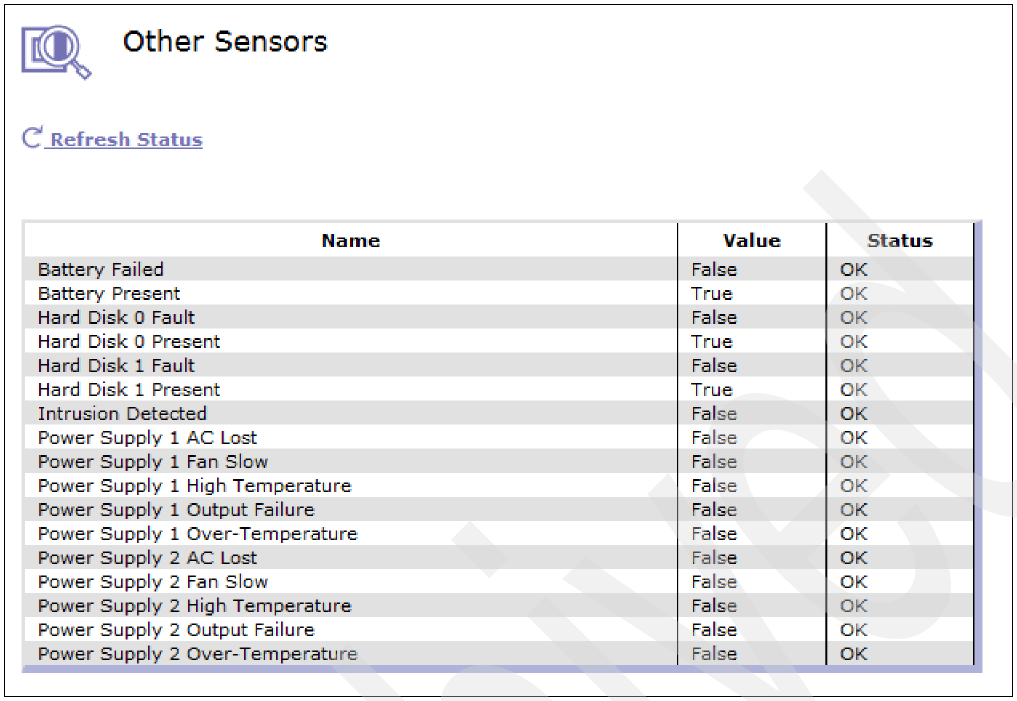
```
0x02220001 Power supply failure
0x02220004 System battery missing
0x02220005 System battery failed
```

*Figure 4-25 Error codes associated with DataPower's other sensors*

Table 4-12 shows the various ways for obtaining other sensor metrics. Figure 4-26 on page 116 shows other sensor status, as displayed in the WebGUI. And, Example 4-12 on page 116 shows the SOAP response from the XMI request for OtherSensors.

*Table 4-12 Obtaining other sensor information*

| **Access method** | **Menu location, command, or variable** |
|---|---|
| WebGUI | **Status** → **System** → **Other Sensors** |
| CLI | show load |
| XMI Status Class | OtherSensors |
| Status MIB | dpStatusOtherSensorsTable |



Other Sensors

Refresh Status

| Name | Value | Status |
|---|---|---|
| Battery Failed | False | OK |
| Battery Present | True | OK |
| Hard Disk 0 Fault | False | OK |
| Hard Disk 0 Present | True | OK |
| Hard Disk 1 Fault | False | OK |
| Hard Disk 1 Present | True | OK |
| Intrusion Detected | False | OK |
| Power Supply 1 AC Lost | False | OK |
| Power Supply 1 Fan Slow | False | OK |
| Power Supply 1 High Temperature | False | OK |
| Power Supply 1 Output Failure | False | OK |
| Power Supply 1 Over-Temperature | False | OK |
| Power Supply 2 AC Lost | False | OK |
| Power Supply 2 Fan Slow | False | OK |
| Power Supply 2 High Temperature | False | OK |
| Power Supply 2 Output Failure | False | OK |
| Power Supply 2 Over-Temperature | False | OK |

*Figure 4-26 Other sensors status as shown in the WebGUI*

*Example 4-12 Response from XMI get-status, class: OtherSensors*

```
<dp:response xmlns:dp="http://www.datapower.com/schemas/management">
   <dp:timestamp>2010-07-19T16:06:37-04:00</dp:timestamp>
   <dp:status>
      <OtherSensors xmlns:env="http://www.w3...[omitted]...elope">
         <Name>Intrusion Detected</Name>
         <Value>false</Value>
         <ReadingStatus>ok</ReadingStatus>
      </OtherSensors>
      <OtherSensors xmlns:env="http://www.w3...[omitted]...elope">
         <Name>Power Supply 1 Output Failure</Name>
         <Value>false</Value>
         <ReadingStatus>ok</ReadingStatus>
      </OtherSensors>
   </dp:status>
</dp:response>
```

## 4.6.2 Interface utilization statistics

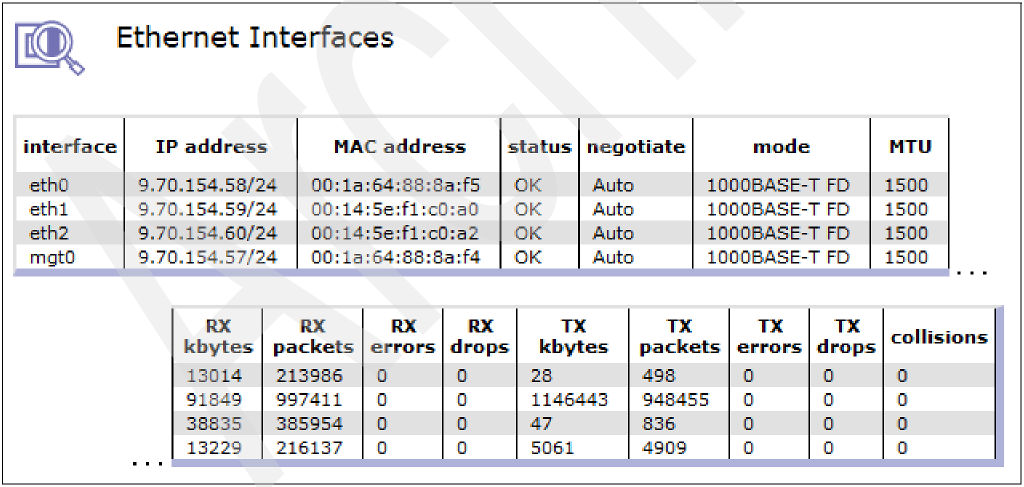
Interface utilization monitors provide an analysis of the amount of data that is being received and transmitted by the DataPower device. Each device contains four gigabit (Gb) interfaces. Monitoring interface utilization can help predict and prepare for increased throughput and growth, both for DataPower and back-end services.

### Ethernet interface status

Table 4-13 shows the various ways for obtaining Ethernet interface metrics. Figure 4-27 shows the Ethernet interface status, as displayed in the WebGUI. And, Example 4-13 on page 118 shows the SOAP response from the XMI request for EthernetInterfaceStatus.

*Table 4-13 Obtaining Ethernet interface status*

| Access method | Menu location, command, or variable |
|---|---|
| WebGUI | **Status → IP-Network → Ethernet Interfaces** |
| CLI | Show Ethernet |
| XMI Status Class | EthernetInterfaceStatus |
| Status MIB | dpStatusEthernetInterfaceStatusTable |


Ethernet Interfaces

| interface | IP address | MAC address | status | negotiate | mode | MTU |
|---|---|---|---|---|---|---|
| eth0 | 9.70.154.58/24 | 00:1a:64:88:8a:f5 | OK | Auto | 1000BASE-T FD | 1500 |
| eth1 | 9.70.154.59/24 | 00:14:5e:f1:c0:a0 | OK | Auto | 1000BASE-T FD | 1500 |
| eth2 | 9.70.154.60/24 | 00:14:5e:f1:c0:a2 | OK | Auto | 1000BASE-T FD | 1500 |
| mgt0 | 9.70.154.57/24 | 00:1a:64:88:8a:f4 | OK | Auto | 1000BASE-T FD | 1500 |

...

...

| RX kbytes | RX packets | RX errors | RX drops | TX kbytes | TX packets | TX errors | TX drops | collisions |
|---|---|---|---|---|---|---|---|---|
| 13014 | 213986 | 0 | 0 | 28 | 498 | 0 | 0 | 0 |
| 91849 | 997411 | 0 | 0 | 1146443 | 948455 | 0 | 0 | 0 |
| 38835 | 385954 | 0 | 0 | 47 | 836 | 0 | 0 | 0 |
| 13229 | 216137 | 0 | 0 | 5061 | 4909 | 0 | 0 | 0 |

*Figure 4-27 Ethernet interface status as shown in the WebGUI*

*Example 4-13 Response from XMI get-status, class: EthernetInterfaceStatus*

```
<dp:response xmlns:dp="http://www.datapower.com/schemas/management">
   <dp:timestamp>2010-07-19T16:09:38-04:00</dp:timestamp>
   <dp:status>
      <EthernetInterfaceStatus xmlns:env="http:/.[omitted]...elope">
         <Name>eth0</Name>
         <IP>9.42.170.230/23</IP>
         <MACAddress>00:0a:4b:80:3f:7c</MACAddress>
         <Status>ok</Status>
         <Negotiate>auto</Negotiate>
         <Mode>100BASE-TX-FD</Mode>
         <MTU>1500</MTU>
         <RxKbytes>146375</RxKbytes>
         <RxPackets>1672188</RxPackets>
         <RxErrors>0</RxErrors>
         <RxDrops>0</RxDrops>
         <TxKbytes>853424</TxKbytes>
         <TxPackets>832308</TxPackets>
         <TxErrors>0</TxErrors>
         <TxDrops>0</TxDrops>
         <Collisions>0</Collisions>
      </EthernetInterfaceStatus>
      <EthernetInterfaceStatus xmlns:env="http:/.[omitted]...elope">
         <.. repeated for each interface ... />
      </EthernetInterfaceStatus>
   </dp:status>
</dp:response>
```

## Receive/Transmit throughput

Receive and transmit throughput information can help you to understand the amount of data that is being processed by the device. These statistics are provided for five time intervals ranging from 10 seconds up to the most recent 24-hour period and help you to capture and understand network load. Metrics include traffic on the mgt0 (management) interface, so the WebGUI, CLI, and other management traffic is included in the totals.

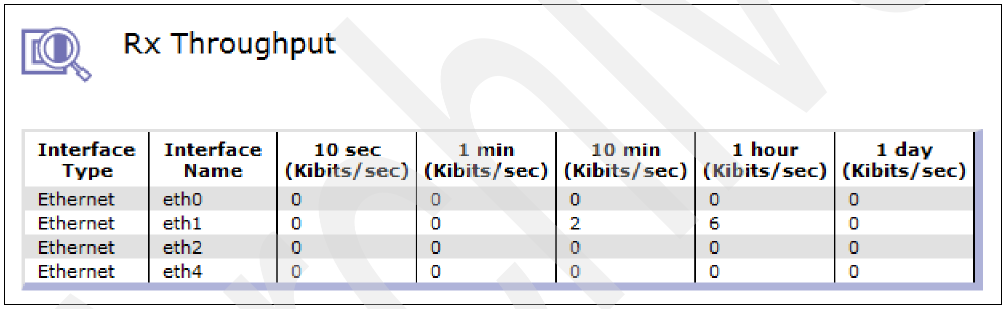
Depending on how DataPower processing rules are configured, the amount of processing can vary greatly. The message size is not always a good factor in determining throughput. For example, a small message can trigger significant processing actions, such as cryptographic operations or off-box communications, and a large message might require nothing more than dynamic routing.

Being aware of increases in receive and transmit throughput can also help you in capacity planning and help you avoid over-tasking the appliances.

Table 4-14 shows the various ways for obtaining receive and transmit throughput metrics. Figure 4-28 and Figure 4-29 on page 120 show status, as displayed in the WebGUI. Example 4-14 on page 120 and Example 4-15 on page 121 show the SOAP response from the XMI request for ReceiveKbpsThroughput and TransmitKbpsThroughput.

*Table 4-14 Obtaining the interface throughput*

| **Access method** | **Menu location, command, or variable** |
|---|---|
| WebGUI | **Status → IP-Network → Rx Throughput**<br>**Status → IP-Network → Tx Throughput** |
| CLI | show receive-kbps<br>show transmit-kbps |
| XMI Status Class | ReceiveKbpsThroughput<br>TransmitKbpsThroughput |
| Status MIB | dpStatusReceiveKbpsThroughputTable<br>dpStatusTransmitKbpsThroughputTable |

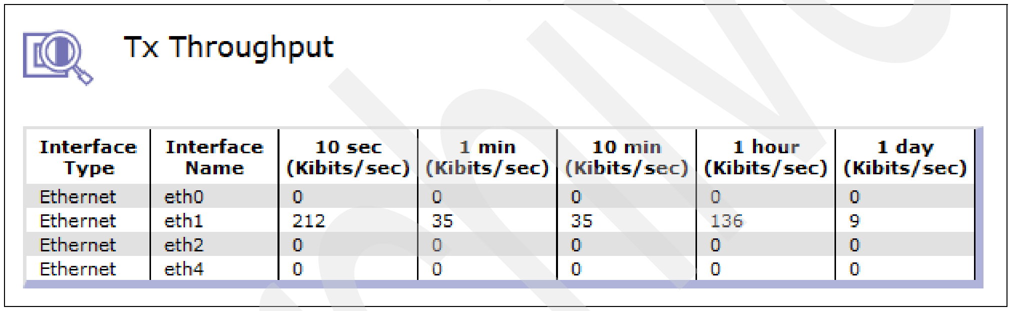

Rx Throughput

| Interface Type | Interface Name | 10 sec (Kibits/sec) | 1 min (Kibits/sec) | 10 min (Kibits/sec) | 1 hour (Kibits/sec) | 1 day (Kibits/sec) |
|---|---|---|---|---|---|---|
| Ethernet | eth0 | 0 | 0 | 0 | 0 | 0 |
| Ethernet | eth1 | 0 | 0 | 2 | 6 | 0 |
| Ethernet | eth2 | 0 | 0 | 0 | 0 | 0 |
| Ethernet | eth4 | 0 | 0 | 0 | 0 | 0 |

*Figure 4-28 Receive throughput as shown in the WebGUI*

*Example 4-14 Response from XMI get-status, class: ReceiveKbpsThroughput*

```
<dp:response xmlns:dp="http://www.datapower.com/schemas/management">
   <dp:timestamp>2010-07-19T16:14:14-04:00</dp:timestamp>
   <dp:status>
      <ReceiveKbpsThroughput xmlns:env="ht..[omitted]...oap-envelope">
         <Interface>eth0</Interface>
         <tenSeconds>2</tenSeconds>
         <oneMinute>3</oneMinute>
         <tenMinutes>7</tenMinutes>
         <oneHour>6</oneHour>
         <oneDay>6</oneDay>
      </ReceiveKbpsThroughput>
      <ReceiveKbpsThroughput>
         ... repeated for remaining interfaces ...
      </ReceiveKbpsThroughput>
   </dp:status>
</dp:response>
```



Tx Throughput

| Interface Type | Interface Name | 10 sec (Kibits/sec) | 1 min (Kibits/sec) | 10 min (Kibits/sec) | 1 hour (Kibits/sec) | 1 day (Kibits/sec) |
|---|---|---|---|---|---|---|
| Ethernet | eth0 | 0 | 0 | 0 | 0 | 0 |
| Ethernet | eth1 | 212 | 35 | 35 | 136 | 9 |
| Ethernet | eth2 | 0 | 0 | 0 | 0 | 0 |
| Ethernet | eth4 | 0 | 0 | 0 | 0 | 0 |

*Figure 4-29 Transmit throughput as shown in the WebGUI*

*Example 4-15 Response from XMI get-status, class: TransmitKbpsThroughput*

```
<dp:response xmlns:dp="http://www.datapower.com/schemas/management">
   <dp:timestamp>2010-07-19T16:46:21-04:00</dp:timestamp>
   <dp:status>
      <TransmitKbpsThroughput xmlns:env="http:/...[omitted]...elope">
         <Interface>eth0</Interface>
         <tenSeconds>0</tenSeconds>
         <oneMinute>0</oneMinute>
         <tenMinutes>5</tenMinutes>
         <oneHour>33</oneHour>
         <oneDay>63</oneDay>
      </TransmitKbpsThroughput>
      <TransmitKbpsThroughput xmlns:env="http:/...[omitted]...elope">
         ... repeated for remaining interfaces ...
      </TransmitKbpsThroughput>
   </dp:status>
</dp:response>
```

## HTTP connection status

HTTP connections are produced at the domain level. Statistics must be enabled for each domain that is to produce HTTP connection data. Status data is grouped by XML-Manager and contains a wealth of HTTP connections data.

**Important:** HTTP connection status statistics do *not* include connection data for services that are configured as loop backs.

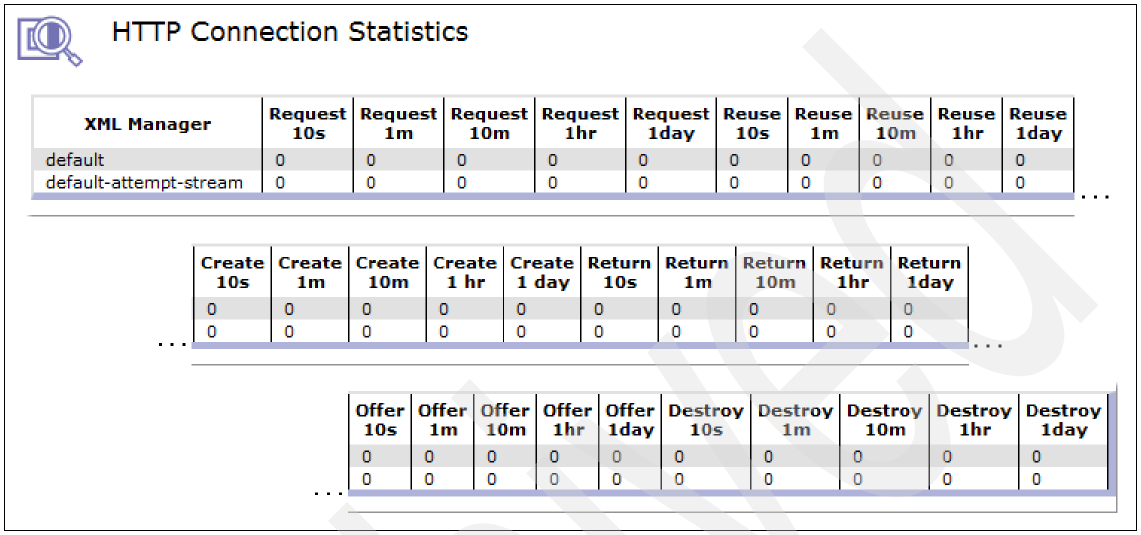
When using SNMP to obtain HTTP connection status, the target domain is specified when setting up communities (for SNMPv1 and SNMPv2c) or when setting up contexts (for SNMPv3).

Table 4-15 shows the various ways for obtaining HTTP connection statistics. Figure 4-30 on page 122 shows the status, as displayed in the WebGUI, and Example 4-16 on page 122 shows the SOAP response from the XMI request for HTTPConnections.

*Table 4-15 Obtaining HTTP connection statistics*

| Access method | Menu location, command, or variable |
|---|---|
| WebGUI | **Status → Connection → HTTP Connection Statistics** |
| CLI | show http-connection |
| XMI Status Class | HTTPConnections |

| Access method | Menu location, command, or variable |
|---|---|
| Status MIB | dpStatusHTTPConnectionsTable |


HTTP Connection Statistics

| XML Manager | Request 10s | Request 1m | Request 10m | Request 1hr | Request 1day | Reuse 10s | Reuse 1m | Reuse 10m | Reuse 1hr | Reuse 1day |
|---|---|---|---|---|---|---|---|---|---|---|
| default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| default-attempt-stream | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| Create 10s | Create 1m | Create 10m | Create 1 hr | Create 1 day | Return 10s | Return 1m | Return 10m | Return 1hr | Return 1day |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| Offer 10s | Offer 1m | Offer 10m | Offer 1hr | Offer 1day | Destroy 10s | Destroy 1m | Destroy 10m | Destroy 1hr | Destroy 1day |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Figure 4-30 HTTP Connection Statistics as shown in the WebGUI*

*Example 4-16 Response from XMI get-status, class: HTTPConnections*

```
<dp:response xmlns:dp="http://www.datapower.com/schemas/management">
   <dp:timestamp>2010-07-19T16:48:28-04:00</dp:timestamp>
   <dp:status>
      <HTTPConnections xmlns:env="http:...[omitted]...soap-envelope">
         <XMLManager class="XMLManager">default</XMLManager>
         <reqTenSec>0</reqTenSec>
         <reqOneMin>0</reqOneMin>
         <reqTenMin>0</reqTenMin>
         <reqOneHr>0</reqOneHr>
         <reqOneDay>33</reqOneDay>
         <reuseTenSec>0</reuseTenSec>
         <reuseOneMin>0</reuseOneMin>
         <reuseTenMin>0</reuseTenMin>
         <reuseOneHr>0</reuseOneHr>
         <reuseOneDay>0</reuseOneDay>
         <createTenSec>0</createTenSec>
         <createOneMin>0</createOneMin>
         <createTenMin>0</createTenMin>
         <createOneHr>0</createOneHr>
```

```
            <createOneDay>33</createOneDay>
            <returnTenSec>0</returnTenSec>
            <returnOneMin>0</returnOneMin>
            <returnTenMin>0</returnTenMin>
            <returnOneHr>0</returnOneHr>
            <returnOneDay>66</returnOneDay>
            <offerTenSec>0</offerTenSec>
            <offerOneMin>0</offerOneMin>
            <offerTenMin>0</offerTenMin>
            <offerOneHr>0</offerOneHr>
            <offerOneDay>0</offerOneDay>
            <destroyTenSec>0</destroyTenSec>
            <destroyOneMin>0</destroyOneMin>
            <destroyTenMin>0</destroyTenMin>
            <destroyOneHr>0</destroyOneHr>
            <destroyOneDay>66</destroyOneDay>
         </HTTPConnections>
         <HTTPConnections xmlns:env="http:...[omitted]...soap-envelope">
            ... repeated for additional XML Managers ...
         </HTTPConnections>
      </dp:status>
   </dp:response>
```

## Transaction rate status

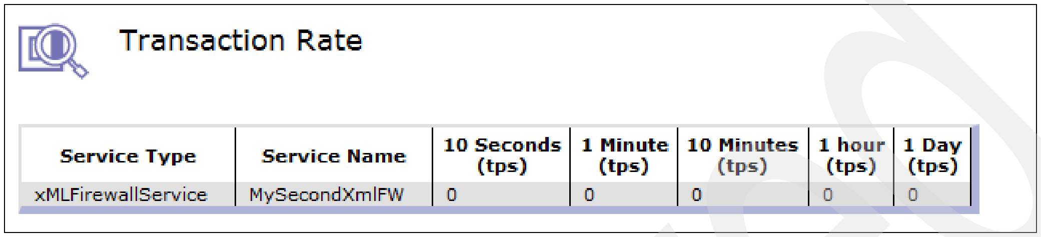
Transaction rates and elapsed times for individual services are accumulated at the domain level. Transaction rates and times are not provided unless statistics are enabled for each specific domain where statistics are needed. This metric can help you to understand the number of transactions processed and the average response time of those transactions for a particular service over several time intervals.

Table 4-16 shows the various ways for obtaining receive and transmit throughput metrics. Figure 4-31 on page 124 and Figure 4-32 on page 124 show the status, as displayed in the WebGUI. Example 4-17 on page 124 and Example 4-18 on page 125 show the SOAP response from the XMI request for HTTPTransactions and HTTPMeanTransactionTime.

*Table 4-16 Obtaining transaction rate statistics*

| Access method | Menu location, command, or variable |
|---|---|
| WebGUI | **Status → Connection → Transaction Rate**<br>**Status → Connection → Transaction Time** |
| CLI | show http |

| Access method | Menu location, command, or variable |
|---|---|
| XMI Status Class | HTTPTransactions<br>HTTPMeanTransactionTime |
| Status MIB | dpStatusHTTPTransactionsTable<br>dpStatusHTTPMeanTransactionTimeTable |

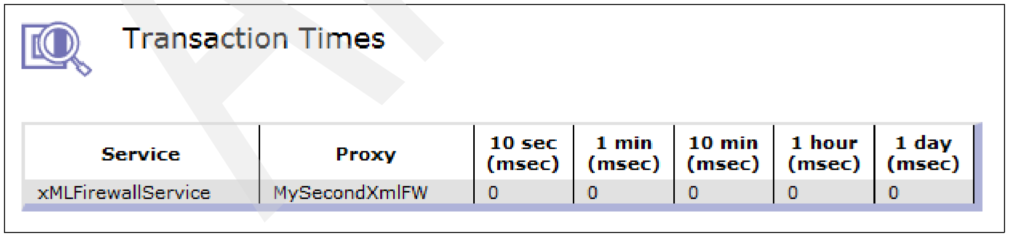

Transaction Rate

| Service Type | Service Name | 10 Seconds (tps) | 1 Minute (tps) | 10 Minutes (tps) | 1 hour (tps) | 1 Day (tps) |
|---|---|---|---|---|---|---|
| xMLFirewallService | MySecondXmlFW | 0 | 0 | 0 | 0 | 0 |

*Figure 4-31 Transaction rates as shown in the WebGUI*

*Example 4-17 Response from XMI get-status, class: HTTPTransactions*

```
<dp:response xmlns:dp="http://www.datapower.com/schemas/management">
   <dp:timestamp>2010-07-19T17:01:13-04:00</dp:timestamp>
   <dp:status>
      <HTTPTransactions xmlns:env="http:...[omitted]...ope">
         <proxy>GenLogMessageFW</proxy>
         <tenSeconds>0</tenSeconds>
         <oneMinute>0</oneMinute>
         <tenMinutes>0</tenMinutes>
         <oneHour>0</oneHour>
         <oneDay>0</oneDay>
      </HTTPTransactions>
   </dp:status>
</dp:response>
```


Transaction Times

| Service | Proxy | 10 sec (msec) | 1 min (msec) | 10 min (msec) | 1 hour (msec) | 1 day (msec) |
|---|---|---|---|---|---|---|
| xMLFirewallService | MySecondXmlFW | 0 | 0 | 0 | 0 | 0 |

*Figure 4-32 Transaction times as shown in the WebGUI*

*Example 4-18 Response from XMI get-status, class: HTTPMeanTransactionTime*

```
<dp:response xmlns:dp="http://www.datapower.com/schemas/management">
   <dp:timestamp>2010-07-19T16:58:51-04:00</dp:timestamp>
   <dp:status>
      <HTTPMeanTransactionTime xmlns:env="http:...[omitted]...ope">
         <proxy>GenLogMessageFW</proxy>
         <tenSeconds>0</tenSeconds>
         <oneMinute>0</oneMinute>
         <tenMinutes>0</tenMinutes>
         <oneHour>0</oneHour>
         <oneDay>28</oneDay>
      </HTTPMeanTransactionTime>
   </dp:status>
</dp:response>
```

### 4.6.3 Other network status providers

In addition to HTTP, DataPower supports various other protocols, including FTP, Information Management System (IMS), WebSphere MQ, Network File System (NFS), Network Time Protocol (NTP), SQL, Tibco, and WebSphere Java Message Service (JMS). Each of these protocols is represented by status providers and is supported by the WebGUI, CLI, XMI, and SNMP for monitoring.

## 4.7 SNMP traps

Effective monitoring of DataPower appliances needs to include the utilization of both active and proactive status inquiry. SNMP monitoring tools must be configured for both trap monitoring and periodic device polling.

Application monitoring must be employed to assure that round-trip processing is successful and that the back-end services perform within permissible limits. Automated or robotic clients can be set up to send sample messages through DataPower services to ensure that all network links (for example, load balancers, routers, and so on) are operational. Sending messages through to back-end service provider applications helps to assure that both front-side and back-side links are in service. Both DataPower and back-side resources must be configured to respond appropriately to the test messages.

DataPower SNMP traps provide a useful means of receiving notification of events, both normal and abnormal, from DataPower appliances. Figure 4-33 provides a list of suggested error codes for trap subscriptions, and Figure 4-34 lists various MIB status values worth monitoring.

```
0x02220001  environmental  critical  Power supply failure.
0x02220002  environmental  warning   Internal cooling fan has slowed.
0x02220003  environmental  critical  Internal cooling fan has stopped.
0x02220004  environmental  critical  System battery missing.
0x02220005  environmental  critical  System battery failed.
0x00330002  mgmt           error     Memory full
0x01a40001  system         warning   Throttling connections due to low memory
0x01a30002  system         error     Restart due to low memory
0x01a30003  system         error     Restart due to resource shortage timeout
0x01a50004  system         notice    Memory usage recovered above threshold
0x01a50005  system         warning   Throttling connections due to low temporary file space
0x01a30006  system         error     Restart due to low temporary file space
0x01a50007  system         notice    Temporary file space recovered above threshold
0x01a40008  system         warning   Throttling connections due to low number of free ports
0x01a30009  system         error     Restart due to port shortage
0x01a3000b  system         error     Restart due to prefix qcode shortage
0x01a3000c  system         error     Restart due to namespace qcode shortage
0x01a3000d  system         error     Restart due to local qcode shortage
0x01a2000e  system         critical  Installed battery is nearing end of life
0x01a30011  system         error     Invalid virtual file system
0x01a30012  system         error     File not found
0x01a30013  system         error     Buffer too small
0x01a30014  system         error     I/O error
0x01a30015  system         error     Out of memory
0x01a10016  system         alert     Number of free qcodes is very low
0x01a30017  system         error     Restart due to low file descriptor
0x01a40018  system         warning   Throttling due to low number of available file
descriptors
```

*Figure 4-33 Important error codes*

```
dpStatusSystemUsageLoad                   >80% for interval of 10 minutes or more
dpStatusCPUUsagetenMinutes                >90% 10 minute interval
dpStatusFilesystemStatusFreeTemporary     <20% alternatively use error code subscription
dpStatusFilesystemStatusFreeUnencrypted   <20% alternatively use error code subscription
dpStatusFilesystemStatusFreeEncrypted     <20% alternatively use error code subscription
dpStatusMemoryStatusFreeMemory            <20% alternatively use error code subscription
dpStatusTemperatureSensorsReadingStatus   various temperature sensor readings
dpStatusEthernetInterfaceStatusStatus     for configured interfaces
```

*Figure 4-34 MIB status values*

Being able to ascertain the normal traffic patterns of applications over time helps to predict growth and capacity requirements. The SNMP MIB values that are shown in Figure 4-35 can be queried to help capture and monitor the amount of network traffic that the device is processing.

```
dpStatusNetworkTransmitDataThroughputTenMinutesBits  Capture values of extended period of time
dpStatusNetworkTransmitDataThroughputTenMinutesBits  Capture values of extended period of time
```

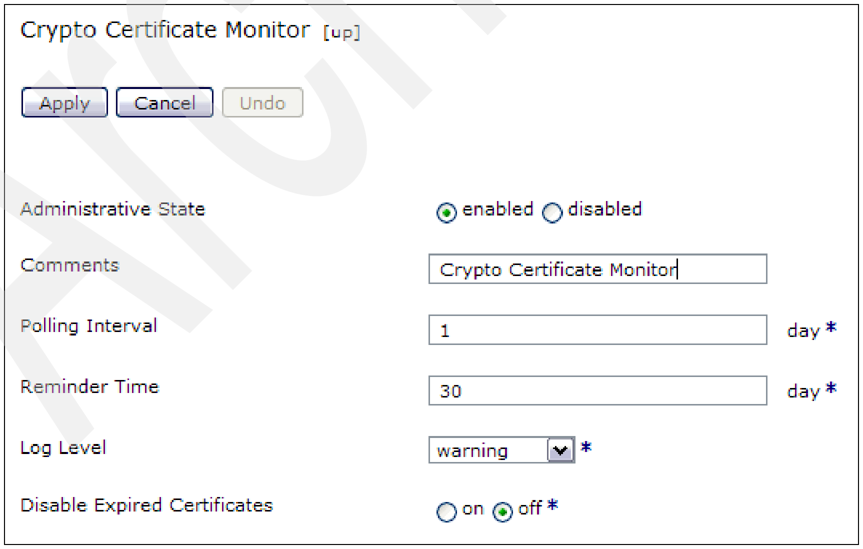
*Figure 4-35 MIB Interface utilization status values*

## 4.8 Certificate monitoring considerations

DataPower appliances come with an embedded function for certificate monitoring, called *Crypto Certificate Monitor*. This function is available only at the default domain. The certificate monitor object can help to keep you informed about every X.509 certificate expiration date that is installed in the device.

To open the Crypto Certificate Monitor, click **Objects** → **Crypto Configuration** → **Crypto Certificate** in the left menu.

Figure 4-36 shows an example of the crypto certificate monitor object. You can customize and tune crypto certificate object settings, such as the Polling Interval, Reminder Time, and Log Level. These settings need to be in agreement with your company's certificate replacement policy.



| | |
|---|---|
| Administrative State | [✓ enabled] disabled |
| Comments | Crypto Certificate Monitor |
| Polling Interval | 1 day * |
| Reminder Time | 30 day * |
| Log Level | warning * |
| Disable Expired Certificates | on [✓ off] * |

*Figure 4-36 The Crypto Certificate Monitor object settings*

Every time that a certificate expiration or expiry date is within the Reminder Time, a log message with the specified log level is generated in the appliance system's logs. You can also set the expired certificate object to be automatically disabled.

**Important:** Any other crypto objects that reference the disabled certificate object will also be disabled.

For better results and visibility regarding the certificate's expiration, always enable the crypto certificate monitor functionality. The device administrator needs to make sure that this step is included on every initial setup process.

## Set a log target with the cert-monitor category

A log target can capture log messages that are generated by the objects and services that are set on a DataPower appliance. The main feature within a log target is the *target type option*. A target type allows the appliance to deal with log messages and files, such as using encryption and signing, and it can also send the messages to remote servers.

During a log target setup, you must set up an event category subscription. A log category is used to relate log events and messages under the same subject. Thus, a category determines the subjects in which a log target is interested. A log target receives only messages that are related to its subscribed categories. DataPower appliances come with several log categories set and enabled, by default. A useful category for certificate monitoring is the *cert-monitor* category. You can use this category when setting monitoring for certificate expiration.

A good monitoring option for certificates is to combine an event category, such as the cert-monitor, with a remote target type option. This way, certificate expiration-related messages can be sent remotely using one of the various available options, such as Simple Mail Transfer Protocol (SMTP), Network File System (NFS), SOAP, and syslog (or syslog-ng).

## Ensure monitoring traps are set

Information regarding certificate expiration is generated when the crypto certificate monitor object is enabled and when a log target is set. The problem is that information can be useless if no one is watching for it. The best monitoring suites available offer the ability to set an alert or an alarm trap. These traps can be set in order to call for attention.

For example, you might have the device administrator group emailed every time that a certificate expired log entry is found. Alternatively, the production support team can be paged, or perhaps both situations can occur. The monitoring response can vary depending on your company's support process.

It is essential that anyone who works with monitoring traps have a deep knowledge of the monitoring suite that is used. Alerts and alarms are generally not enabled, by default. They need to be enabled and set based on your company criteria. For best results when monitoring certificates, set alarms and traps.

### Define a certificate replacement policy

Most companies transact business with several partners. Thus, a DataPower appliance can have certificates from several companies installed on it. Because certificates are critical documents, a company must have a well-defined certificate replacement policy.

Remember that your partners have their own policy for dealing with certificates. Certain partners can take more time to deploy a new certificate than others. Also, certificates need to be signed by a certificate authority (CA). Each CA has its own service-level agreement (SLA), which can also cause a delay.

## 4.9 Preferred practices and considerations

Consider these preferred practices:

- Use both subscription-based alerts and device polling for the most robust monitoring strategy. Reliance on alerts alone is not a sufficient monitoring strategy. The device might become unable to transmit alerts.
- Host aliases must be defined (in the default domain) and used instead of an actual IP address when identifying SNMP managers.
- Use a host alias when specifying the IP address for the XML management interface, especially in production environments. Leaving the IP address as 0.0.0.0 allows requests to be received on any IP address that is defined on the appliance. Generally speaking, the management interface is used for XMI traffic (mgt0 or eth4).
- Because SNMP community strings are essentially passwords that allow access to the SNMP agent, community strings must adhere to the same creation rules (mixed case, must contain a number, and so on) as regular passwords.
- Unless it is necessary for the SNMP manager to set values from MIB-II and other IETF MIBs, it is recommended that all communities that are defined on DataPower be read only. There are no read-write values defined within the DataPower MIBs.
- Host aliases must be defined (in the default domain) and used instead of actual IP address when identifying SNMP managers.

- Unless application-specific or domain-specific data is required, associate SNMP communities with the default domain.

5

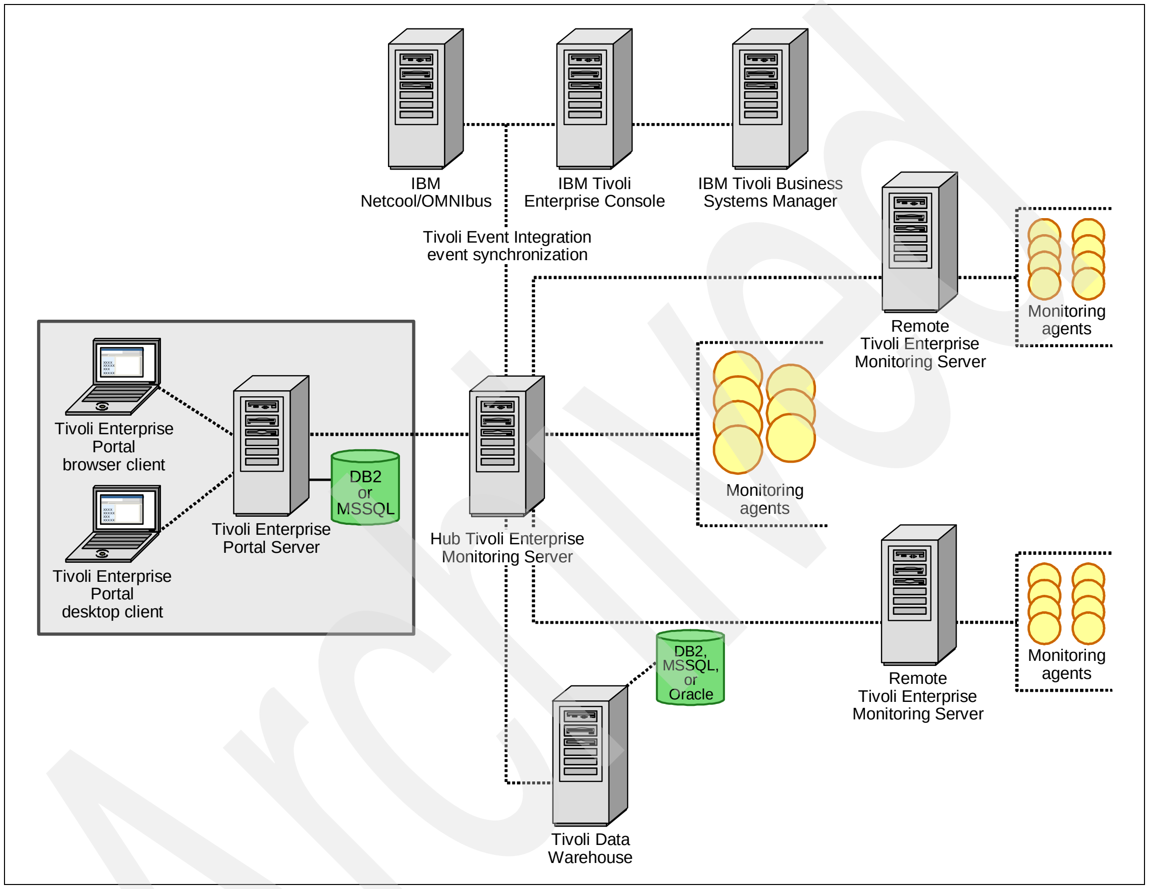
# IBM Tivoli Monitoring

IBM Tivoli Monitoring is a collection of components that provide a means to manage distributed resources through centralized control and configuration. Tivoli Monitoring is used as the foundation for a set of products that are built on top of Tivoli Monitoring, such as IBM Tivoli Composite Application Manager and the Omegamon family of products. These Tivoli Monitoring-based products can help you manage the performance and availability of distributed operating systems, applications, and DataPower appliances. Tivoli Monitoring seamlessly integrates these products that alert, identify, and isolate an incident with the subject matter expert tools that diagnose and resolve the problem.

This chapter introduces the various Tivoli components and how they work together with DataPower appliances.

## 5.1 IBM Tivoli Monitoring environment architecture

Tivoli Monitoring consists of a set of common service components, referred to collectively as *Tivoli Management Services*, as depicted in Figure 5-1.



IBM Netcool/OMNIbus
IBM Tivoli Enterprise Console
IBM Tivoli Business Systems Manager
Tivoli Event Integration event synchronization
Remote Tivoli Enterprise Monitoring Server
Monitoring agents
Tivoli Enterprise Portal browser client
Tivoli Enterprise Portal Server
DB2 or MSSQL
Hub Tivoli Enterprise Monitoring Server
Monitoring agents
Tivoli Enterprise Portal desktop client
DB2, MSSQL, or Oracle
Remote Tivoli Enterprise Monitoring Server
Monitoring agents
Tivoli Data Warehouse

*Figure 5-1 Tivoli Monitoring environment architecture overview*

### 5.1.1 Tivoli Management Services components

The following Tivoli Management Services components provide the infrastructure for Tivoli Monitoring-based products, such as Tivoli Composite Application Manager and Omegamon family.

## Monitoring Agents

Tivoli Enterprise Monitoring Agents are responsible for collecting application and resource metrics from various enterprise systems. IBM Tivoli Enterprise Management Agent can be agent-based or agent-less. In the case of DataPower, the Tivoli Enterprise Management Agent is considered agent-less. The Tivoli Enterprise Management Agent resides on a remote system and can monitor multiple DataPower appliances simultaneously.

Tivoli Monitoring-based products supply a variety of agent types that are compatible with many types of systems. For example, IBM Tivoli Composite Application Manager for SOA includes a number of monitoring agents, several of which are specific to DataPower appliances.

The metrics collected by each monitoring agent are packaged and transmitted to a Tivoli Enterprise Monitoring Server for further analysis.

## Tivoli Enterprise Monitoring Server

The monitoring server acts as a collection and control point for performance and health metrics that are received from the various monitoring agents. Depending on the deployment, remote Tivoli Enterprise Monitoring Servers can be configured to consolidate metrics from groups of agents and relay the data to the hub monitoring server.

The hub monitoring server correlates the monitoring data that is collected by monitoring agents and any remote monitoring servers and passes that data to the Tivoli Enterprise Portal Server for presentation by portal clients. It can also be configured to forward data to the data warehouse for subsequent inspection and analytics.

## Tivoli Enterprise Portal Server

Desktop and browser-based clients connect to the Tivoli Enterprise Portal Server. It provides the core presentation layer for retrieval, manipulation, analysis, and preformatting of data. The portal server retrieves data from the hub monitoring server and sends the data back to the portal client for presentation.

## Tivoli Enterprise Portal desktop client

The Tivoli Enterprise Portal client is a dashboard for viewing and monitoring an enterprise network. It can be viewed either as a desktop application or through a browser as a web application. It can be configured to test various monitored values against a threshold and display an alert icon when that threshold is exceeded or a value is matched. These tests are called *situations*.

### Data warehouse

The Tivoli Data Warehouse is an optional component for storing historical data that is collected from the various monitoring agents. It includes a relational database that allows the historical and trending analysis of all collected metrics. This analysis is useful for baselining and viewing peak load periods for an hour, day, week, or other specified time period.

### Event synchronization

The event synchronization components are optional. These components are configured to send situation event updates that were forwarded to a Tivoli Enterprise Console® Event Server, Tivoli Netcool/OMNIbus Object Server, or Tivoli Business Service Management.

## 5.1.2 IBM Tivoli Composite Application Manager

IBM Tivoli Composite Application Manager is a family of monitoring products that combines end-to-end application management with deep-dive, root cause capabilities. Tivoli Composite Application Manager delivers an integrated solution for monitoring and management across the enterprise and offers a single set of tools that can help optimize performance and availability at every level of the IT infrastructure.

Tivoli Composite Application Manager products provide a workflow for solving business application problems, as shown in Figure 5-2.

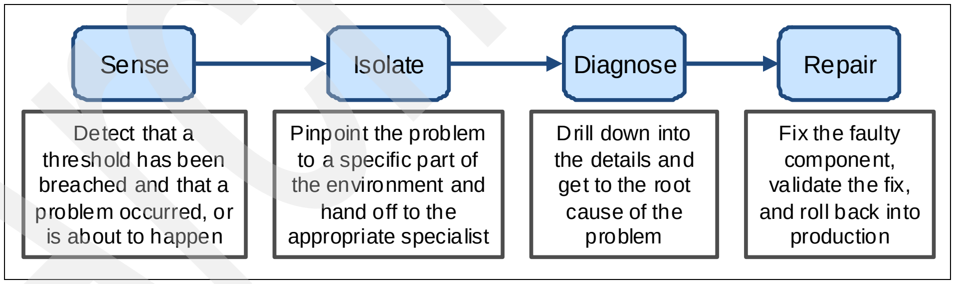

Sense
Isolate
Diagnose
Repair
Detect that a threshold has been breached and that a problem occurred, or is about to happen
Pinpoint the problem to a specific part of the environment and hand off to the appropriate specialist
Drill down into the details and get to the root cause of the problem
Fix the faulty component, validate the fix, and roll back into production

*Figure 5-2 Tivoli Composite Application Manager workflow for solving problems*

Tivoli Composite Application Manager helps to simplify and enhance application management for components that can reside in the following locations:

- On multiple servers
- Across diverse platforms, such as DataPower appliances and mainframes
- Within separate Java 2 Platform, Enterprise Edition (J2EE) environments

Integration begins at the data layer, where a common data model enables a consistent view of information across all components and agents. This information is then consolidated in Tivoli Enterprise Portal, which provides single sign-on (SSO) to the monitoring data and management tools needed for server management, application management, transaction management, and advanced management capabilities.

The following Tivoli Composite Application Manager products are among the most popular:

- IBM Tivoli Composite Application Manager for SOA Platform: Observes, monitors, tracks, and applies controls to web service messages
- Tivoli Composite Application Manager for Application Diagnostics: Monitors and performs deep-dive diagnostics for J2EE applications
- Tivoli Composite Application Manager for Applications: Monitors applications and application infrastructures
- Tivoli Composite Application Manager for Transactions: Consists of real user monitoring (web response time), synthetic monitoring (robotic response time), protocol-based monitoring (Internet service monitoring), and end-to-end transaction monitoring (transaction tracking)
- Tivoli Composite Application Manager for Virtual Servers: Monitors VMware, zVM, Power systems, Hyper-V, Citrix, KVM, Xen, and Microsoft® Virtual Server environments
- Tivoli Monitoring for Energy Management: Monitors and optimizes power consumption

The remainder of this chapter will focus on the IBM Tivoli Composite Application Manager for SOA product and its relationship to DataPower appliances.

### 5.1.3 IBM Tivoli Composite Application Manager for SOA

IBM Tivoli Composite Application Manager for SOA is a bundle of products that are part of a series of integrated performance management solutions that plug directly into IBM Tivoli Monitoring. It is designed to observe, monitor, track, and apply controls to web services in an SOA environment. The data that is collected by IBM Tivoli Composite Application Manager for SOA can then be graphically displayed within the integrated console, as shown in Figure 5-3 on page 136. This integration and graphical display or *dashboard* helps engineers and IT operators pinpoint issues at the web services layer in addition to providing automation capabilities for service mediation.

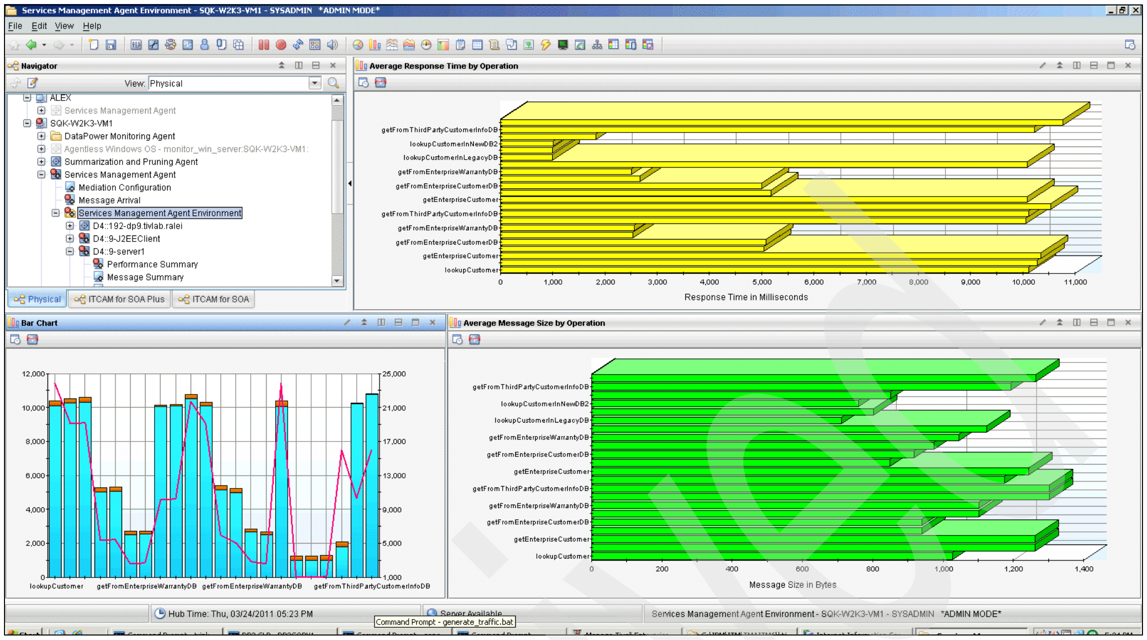
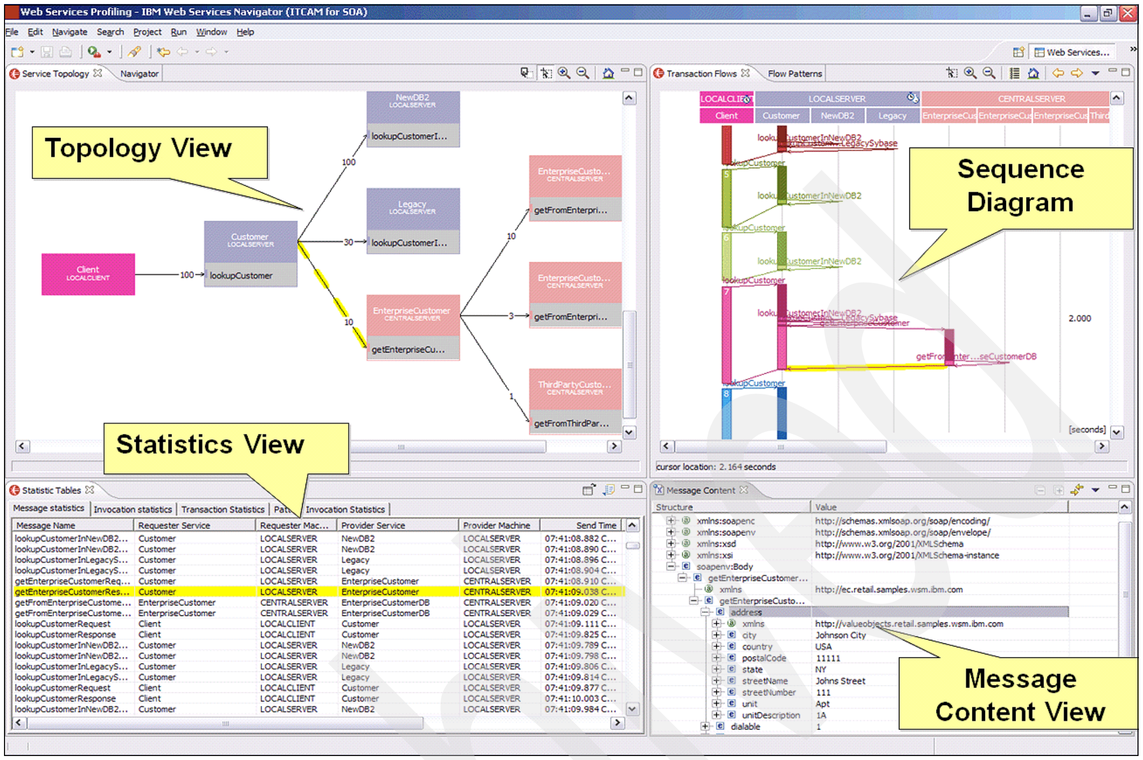

Services Management Agent Environment - SQK-W2K3-VM1 - SYSADMIN *ADMIN MODE*
File Edit View Help
Navigator
View: Physical
Average Response Time by Operation
Response Time in Milliseconds
Bar Chart
Average Message Size by Operation
Message Size in Bytes
Physical
ITCAM for SOA Plus
ITCAM for SOA
Hub Time: Thu, 03/24/2011 05:23 PM
Server Available
Services Management Agent Environment - SQK-W2K3-VM1 - SYSADMIN *ADMIN MODE*

*Figure 5-3 IBM Tivoli Composite Application Manager for SOA dashboard example*

## Tivoli Composite Application Manager for SOA Web Services Navigator

In addition to the dashboards that are provided with Tivoli Enterprise Portal, IBM Tivoli Composite Application Manager for SOA includes the Web Services Navigator. This tool is a plug-in to IBM Rational® Application Development and other Eclipse-based tools. It provides a deep understanding of the service flow, patterns, and relationships for developers and architects. The Web Services Navigator uses data from Tivoli Data Warehouse or directly from IBM Tivoli Composite Application Manager for SOA log files. Figure 5-4 on page 137 shows an example of the Web Services Navigator.



| Message Name | Requester Service | Requester Mac… | Provider Service | Provider Machine | Send Time |
|---|---|---|---|---|---|
| lookupCustomerInNewDB2… | Customer | LOCALSERVER | NewDB2 | LOCALSERVER | 07:41:08.882 C… |
| lookupCustomerInNewDB2… | Customer | LOCALSERVER | NewDB2 | LOCALSERVER | 07:41:08.890 C… |
| lookupCustomerInLegacyS… | Customer | LOCALSERVER | Legacy | LOCALSERVER | 07:41:08.896 C… |
| lookupCustomerInLegacyS… | Customer | LOCALSERVER | Legacy | LOCALSERVER | 07:41:08.904 C… |
| getEnterpriseCustomerReq… | Customer | LOCALSERVER | EnterpriseCustomer | CENTRALSERVER | 07:41:08.910 C… |
| getEnterpriseCustomerRes… | Customer | LOCALSERVER | EnterpriseCustomer | CENTRALSERVER | 07:41:09.038 C… |
| getFromEnterpriseCustome… | EnterpriseCustomer | CENTRALSERVER | EnterpriseCustomerDB | CENTRALSERVER | 07:41:09.020 C… |
| getFromEnterpriseCustome… | EnterpriseCustomer | CENTRALSERVER | EnterpriseCustomerDB | CENTRALSERVER | 07:41:09.029 C… |
| lookupCustomerRequest | Client | LOCALCLIENT | Customer | LOCALSERVER | 07:41:09.111 C… |
| lookupCustomerResponse | Client | LOCALCLIENT | Customer | LOCALSERVER | 07:41:09.825 C… |
| lookupCustomerInNewDB2… | Customer | LOCALSERVER | NewDB2 | LOCALSERVER | 07:41:09.789 C… |
| lookupCustomerInNewDB2… | Customer | LOCALSERVER | NewDB2 | LOCALSERVER | 07:41:09.798 C… |
| lookupCustomerInLegacyS… | Customer | LOCALSERVER | Legacy | LOCALSERVER | 07:41:09.806 C… |
| lookupCustomerInLegacyS… | Customer | LOCALSERVER | Legacy | LOCALSERVER | 07:41:09.814 C… |
| lookupCustomerRequest | Client | LOCALCLIENT | Customer | LOCALSERVER | 07:41:09.877 C… |
| lookupCustomerResponse | Client | LOCALCLIENT | Customer | LOCALSERVER | 07:41:10.003 C… |
| lookupCustomerInNewDB2… | Customer | LOCALSERVER | NewDB2 | LOCALSERVER | 07:41:09.984 C… |

| Structure | Value |
|---|---|
| xmlns:soapenc | http://schemas.xmlsoap.org/soap/encoding/ |
| xmlns:soapenv | http://schemas.xmlsoap.org/soap/envelope/ |
| xmlns:xsd | http://www.w3.org/2001/XMLSchema |
| xmlns:xsi | http://www.w3.org/2001/XMLSchema-instance |
| soapenv:Body | |
| getEnterpriseCustomer… | |
| xmlns | http://ec.retail.samples.wsm.ibm.com |
| getEnterpriseCusto… | |
| address | |
| xmlns | http://valueobjects.retail.samples.wsm.ibm.com |
| city | Johnson City |
| country | USA |
| postalCode | 11111 |
| state | NY |
| streetName | Johns Street |
| streetNumber | 111 |
| unit | Apt |
| unitDescription | 1A |
| dialable | 1 |

*Figure 5-4 Web Services Navigator*

The IBM Tivoli Composite Application Manager for SOA Web Services Navigator provides the following capabilities:

- Topology View: A graphical representation of the interactions among all monitored web services
- Statistics View: Tables of the metric data that is collected by the agents at each interception point
- Sequence Diagram: The exact sequence of messages over time (Unified Modeling Language (UML)-type sequence diagrams and call flows)
- Message Flow Pattern: A visual representation of the various patterns of transactions; each pattern represents a distinct sequence of web service calls
- Message Content View: Content of the SOAP message itself

## 5.2 Monitoring DataPower appliances

IBM Tivoli Composite Application Manager for SOA ships with a complete monitoring solution for DataPower appliances that is ready for immediate use. The solution uses two dedicated DataPower agents that operate at separate layers of the open systems interconnection (OSI) model:

- *IBM Tivoli Composite Application Manager for SOA DataPower data collector* monitors application-level traffic that flows through various DataPower services, such as the Web Service Proxy (WS-Proxy) and Multi-Protocol Gateway objects. This agent is often referred to as the "*Traffic Monitor*".
- *Tivoli Composite Application Manager Agent for WebSphere DataPower Appliance* monitors DataPower device health and availability. This agent is often referred to as the "*Health Monitor*".

These agents complement each other and provide excellent control and visibility of DataPower devices.

IBM Tivoli Composite Application Manager for SOA ships with and plugs into the Tivoli Monitoring framework. Tivoli Monitoring provides the base enterprise-class monitoring functionality, including alerting, performance thresholds, historical trending analysis, reporting capability, high availability, and policies to perform actions, schedule work, and automate manual tasks (see 5.1, "IBM Tivoli Monitoring environment architecture" on page 132).

### 5.2.1 Monitoring DataPower application-level traffic

Of the two agents, the IBM Tivoli Composite Application Manager for SOA DataPower data collector is used for monitoring DataPower appliances for application-related metrics. Depending on how the appliance is configured, it extracts application-related details pertaining to traffic passing through service objects, such as the WS-Proxy and Multi-Protocol Gateway.

The data collector forwards the extracted metrics to a Tivoli Enterprise Monitoring Server where it can be consolidated with metrics from other Tivoli Composite Application Manager agents, such as .Net, WebSphere, WebLogic, and so on. This aggregate of metrics allows for a greater visibility of not only DataPower application traffic, but also the upstream and downstream services and components that affect overall application throughput.

This *correlated data* is automatically drawn in a topology workspace that contains performance metrics and alerts. Figure 5-5 shows an example of the IBM Tivoli Composite Application Manager for SOA workspace within the Tivoli Enterprise Portal.

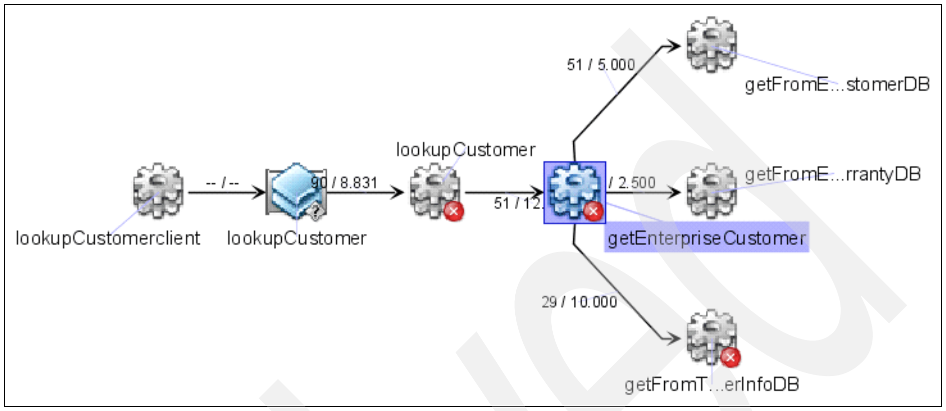


*Figure 5-5 Web service topology diagram with alerts and metrics*

The web service topology diagram workspace allows for the creation of *service groups*. A service group encapsulates a set of operations that collectively provide business function, such as createPolicy or lookupCustomer (see Figure 5-6 on page 140). IBM Tivoli Composite Application Manager for SOA can provide management of the SOA environment monitoring from the edge, through DataPower devices, and follow the service to service hops. IBM Tivoli Composite Application Manager for SOA ships with the agents that are required to track this flow from both distributed applications through the mainframe, such as CICS® on z/OS®.

IBM Tivoli Composite Application Manager for SOA can also determine the unavailability for services and service groups in the following terms:

- Unavailability by faults: Situations triggered when faults are detected
- Absence of expected traffic: Situations triggered by monitoring traffic volumes
- Requests without responses: Situations triggered by missing or invalid responses
- Request/response/fault counts: Situations triggered by the ratio of requests to responses or faults

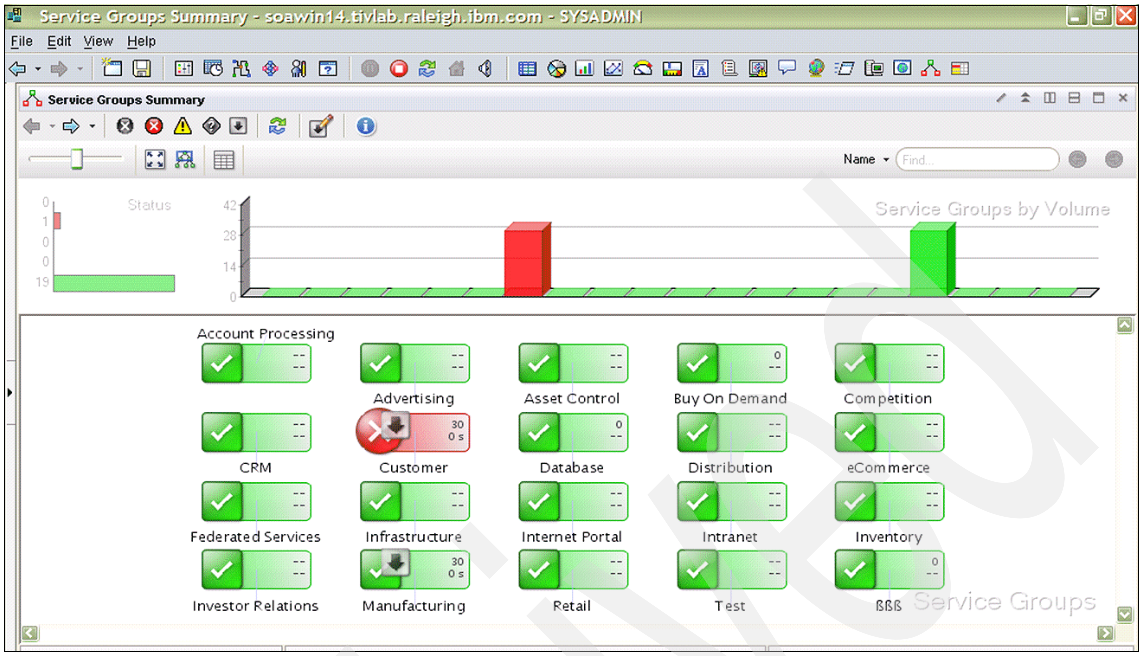


Figure 5-6 IBM Tivoli Composite Application Manager for SOA Service Groups dashboard

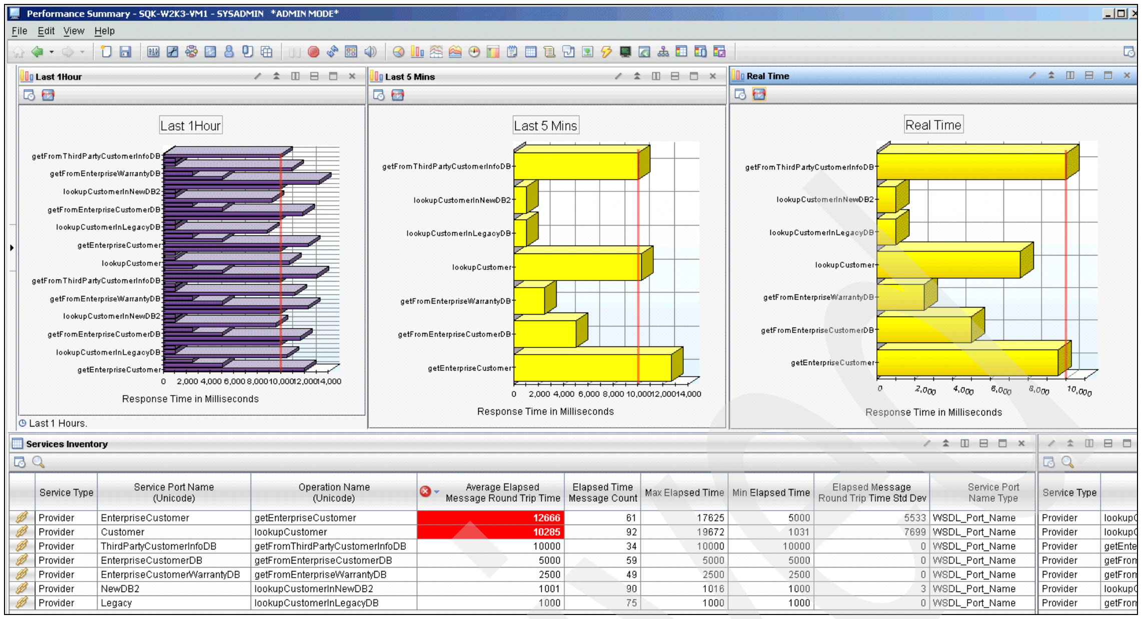
## Monitoring key performance indicators

IBM Tivoli Composite Application Manager for SOA DataPower data collector also monitors critical service-level metrics, such as response times, message sizes, message counts, and faults. It operates on fixed intervals and calculates aggregate information, such as these examples:

- Response time averages and standard deviations
- Arrival rates
- Service latency
- Weighted averages
- Minimum and maximum values
- Message sizes, counts, and faults

You can use these key performance indicators (KPIs) to create a multitude of graphs, charts, table views, and so on (see Figure 5-7 on page 141). For information about the complete KPI list, see Appendix B, Attribute groups, in *IBM Tivoli Composite Application Manager for SOA, User's Guide Version 7.1.1,* or visit the following URL:

http://publib.boulder.ibm.com/infocenter/tivihelp/v3r1/topic/com.ibm.itcamsoa.doc/kd4ugmst204.htm#app_attributes



Services Inventory

| Service Type | Service Port Name (Unicode) | Operation Name (Unicode) | Average Elapsed Message Round Trip Time | Elapsed Time Message Count | Max Elapsed Time | Min Elapsed Time | Elapsed Message Round Trip Time Std Dev | Service Port Name Type |
|---|---|---|---|---|---|---|---|---|
| Provider | EnterpriseCustomer | getEnterpriseCustomer | 12666 | 61 | 17625 | 5000 | 5533 | WSDL_Port_Name |
| Provider | Customer | lookupCustomer | 10285 | 92 | 19672 | 1031 | 7699 | WSDL_Port_Name |
| Provider | ThirdPartyCustomerInfoDB | getFromThirdPartyCustomerInfoDB | 10000 | 34 | 10000 | 10000 | 0 | WSDL_Port_Name |
| Provider | EnterpriseCustomerDB | getFromEnterpriseCustomerDB | 5000 | 59 | 5000 | 5000 | 0 | WSDL_Port_Name |
| Provider | EnterpriseCustomerWarrantyDB | getFromEnterpriseWarrantyDB | 2500 | 49 | 2500 | 2500 | 0 | WSDL_Port_Name |
| Provider | NewDB2 | lookupCustomerInNewDB2 | 1001 | 90 | 1016 | 1000 | 3 | WSDL_Port_Name |
| Provider | Legacy | lookupCustomerInLegacyDB | 1000 | 75 | 1000 | 1000 | 0 | WSDL_Port_Name |

Figure 5-7 IBM Tivoli Composite Application Manager for SOA view of DataPower services for various time intervals

### Collecting application message content

You can configure IBM Tivoli Composite Application Manager for SOA to collect web services message content (options: full, body, or header). The message content is stored locally on the system where the Tivoli Enterprise Management Agent resides. You can view the captured data either with a text editor or with IBM Tivoli Composite Application Manager for SOA Web Services Navigator.

**Content file size:** IBM Tivoli Composite Application Manager for SOA does not truncate, move, or manage the content files. You must clean up the files via schedule jobs or manually. The size of the files can be significant, because the size is based on the number of web services calls and the message size.

## 5.2.2 Monitoring hardware metrics and resource use

Tivoli Composite Application Manager Agent for WebSphere DataPower Appliance focuses on device health and availability, including these types of information:

- Resource usage (CPU, memory, and network)
- Object status
- System logs

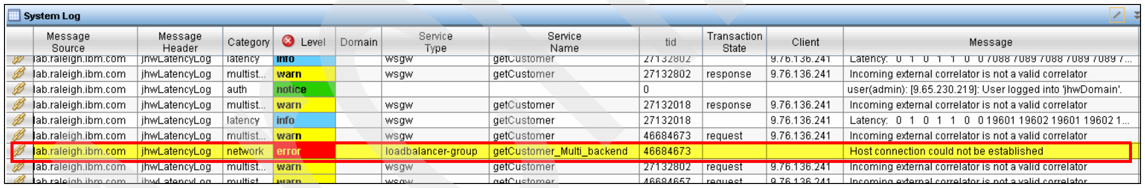
- Events
- Connection statistics
- Transaction latency

Another useful feature of the Tivoli Composite Application Manager Agent for DataPower is the ability to receive Simple Network Management Protocol (SNMP) alerts and notifications that are sent by the DataPower device. This feature allows the monitoring of critical device events, including restarts, disabled interfaces, security access violations, or other hardware issues, such as memory, power supply, battery, or fan failures.

Similar to the IBM Tivoli Composite Application Manager for SOA DataPower data collector, this agent can also monitor transaction-level metrics using the DataPower latency logs. This method is a quick way to view transactions without having to instrument DataPower processing rules with customized Extensible Stylesheet Language (XSL) templates.

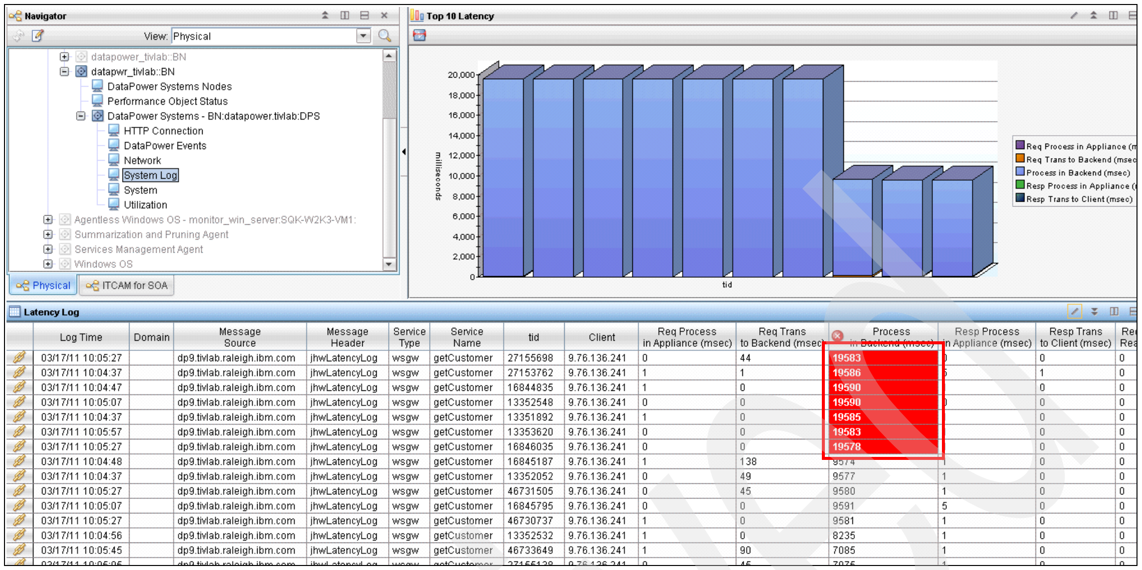
Although the Tivoli Composite Application Manager Agent for WebSphere DataPower Appliance has the ability to monitor transaction-level metrics, the metrics are not automatically correlated or aggregated; thus, it can be difficult to find the start of a transaction.

Figure 5-8 shows an example view of system log content that is extracted by the Tivoli Composite Application Manager Agent for WebSphere DataPower Appliance. The view in Figure 5-9 on page 143 shows uncorrelated latency logs.


System Log

| Message Source | Message Header | Category | Level | Domain | Service Type | Service Name | tid | Transaction State | Client | Message |
|---|---|---|---|---|---|---|---|---|---|---|
| lab.raleigh.ibm.com | jhwLatencyLog | latency | info | | wsgw | getCustomer | 27132802 | | 9.76.136.241 | Latency: 0 1 0 1 1 0 0 7088 7089 7088 7089 7089 7... |
| lab.raleigh.ibm.com | jhwLatencyLog | multist... | warn | | wsgw | getCustomer | 27132802 | response | 9.76.136.241 | Incoming external correlator is not a valid correlator |
| lab.raleigh.ibm.com | jhwLatencyLog | auth | notice | | | | 0 | | | user(admin): [9.65.230.219]: User logged into 'jhwDomain'. |
| lab.raleigh.ibm.com | jhwLatencyLog | multist... | warn | | wsgw | getCustomer | 27132018 | response | 9.76.136.241 | Incoming external correlator is not a valid correlator |
| lab.raleigh.ibm.com | jhwLatencyLog | latency | info | | wsgw | getCustomer | 27132018 | | 9.76.136.241 | Latency: 0 1 0 1 1 0 0 19601 19602 19601 19602 1... |
| lab.raleigh.ibm.com | jhwLatencyLog | multist... | warn | | wsgw | getCustomer | 46684673 | request | 9.76.136.241 | Incoming external correlator is not a valid correlator |
| lab.raleigh.ibm.com | jhwLatencyLog | network | error | | loadbalancer-group | getCustomer_Multi_backend | 46684673 | | | Host connection could not be established |
| lab.raleigh.ibm.com | jhwLatencyLog | multist... | warn | | wsgw | getCustomer | 27132802 | request | 9.76.136.241 | Incoming external correlator is not a valid correlator |
| lab.raleigh.ibm.com | jhwLatencyLog | multist... | warn | | wsgw | getCustomer | 46684657 | request | 9.76.136.241 | Incoming external correlator is not a valid correlator |

*Figure 5-8 DataPower system logs*


Navigator
View: Physical
datapower_tivlab::BN
datapwr_tivlab::BN
DataPower Systems Nodes
Performance Object Status
DataPower Systems - BN:datapower.tivlab:DPS
HTTP Connection
DataPower Events
Network
System Log
System
Utilization
Agentless Windows OS - monitor_win_server:SQK-W2K3-VM1:
Summarization and Pruning Agent
Services Management Agent
Windows OS
Physical
ITCAM for SOA
Top 10 Latency
milliseconds
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
tid
Req Process in Appliance (m
Req Trans to Backend (msec
Process in Backend (msec)
Resp Process in Appliance (
Resp Trans to Client (msec)
Latency Log

| Log Time | Domain | Message Source | Message Header | Service Type | Service Name | tid | Client | Req Process in Appliance (msec) | Req Trans to Backend (msec) | Process in Backend (msec) | Resp Process in Appliance (msec) | Resp Trans to Client (msec) | Re Rea |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 03/17/11 10:05:27 | | dp9.tivlab.raleigh.ibm.com | jhwLatencyLog | wsgw | getCustomer | 27155698 | 9.76.136.241 | 0 | 44 | 19583 | 0 | 0 | 0 |
| 03/17/11 10:04:37 | | dp9.tivlab.raleigh.ibm.com | jhwLatencyLog | wsgw | getCustomer | 27153762 | 9.76.136.241 | 1 | 1 | 19586 | 5 | 1 | 0 |
| 03/17/11 10:04:47 | | dp9.tivlab.raleigh.ibm.com | jhwLatencyLog | wsgw | getCustomer | 16844835 | 9.76.136.241 | 1 | 0 | 19590 | [illegible] | 0 | 0 |
| 03/17/11 10:05:07 | | dp9.tivlab.raleigh.ibm.com | jhwLatencyLog | wsgw | getCustomer | 13352548 | 9.76.136.241 | 0 | 0 | 19590 | 0 | 0 | 0 |
| 03/17/11 10:04:37 | | dp9.tivlab.raleigh.ibm.com | jhwLatencyLog | wsgw | getCustomer | 13351892 | 9.76.136.241 | 1 | 0 | 19585 | [illegible] | 0 | 0 |
| 03/17/11 10:05:57 | | dp9.tivlab.raleigh.ibm.com | jhwLatencyLog | wsgw | getCustomer | 13353620 | 9.76.136.241 | 0 | 0 | 19583 | [illegible] | 0 | 0 |
| 03/17/11 10:05:27 | | dp9.tivlab.raleigh.ibm.com | jhwLatencyLog | wsgw | getCustomer | 16846035 | 9.76.136.241 | 0 | 0 | 19578 | [illegible] | 0 | 0 |
| 03/17/11 10:04:48 | | dp9.tivlab.raleigh.ibm.com | jhwLatencyLog | wsgw | getCustomer | 16845187 | 9.76.136.241 | 1 | 138 | 9574 | 1 | 0 | 0 |
| 03/17/11 10:04:37 | | dp9.tivlab.raleigh.ibm.com | jhwLatencyLog | wsgw | getCustomer | 13352052 | 9.76.136.241 | 0 | 49 | 9577 | 1 | 0 | 0 |
| 03/17/11 10:05:27 | | dp9.tivlab.raleigh.ibm.com | jhwLatencyLog | wsgw | getCustomer | 46731505 | 9.76.136.241 | 0 | 45 | 9580 | 1 | 0 | 0 |
| 03/17/11 10:05:07 | | dp9.tivlab.raleigh.ibm.com | jhwLatencyLog | wsgw | getCustomer | 16845795 | 9.76.136.241 | 0 | 0 | 9591 | 5 | 0 | 0 |
| 03/17/11 10:05:27 | | dp9.tivlab.raleigh.ibm.com | jhwLatencyLog | wsgw | getCustomer | 46730737 | 9.76.136.241 | 1 | 0 | 9581 | 1 | 0 | 0 |
| 03/17/11 10:04:56 | | dp9.tivlab.raleigh.ibm.com | jhwLatencyLog | wsgw | getCustomer | 13352532 | 9.76.136.241 | 1 | 0 | 8235 | 1 | 0 | 0 |
| 03/17/11 10:05:45 | | dp9.tivlab.raleigh.ibm.com | jhwLatencyLog | wsgw | getCustomer | 46733649 | 9.76.136.241 | 1 | 90 | 7085 | 1 | 0 | 0 |

*Figure 5-9 DataPower latency logs show uncorrelated transaction-level metrics*

Figure 5-10 on page 144, Figure 5-11 on page 145, Figure 5-12 on page 146, and Figure 5-13 on page 147 show samples of the numerous workspaces that ship with this solution.

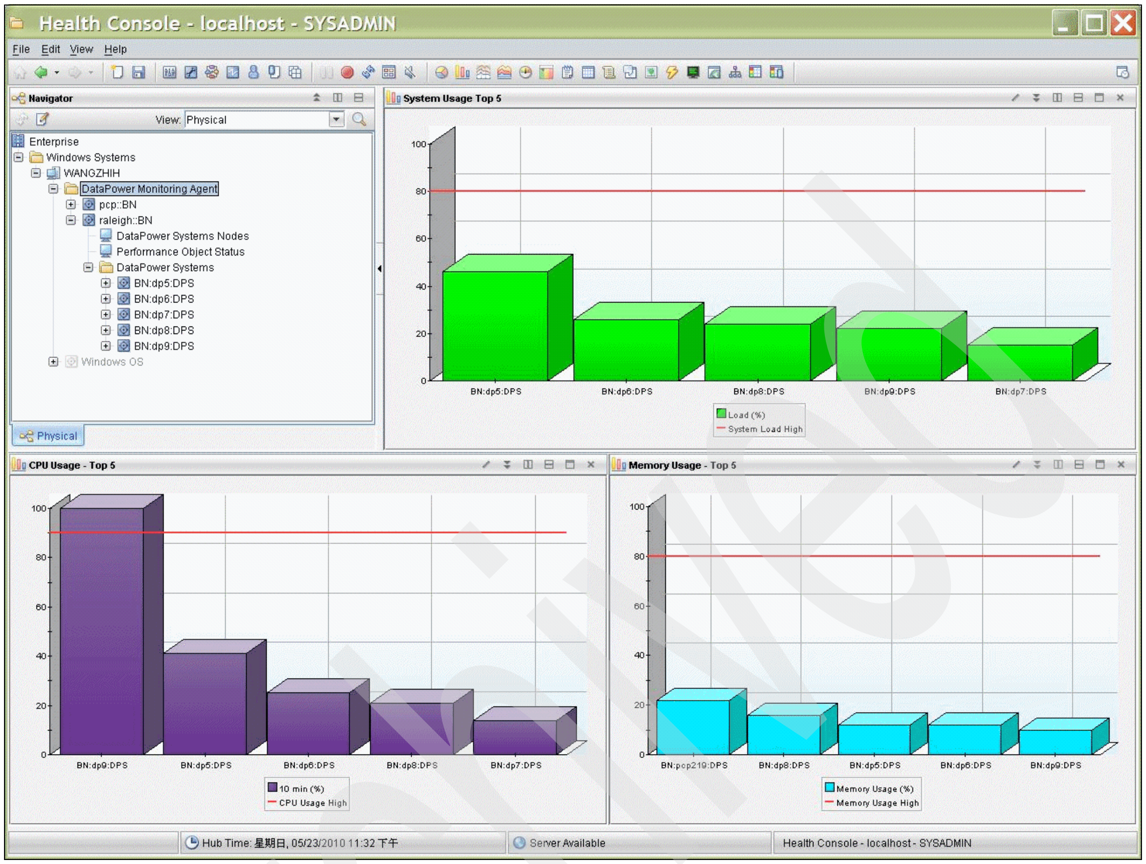
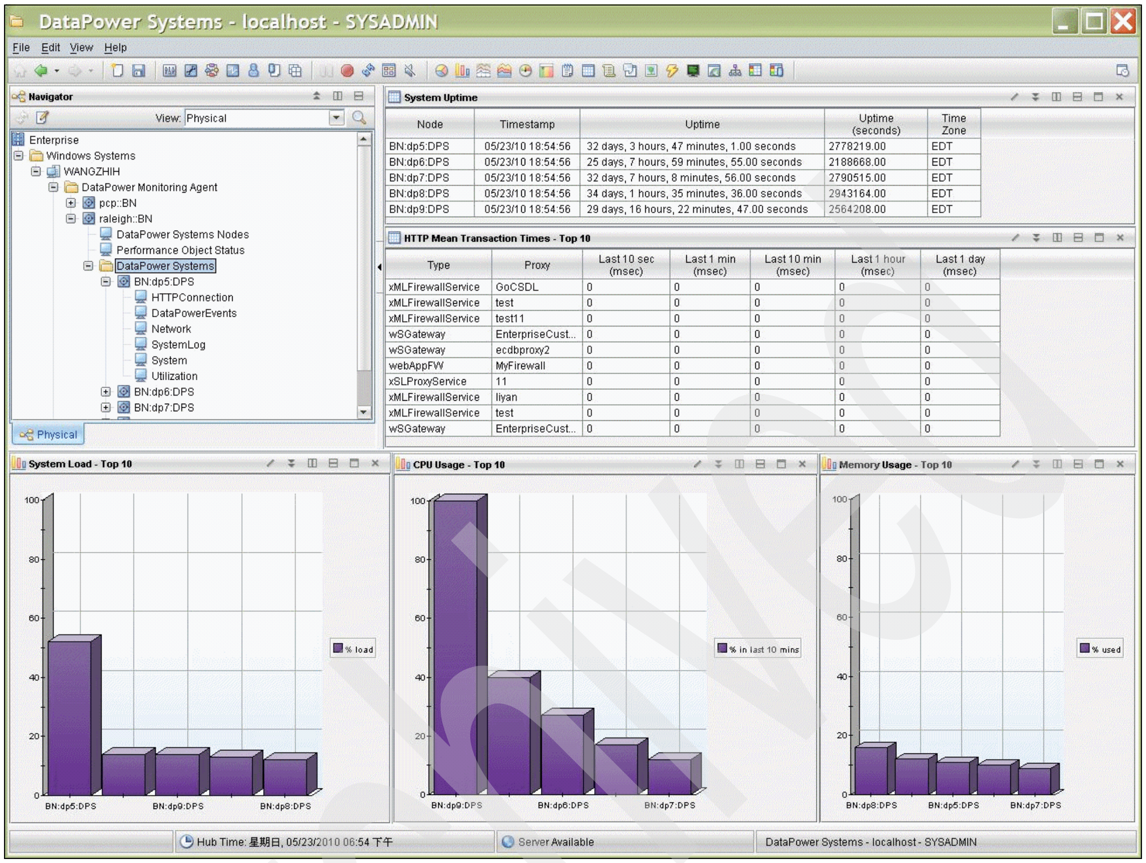


*Figure 5-10 DataPower health console: Top resource usage*



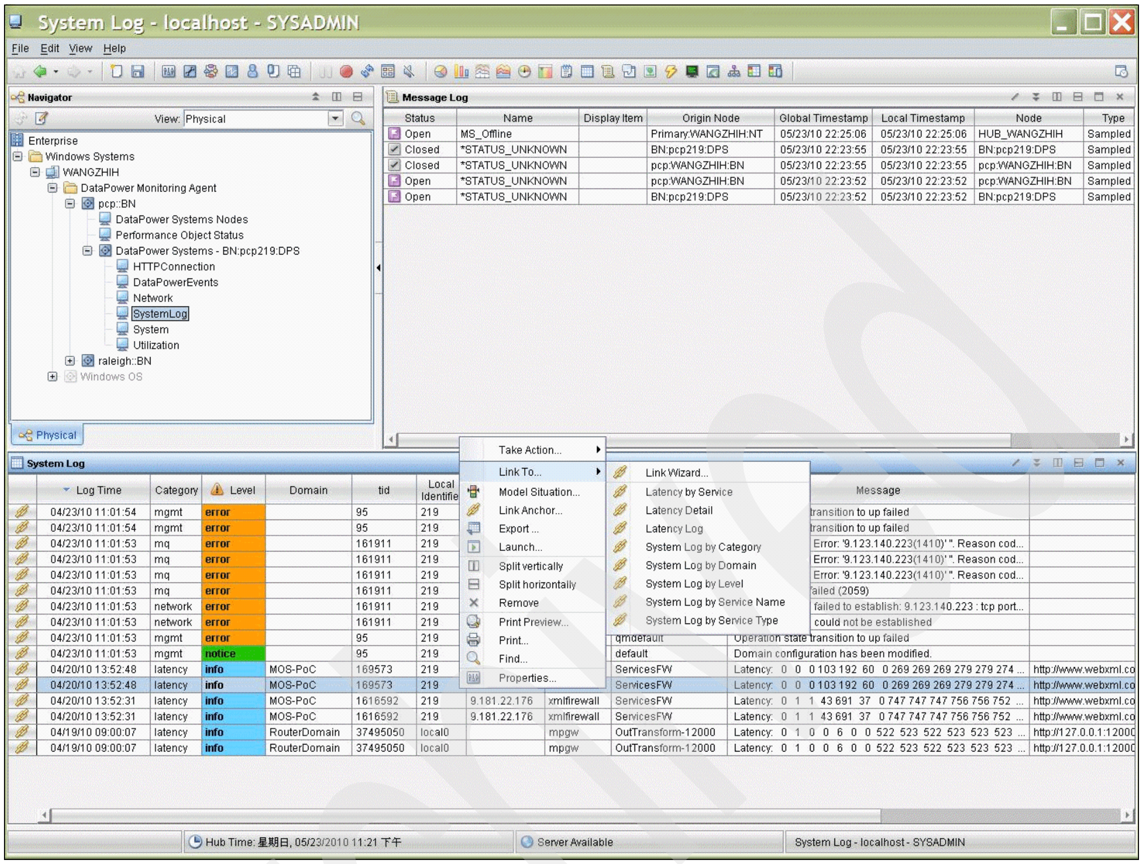
System Uptime

| Node | Timestamp | Uptime | Uptime (seconds) | Time Zone |
|---|---|---|---|---|
| BN:dp5:DPS | 05/23/10 18:54:56 | 32 days, 3 hours, 47 minutes, 1.00 seconds | 2778219.00 | EDT |
| BN:dp6:DPS | 05/23/10 18:54:56 | 25 days, 7 hours, 59 minutes, 55.00 seconds | 2188668.00 | EDT |
| BN:dp7:DPS | 05/23/10 18:54:56 | 32 days, 7 hours, 8 minutes, 56.00 seconds | 2790515.00 | EDT |
| BN:dp8:DPS | 05/23/10 18:54:56 | 34 days, 1 hours, 35 minutes, 36.00 seconds | 2943164.00 | EDT |
| BN:dp9:DPS | 05/23/10 18:54:56 | 29 days, 16 hours, 22 minutes, 47.00 seconds | 2564208.00 | EDT |

HTTP Mean Transaction Times - Top 10

| Type | Proxy | Last 10 sec (msec) | Last 1 min (msec) | Last 10 min (msec) | Last 1 hour (msec) | Last 1 day (msec) |
|---|---|---|---|---|---|---|
| xMLFirewallService | GoCSDL | 0 | 0 | 0 | 0 | 0 |
| xMLFirewallService | test | 0 | 0 | 0 | 0 | 0 |
| xMLFirewallService | test11 | 0 | 0 | 0 | 0 | 0 |
| wSGateway | EnterpriseCust... | 0 | 0 | 0 | 0 | 0 |
| wSGateway | ecdbproxy2 | 0 | 0 | 0 | 0 | 0 |
| webAppFW | MyFirewall | 0 | 0 | 0 | 0 | 0 |
| xSLProxyService | 11 | 0 | 0 | 0 | 0 | 0 |
| xMLFirewallService | liyan | 0 | 0 | 0 | 0 | 0 |
| xMLFirewallService | test | 0 | 0 | 0 | 0 | 0 |
| wSGateway | EnterpriseCust... | 0 | 0 | 0 | 0 | 0 |

*Figure 5-11 DataPower system uptime, HTTP mean transaction, system load, CPU, and memory usage*



**Message Log**

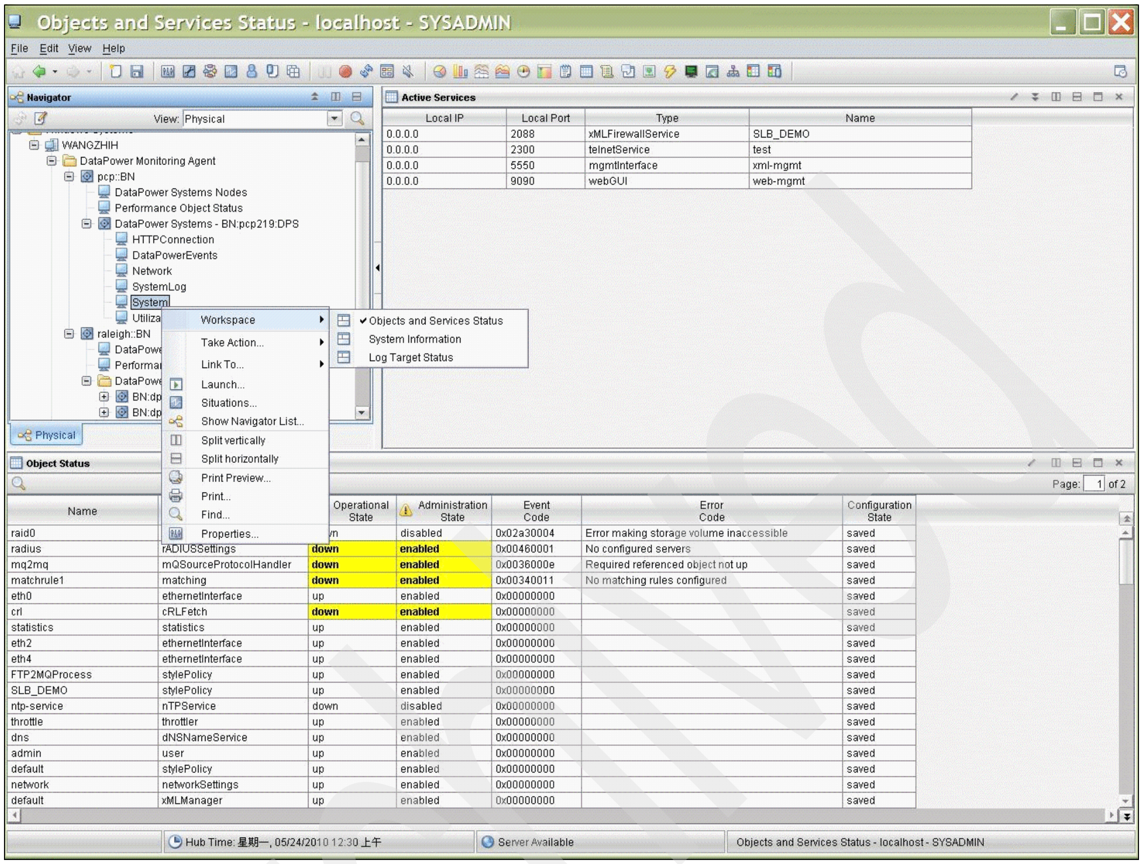
| Status | Name | Display Item | Origin Node | Global Timestamp | Local Timestamp | Node | Type |
|---|---|---|---|---|---|---|---|
| Open | MS_Offline | | Primary:WANGZHIH:NT | 05/23/10 22:25:06 | 05/23/10 22:25:06 | HUB_WANGZHIH | Sampled |
| Closed | *STATUS_UNKNOWN | | BN:pcp219:DPS | 05/23/10 22:23:55 | 05/23/10 22:23:55 | BN:pcp219:DPS | Sampled |
| Closed | *STATUS_UNKNOWN | | pcp:WANGZHIH:BN | 05/23/10 22:23:55 | 05/23/10 22:23:55 | pcp:WANGZHIH:BN | Sampled |
| Open | *STATUS_UNKNOWN | | pcp:WANGZHIH:BN | 05/23/10 22:23:52 | 05/23/10 22:23:52 | pcp:WANGZHIH:BN | Sampled |
| Open | *STATUS_UNKNOWN | | BN:pcp219:DPS | 05/23/10 22:23:52 | 05/23/10 22:23:52 | BN:pcp219:DPS | Sampled |

**System Log**

| Log Time | Category | Level | Domain | tid | Local Identifie | | | | Message | |
|---|---|---|---|---|---|---|---|---|---|---|
| 04/23/10 11:01:54 | mgmt | error | | 95 | 219 | | | | transition to up failed | |
| 04/23/10 11:01:54 | mgmt | error | | 95 | 219 | | | | transition to up failed | |
| 04/23/10 11:01:53 | mq | error | | 161911 | 219 | | | | Error: '9.123.140.223(1410)' ". Reason cod... | |
| 04/23/10 11:01:53 | mq | error | | 161911 | 219 | | | | Error: '9.123.140.223(1410)' ". Reason cod... | |
| 04/23/10 11:01:53 | mq | error | | 161911 | 219 | | | | Error: '9.123.140.223(1410)' ". Reason cod... | |
| 04/23/10 11:01:53 | mq | error | | 161911 | 219 | | | | failed (2059) | |
| 04/23/10 11:01:53 | network | error | | 161911 | 219 | | | | failed to establish: 9.123.140.223 : tcp port... | |
| 04/23/10 11:01:53 | network | error | | 161911 | 219 | | | | could not be established | |
| 04/23/10 11:01:53 | mgmt | error | | 95 | 219 | | | qmdefault | Operation state transition to up failed | |
| 04/23/10 11:01:53 | mgmt | notice | | 95 | 219 | | | default | Domain configuration has been modified. | |
| 04/20/10 13:52:48 | latency | info | MOS-PoC | 169573 | 219 | | | ServicesFW | Latency: 0 0 0 103 192 60 0 269 269 269 279 279 274 ... | http://www.webxml.co |
| 04/20/10 13:52:48 | latency | info | MOS-PoC | 169573 | 219 | | | ServicesFW | Latency: 0 0 0 103 192 60 0 269 269 269 279 279 274 ... | http://www.webxml.co |
| 04/20/10 13:52:31 | latency | info | MOS-PoC | 1616592 | 219 | 9.181.22.176 | xmlfirewall | ServicesFW | Latency: 0 1 1 43 691 37 0 747 747 747 756 756 752 ... | http://www.webxml.co |
| 04/20/10 13:52:31 | latency | info | MOS-PoC | 1616592 | 219 | 9.181.22.176 | xmlfirewall | ServicesFW | Latency: 0 1 1 43 691 37 0 747 747 747 756 756 752 ... | http://www.webxml.co |
| 04/19/10 09:00:07 | latency | info | RouterDomain | 37495050 | local0 | | mpgw | OutTransform-12000 | Latency: 0 1 0 0 6 0 0 522 523 522 523 523 523 ... | http://127.0.0.1:12000 |
| 04/19/10 09:00:07 | latency | info | RouterDomain | 37495050 | local0 | | mpgw | OutTransform-12000 | Latency: 0 1 0 0 6 0 0 522 523 522 523 523 523 ... | http://127.0.0.1:12000 |

Hub Time: 星期日, 05/23/2010 11:21 下午 | Server Available | System Log - localhost - SYSADMIN

*Figure 5-12 DataPower system logs: View latency details of a specific transaction*



| Local IP | Local Port | Type | Name |
|---|---|---|---|
| 0.0.0.0 | 2088 | xMLFirewallService | SLB_DEMO |
| 0.0.0.0 | 2300 | telnetService | test |
| 0.0.0.0 | 5550 | mgmtInterface | xml-mgmt |
| 0.0.0.0 | 9090 | webGUI | web-mgmt |

| Name | | Operational State | Administration State | Event Code | Error Code | Configuration State |
|---|---|---|---|---|---|---|
| raid0 | | wn | disabled | 0x02a30004 | Error making storage volume inaccessible | saved |
| radius | rADIUSSettings | **down** | **enabled** | 0x00460001 | No configured servers | saved |
| mq2mq | mQSourceProtocolHandler | **down** | **enabled** | 0x0036000e | Required referenced object not up | saved |
| matchrule1 | matching | **down** | **enabled** | 0x00340011 | No matching rules configured | saved |
| eth0 | ethernetInterface | up | enabled | 0x00000000 | | saved |
| crl | cRLFetch | **down** | **enabled** | 0x00000000 | | saved |
| statistics | statistics | up | enabled | 0x00000000 | | saved |
| eth2 | ethernetInterface | up | enabled | 0x00000000 | | saved |
| eth4 | ethernetInterface | up | enabled | 0x00000000 | | saved |
| FTP2MQProcess | stylePolicy | up | enabled | 0x00000000 | | saved |
| SLB_DEMO | stylePolicy | up | enabled | 0x00000000 | | saved |
| ntp-service | nTPService | down | disabled | 0x00000000 | | saved |
| throttle | throttler | up | enabled | 0x00000000 | | saved |
| dns | dNSNameService | up | enabled | 0x00000000 | | saved |
| admin | user | up | enabled | 0x00000000 | | saved |
| default | stylePolicy | up | enabled | 0x00000000 | | saved |
| network | networkSettings | up | enabled | 0x00000000 | | saved |
| default | xMLManager | up | enabled | 0x00000000 | | saved |

Hub Time: 星期一, 05/24/2010 12:30 上午 | Server Available | Objects and Services Status - localhost - SYSADMIN

*Figure 5-13 DataPower object status and active services*

## 5.2.3 IBM Tivoli Composite Application Manager for SOA DataPower agent comparisons

The two IBM Tivoli Composite Application Manager for SOA monitoring agents that are specific to DataPower appliances are each tailored for specific reporting requirements. They are mutually exclusive of each other and can be deployed either individually for specific monitoring requirements, or together for maximum monitoring capabilities. The following agents are the two IBM Tivoli Composite Application Manager for SOA DataPower-specific agents:

- *Tivoli Composite Application Manager Agent for WebSphere DataPower Appliance*, which focuses on device health and availability. It is quick to deploy and needs to be the first component of a phased deployment plan to monitor DataPower. This agent provides extensive information about DataPower hardware usage with minimum visibility into applications (using latency logs).

- *IBM Tivoli Composite Application Manager for SOA DataPower data collector,* which provides a complete application-level monitoring solution. It focuses on monitoring application traffic that is routed through Multi-Protocol Gateway and WS-Proxy service objects.

Table 5-1 on page 149 shows the differences between the two DataPower agents.

*Table 5-1 ITCAM for SOA DataPower-specific agent comparison*

| ITCAM Agent for WebSphere DataPower Appliance (health metrics) | ITCAM for SOA DataPower data collector (application-traffic metrics) |
|---|---|
| Monitors critical device-level metrics:<br>▶ File system, CPU, and memory utilization<br>▶ Network interface monitoring; TCP and HTTP status and statistics<br><br>Monitors application-level traffic:<br>▶ Resource utilization<br>▶ Object status<br>▶ System logs<br>▶ Event notifications<br>▶ Transaction latency<br>▶ Network and connection statistics<br><br>Receives SNMP traps from DataPower; can monitor any MIB on the device<br><br>Alerts on abnormal conditions of critical events, such as battery failures, certificate expirations, and so on<br><br>Quick deployment, especially for Multi-Protocol Gateways; no need to:<br>▶ Implement XSL style sheets for every Multi-Protocol Gateway<br>▶ Code XSL style sheets for each object flow<br>▶ Map non-SOAP XML messages<br>▶ Maintain XSL style sheets<br><br>Supports XML Firewall objects and Multi-Protocol Gateway and WS-Proxy objects<br><br>Detailed information about the flow itself (latency logs):<br>▶ Includes metrics on front side and back side as well as latency of object flow itself (the application)<br>▶ Data on individual transactions: near-real time<br><br>Latency logs contains individual transaction details and data; potential performance implication | Monitors application-level traffic at the service/operation level for response times, message counts, message size, fault rate, and so on<br><br>Graphical topology; provides an automatically drawn and correlated view of the end-to-end service transaction flow with alerting and metrics in Tivoli Enterprise Portal<br><br>Service/operation grouping capabilities<br><br>Data aggregation for: averages, standard deviations, min/max, missing percentages, faults, and so on<br><br>Message content available<br><br>Requestor ID tracking support<br><br>Web Services Navigator tool<br><br>Supports Multi-Protocol Gateway and WS-Proxy services<br><br>XSL style sheets are required for Multi-Protocol Gateway monitoring:<br>▶ Takes longer to deploy and manage<br>▶ Intrusive to code flow<br><br>Integration using Discovery Library Adapters (DLAs) for WebSphere Service Registry and Repository (WSRR), Tivoli Application Dependency Discovery Manager, and Tivoli Business Service Manager |

## 5.3 Tivoli Composite Application Manager for SOA architecture

This section provides a general overview of how IBM Tivoli Composite Application Manager for SOA communicates with DataPower appliances and other IBM Tivoli Monitoring components. Figure 5-14 shows an architectural overview for the IBM Tivoli Composite Application Manager for SOA and DataPower monitoring solution.

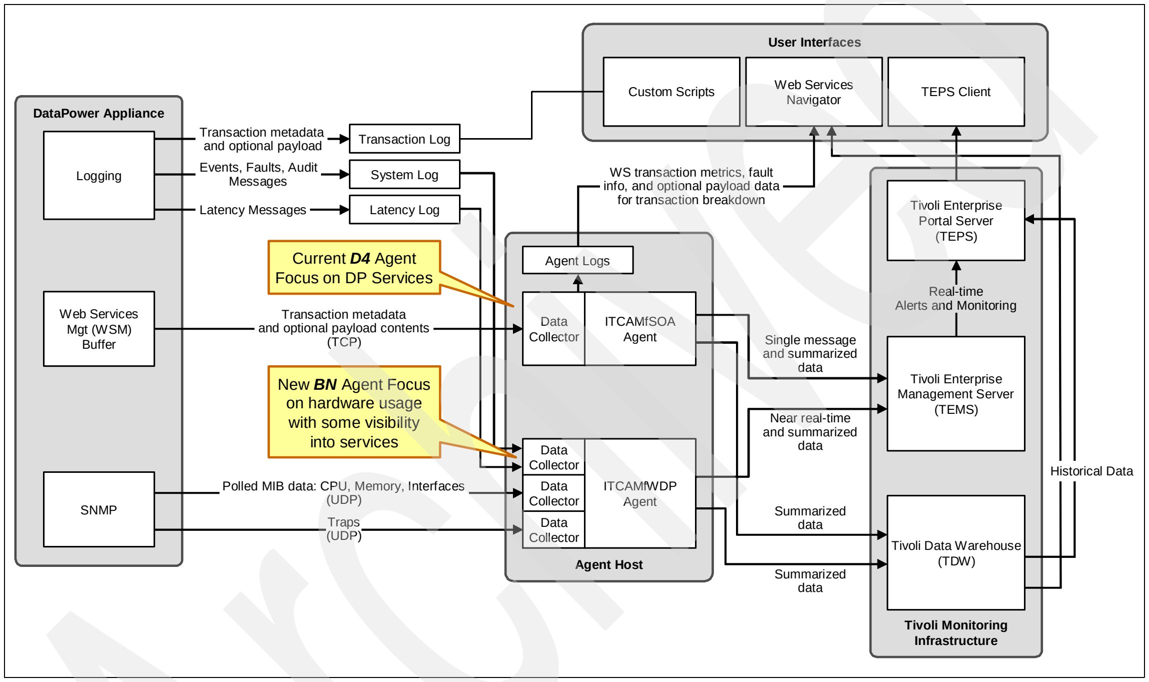

User Interfaces
Custom Scripts
Web Services Navigator
TEPS Client
DataPower Appliance
Logging
Transaction metadata and optional payload
Transaction Log
Events, Faults, Audit Messages
System Log
Latency Messages
Latency Log
WS transaction metrics, fault info, and optional payload data for transaction breakdown
Tivoli Enterprise Portal Server (TEPS)
Current D4 Agent Focus on DP Services
Agent Logs
Web Services Mgt (WSM) Buffer
Transaction metadata and optional payload contents (TCP)
Data Collector
ITCAMfSOA Agent
Single message and summarized data
Real-time Alerts and Monitoring
Tivoli Enterprise Management Server (TEMS)
New BN Agent Focus on hardware usage with some visibility into services
Near real-time and summarized data
Data Collector
SNMP
Polled MIB data: CPU, Memory, Interfaces (UDP)
Data Collector
ITCAMfWDP Agent
Historical Data
Summarized data
Traps (UDP)
Data Collector
Tivoli Data Warehouse (TDW)
Agent Host
Summarized data
Tivoli Monitoring Infrastructure

*Figure 5-14 IBM Tivoli Composite Application Manager for SOA conceptual monitoring architecture*

### 5.3.1 IBM Tivoli Composite Application Manager for SOA agents

Tivoli Composite Application Manager agents consist of two components:

- Data collector
- Tivoli Enterprise Monitoring Agent

For most J2EE platforms (such as WebSphere), the data collector is implemented as a Java API for XML (JAX)-Remote Procedure Call (RPC) Handler (which is also known as a *SOAP Handler*) and runs within the application server that it is monitoring. However, because a data collector cannot run within a DataPower appliance, it resides on a separate machine and queries the DataPower appliance. DataPower agents use the DataPower XML management interface to retrieve performance data from the appliance. The performance data is specifically tailored by the DataPower device for the IBM Tivoli Composite Application Manager for SOA DataPower Data Collector (see Figure 5-15).

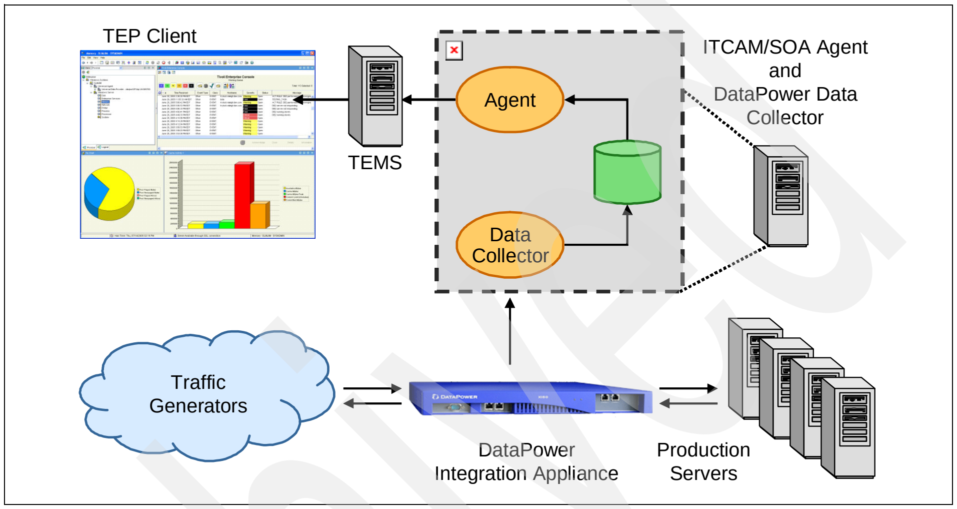

TEP Client
TEMS
Agent
Data Collector
ITCAM/SOA Agent and DataPower Data Collector
Traffic Generators
DataPower Integration Appliance
Production Servers

*Figure 5-15 DataPower integration with Tivoli Monitoring*

Figure 5-16 on page 152 shows a sample DataPower architecture.

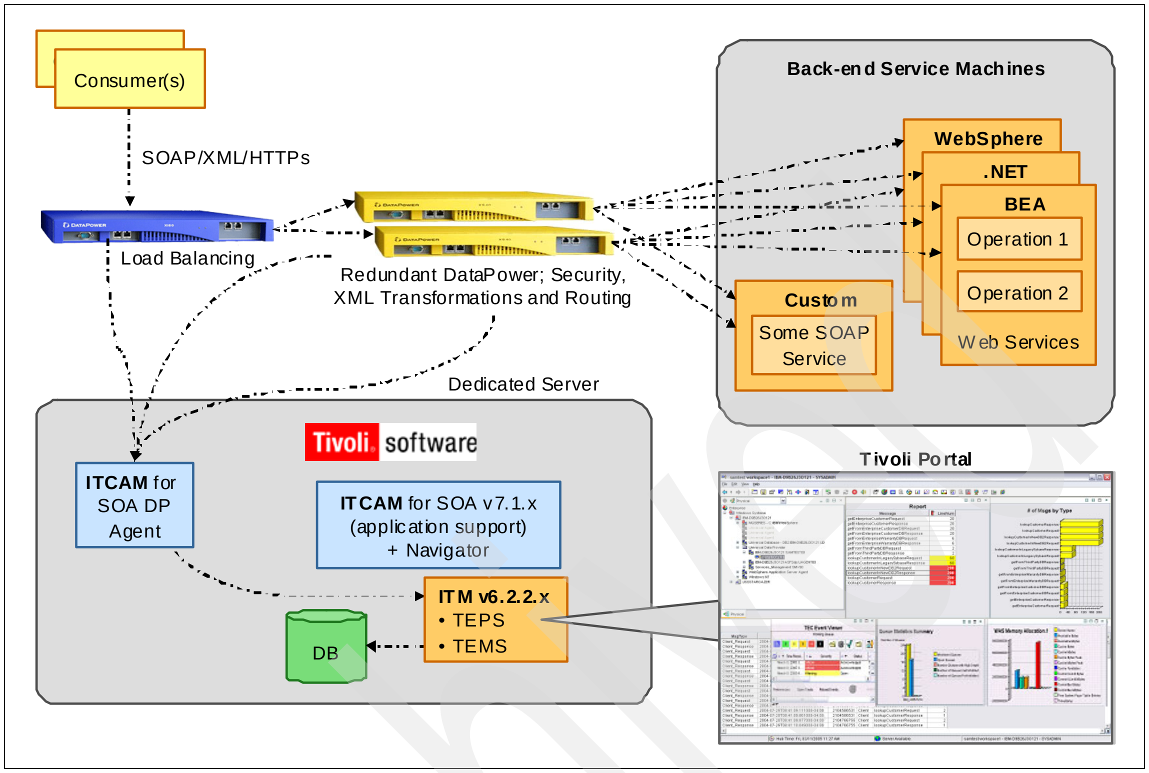


*Figure 5-16 Sample DataPower architecture*

The IBM Tivoli Composite Application Manager for SOA DataPower data collector can aggregate data for multiple DataPower appliances and multiple DataPower domains, allowing for varied architecture patterns, such as the pattern that is shown in Figure 5-16.

It is often a concern whether the IBM Tivoli Composite Application Manager for SOA DataPower Data Collector can keep up with the load that is generated by the DataPower appliances. If a capable machine (in terms of throughput and hardware) is used, the data collector has no problem consuming and processing the DataPower monitoring load. Be sure to always install the most recent fixes for IBM Tivoli Composite Application Manager for SOA. For example, DataPower-specific performance enhancements were put into IBM Tivoli Composite Application Manager for SOA V7.1.1 Fix Pack 2.

## 5.4 Monitoring DataPower service objects

DataPower appliances can process application traffic using three service object types: Web Service Proxy, Multi-Protocol Gateway, and XML Firewall. Each of these service types is tailored to specific uses:

- Web Service Proxy (WS-Proxy): Used exclusively for web services and is self-configuring based on Web Services Description Language (WSDL) documents. Traffic through this service is predictable and is always in the form of SOAP requests, responses, and faults.
- Multi-Protocol Gateway: An all-purpose service listener that can process any type of content, whether raw XML, SOAP, or non-XML. In addition, this service type allows for the mixing and matching of protocols (such as HTTP, HTTPS, MQ, IMS, and so on) on both the front side and back side.
- XML Firewall: An all-purpose service listener that can process any type of content, whether raw XML, SOAP, or non-XML, but it is limited to HTTP and HTTPS protocols only.

The WS-Proxy is ideally suited for application traffic monitoring, because its traffic is always predictable and will be either a SOAP request, response, or fault. For this reason, the IBM Tivoli Composite Application Manager for SOA DataPower data collector can easily extract and interpret detailed service-related metrics, including fault codes and messages. The configuration of the WS-Proxy is minimal in this case.

Alternatively, the Multi-Protocol Gateway is not restricted to SOAP-based traffic, and thus, there is no “standard” way to interpret message content without programmatic inspection. In addition, back-end server response codes cannot be interpreted easily, because the protocols can vary. For example, the same Multi-Protocol Gateway can dynamically select separate back ends that are both HTTP and MQ, with each having separate protocol response codes.

### 5.4.1 Customizing for Multi-Protocol Gateway traffic monitoring

Because the traffic that flows through an Multi-Protocol Gateway (MPGW) service object is not predictable, it is necessary to create a customized solution that can inspect the service traffic and report metrics to DataPower’s onboard Web Services Management (WSM) subsystem. This customization is accomplished using an XSL style sheet that uses a specific WSM extension function to publish the data. After service metrics have been published to WSM, IBM Tivoli Composite Application Manager for SOA monitoring agents can extract the metrics and report them back to Tivoli Enterprise Monitoring Server.

For an in-depth description of integrating IBM Tivoli Composite Application Manager for SOA with WS Proxy and Multi-Protocol Gateway services, see “Configuring processing rules for DataPower Multi-Protocol Gateways” in the *Composite Application Manager for SOA, Version 7.1.1, Installation Guide*, or go to this website:

http://publib.boulder.ibm.com/infocenter/tivihelp/v3r1/index.jsp?topic=/com.ibm.itcamsoa.doc/kd4inmst148.htm

#### WSM customization considerations

Consider the following deployment and instrumentation challenges in environments with large numbers of MPGW objects:

- Managing XSL style sheets is a manual process, and errors can affect the application.
- You must add transform actions to every rule within the service’s policy.
- No ready-to-use mechanism is available to quickly (and globally) turn off all the XSL style sheets or to remove them.

Despite these minor challenges, it is often advantageous (or necessary) to perform the customization to enable the MPGW service to appear as part of the complete end-to-end flow in the IBM Tivoli Composite Application Manager for SOA topology view (see Figure 5-5 on page 139).

### 5.4.2 Using latency logs for transaction monitoring

As an alternative to using the full-featured traffic monitoring agent and writing customized monitoring logic, you can use the health monitor to gain visibility into fine-grained traffic statistics, such as latencies for the front, processing, and back-side phases of Multi-Protocol Gateway, WS-Proxy, or XML Firewall services. The health monitor references the DataPower-generated latency logs. However, the health agent is unable to aggregate the data and does not draw any service-to-service topology information, making it unable to correlate transactions to other components within the high-level application flow. See 5.2.3, “IBM Tivoli Composite Application Manager for SOA DataPower agent comparisons” on page 147 for a detailed comparison of the two agent types.

For latency log monitoring, the latency log target needs to exist on the same machine as the agent that monitors it. If it is not possible to colocate the agent and the log target on the same machine, you can use a file transfer mechanism, such as FTP, to copy the latency logs from the log target machine to the agent’s host machine.

## 5.5 Tivoli Composite Application Manager for SOA deployment scenarios

Because solutions that employ IBM Tivoli Monitoring servers and IBM Tivoli Composite Application Manager for SOA can range from small to extremely large, it can often be confusing as to which pieces are required and how they interact with each other. This section describes the common IBM Tivoli Monitoring, IBM Tivoli Composite Application Manager for SOA, and DataPower deployment patterns.

**For clarity:** For the deployments that are described in this section, we have omitted several of the Tivoli Monitoring components for simplicity.

### 5.5.1 Minimal deployment

Figure 5-17 on page 156 illustrates a simple deployment that includes the data collector, which monitors a single DataPower appliance. This type of deployment is useful for light DataPower loads, such as lab environments or a proof of concept. A single IBM Tivoli Composite Application Manager for SOA data collector can be used for multiple DataPower appliances. This collector can be colocated on a machine with the Tivoli Enterprise Portal Server to further simplify the infrastructure.

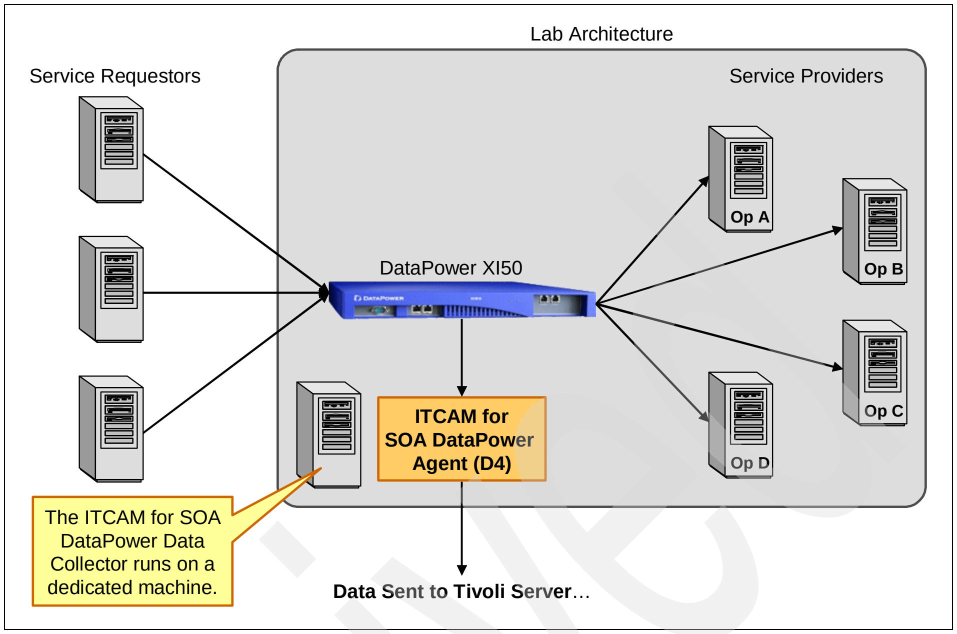

Lab Architecture
Service Requestors
Service Providers
DataPower XI50
Op A
Op B
Op C
Op D
ITCAM for SOA DataPower Agent (D4)
The ITCAM for SOA DataPower Data Collector runs on a dedicated machine.
Data Sent to Tivoli Server…

*Figure 5-17 Minimal IBM Tivoli Composite Application Manager for SOA deployment*

## 5.5.2 Multiple location, single agent deployment

The architecture that is shown in Figure 5-18 on page 157 shows DataPower appliances in multiple locations that are monitored by a single data collector. This architecture is only recommended for low-traffic environments, such as development, and it is not recommended for production environments. The metrics that are collected by the agent are transmitted to a Remote Tivoli Enterprise Monitoring Server, which then forwards the data to the hub monitoring server.

This type of configuration might be excessive for small applications; however, implementing a hub/remote architecture in the early stages allows for growth and scalability. This design builds around Tivoli Monitoring's built-in failover capabilities. Additionally, the usage of Remote Tivoli Enterprise Monitoring Server facilitates traffic from the data collector to flow through a single port, simplifying firewall configuration and security.

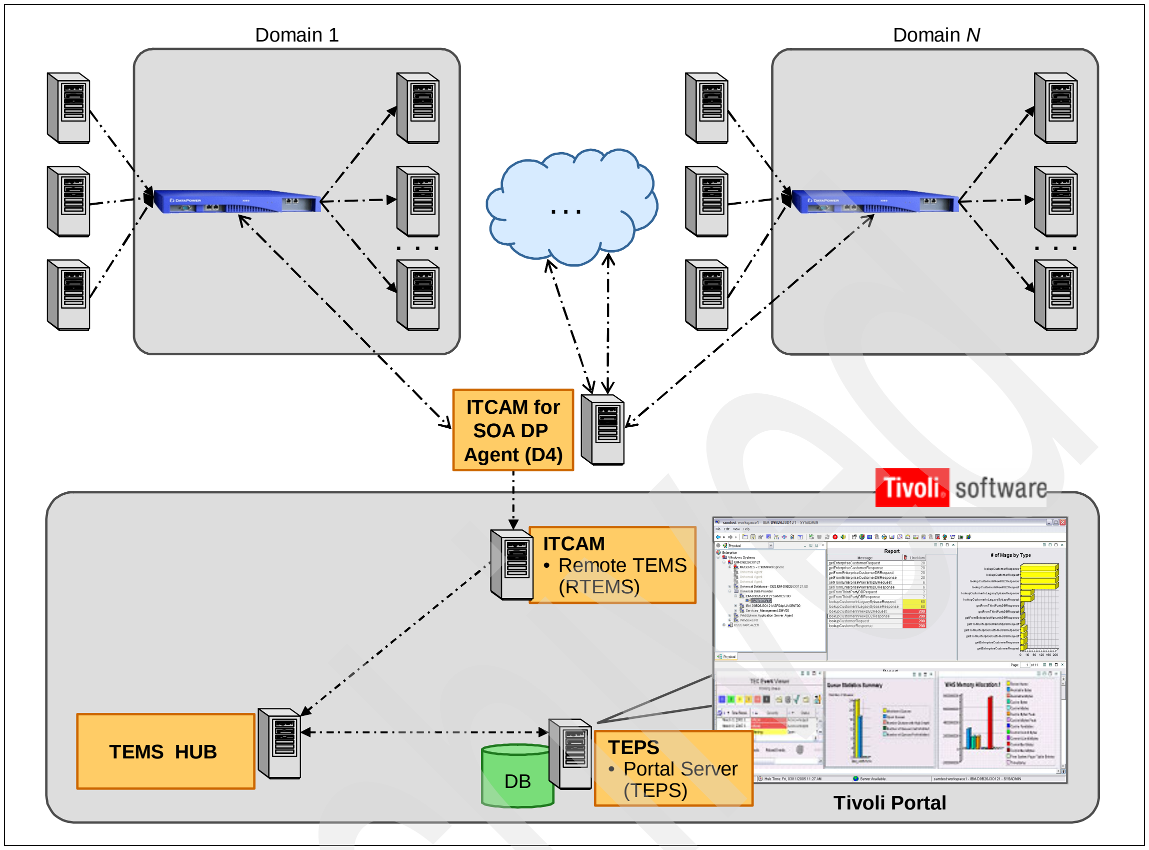


*Figure 5-18 Multiple location, single agent architecture for low traffic only*

## 5.5.3 Multiple location, multi-agent deployment

Figure 5-19 on page 158 shows an architecture with multiple locations (or networks) that are monitored by multiple data collectors (agents). The data collectors transmit metrics to a single remote monitoring server, which relays the data to the hub monitoring server. The use of remote monitoring servers facilitates future growth; additional remote monitoring servers can be deployed, with each server feeding metrics into the hub monitoring server.

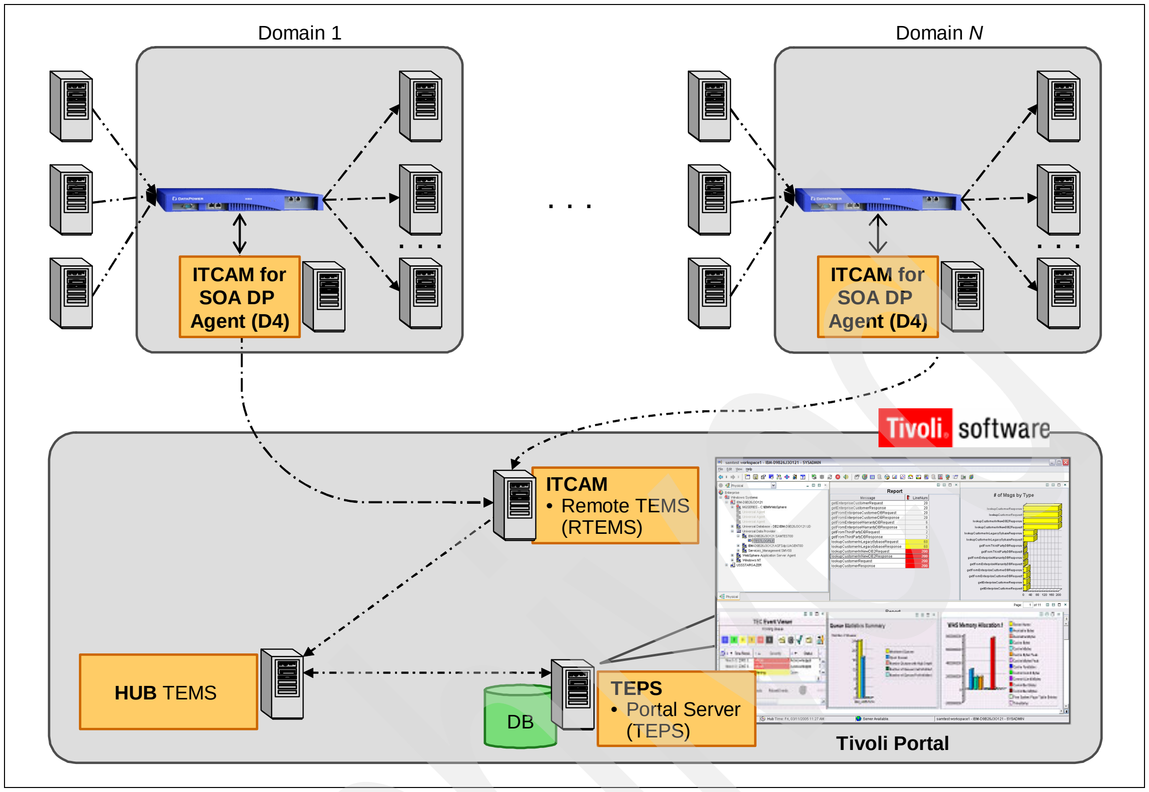


*Figure 5-19   Large multiple location, multi-agent deployment with remote monitoring servers*

## 5.5.4 Large multiple location deployment with health monitoring

Figure 5-20 on page 159 illustrates a large deployment that includes both data collectors (for traffic) and health monitoring agents in multiple locations. All agents transmit collected metrics to a remote monitoring server, which forwards the data to the hub monitoring server for future consumption by the portal server. The architecture also indicates that the health agent (Tivoli Composite Application Manager Agent for DataPower in lower left) is colocated with a log target server (that is, syslog, syslog-ng, and so on).

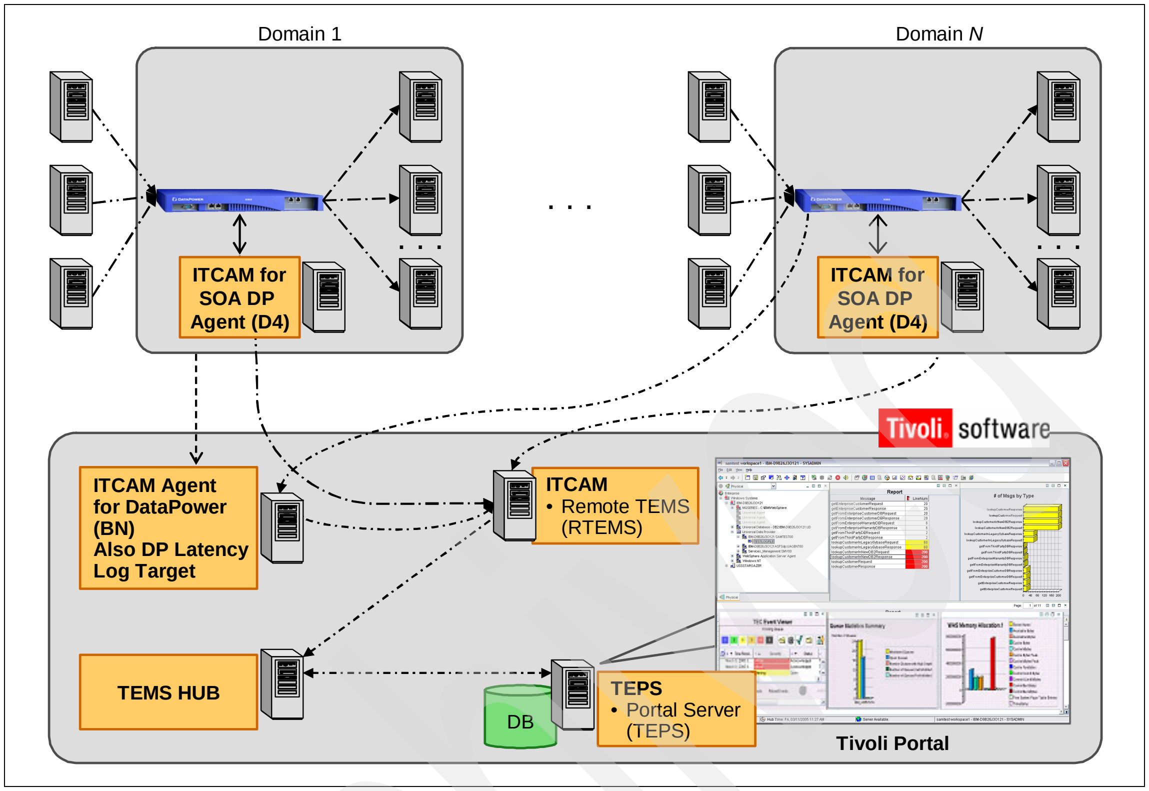


*Figure 5-20 Tivoli Composite Application Manager Agent for DataPower deployment*

## 5.5.5 Complete IBM Tivoli Composite Application Manager for SOA enterprise architecture

By introducing other complementary Tivoli Monitoring components into the architecture, a full-featured robust monitoring solution emerges. Without the additional components, the IBM Tivoli Composite Application Manager for SOA agents can only identify the general problem areas, but they have no ability to react or correlate.

Tivoli Composite Application Manager is most successful when deployed as a horizontal and vertical monitoring solution. Tivoli Composite Application Manager for Application Diagnostics, Omegamon for Messaging, Tivoli Monitoring for OS and other domain and alerting products are absolutely critical. In fact, IBM Tivoli Composite Application Manager for SOA ships with built-in links to these other products. When a problem is diagnosed in the SOA realm, links can be followed to a corresponding deep-dive agent to repair the issue. Therefore, to complete the conversation of DataPower monitoring, it is necessary to include these other critical components, as depicted in Figure 5-21.

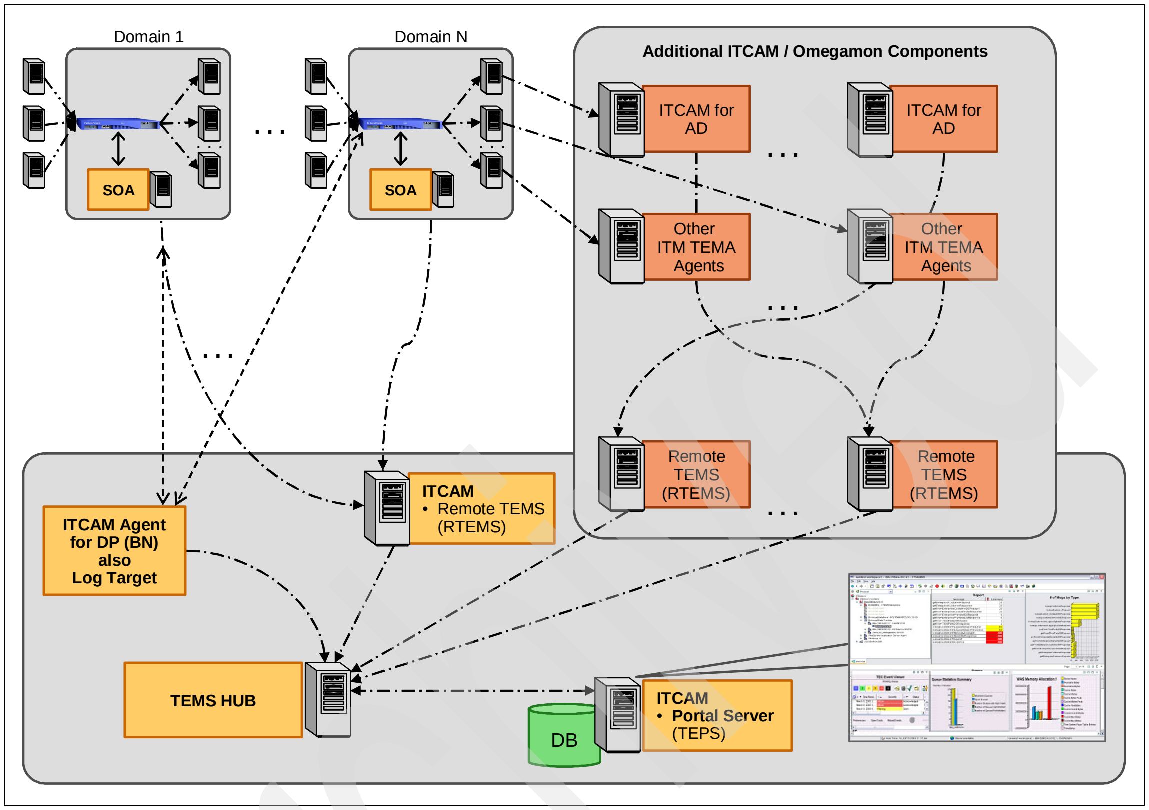


*Figure 5-21 Complete Tivoli Composite Application Manager architecture includes other products*

## 5.6 IBM Tivoli Composite Application Manager for SOA and DataPower's built-in SLM

Although DataPower appliances provide built-in service-level monitoring (SLM) capabilities that can be compared to certain IBM Tivoli Composite Application Manager for SOA functionality, there are significant differentiators that you need to consider when designing an enterprise monitoring solution.

SLM on DataPower appliances includes the following capabilities:

- Monitor and restrict traffic. SLM policies can be configured to throttle (reject), shape (delay), and notify (via logging) in the event that defined thresholds are exceeded. For example, an SLM policy might specify that a given service must not allow more than 1,000 transactions per minute and, after the threshold is reached, must throttle any new transaction until the one-minute interval restarts.

- SLM policies can contain simple rules, as well as complex rules involving message inspection and XPath evaluation. For example, a rule can limit the number of times that a service is called by a specific user for a specified SOAP operation.
- SLM policies can reference latency values, causing notifications to occur if back-end processes exceed certain thresholds.
- Service-level monitors can be applied across multiple DataPower devices, allowing installations to enforce SLM policies that are based on aggregated counts across peer devices.
- Basic graphing through the WebGUI. A simple graph can be displayed showing throttled, shaped, and notified transaction counts over a period of time.

In general, the DataPower SLM feature is excellent for enterprise service bus (ESB)-like capabilities and individual DataPower appliance troubleshooting, but it was not intended to serve as an enterprise-wide, operations-level monitoring solution. IBM Tivoli Composite Application Manager for SOA provides the following capabilities over what DataPower's built-in SLM can provide:

- Long-term storage of transaction metrics for subsequent analysis, historical graphing, reporting, and compliance
- Easy cross-referencing of metrics and correlation to other environmental components
- Impact analysis and "drill-down" capability for root cause analysis

6

# Logging

Organizations of all types and sizes need to keep a record of activity within their enterprise computing systems, particularly when those systems interact directly with external customers. Only by keeping such records, or logs, can the organization find the cause of failures or unexpected results, or, in certain cases, prove that any given transaction actually did occur. A robust logging system can also continually monitor all enterprise systems, to ensure that each system is performing as expected, and that corporate guidelines are followed. Similar to using a security camera in a brick-and-mortar store, logging does not prevent incidents from happening, but it can help to identify the root cause of an issue.

This chapter provides the following information to help you plan a logging solution:

- Overview of the DataPower logging systems
- Log types and destinations available
- Methods for event and transaction logging
- Privacy considerations
- Preferred practice recommendations

## 6.1 Overview

The DataPower device offers two distinct types of logging:

- Message process logging

  These logs capture log messages that are generated as the device processes messages flowing through the device. The device can generate two kinds of processing messages: event-driven messages and transactional messages.

- Audit logging

  Audit logs capture messages that are generated by changes to the configuration of the device, or by administrators logging into the device.

The audit logs and the message process logs are distinct and require separate handling procedures.

### 6.1.1 Message process logging

The DataPower device can generate two kinds of logs during message processing:

- Event logging

  The DataPower device generates log messages automatically during operation. Every subsystem within the device can and will generate log messages as events occur within those systems. These messages can be extremely verbose (at a debug level) or extremely sparse (at a warning or critical level). Administrators can set the depth and frequency of event-driven log messages. See 6.4, “Event logging” on page 168 for more information.

- Transaction logging

  Transaction logging enables the capture of messages flowing through the device during processing. Transaction logging employs either a log action or a results action within the processing policy of the service, allowing access to the contents of messages flowing through the device. The messages logged can be much larger than the standard logging system allows. The standard event logging system is not used at all. See 6.5, “Transaction logging” on page 170 for more information about transactional logging.

### 6.1.2 Publish and subscribe system

The event logging system works as a *publish and subscribe* system. Each of the subsystems, or objects, within the device generate, or *publish*, log messages. Log targets capture, or *subscribe* to one or more published logging streams. The default system log subscribes to all logging streams. It is possible to create a wide range of log targets that subscribe to any subset of published streams, enabling administrators to capture only the information desired.

### 6.1.3 Log targets and log categories

Each log message that is generated belongs to a particular log category, or type. Log targets can subscribe to a selection of categories. In addition to the standard categories of messages that are generated, the logging system also offers the ability to create custom log categories, allowing for the capture of completely custom messages.

The containers, or objects, that subscribe to published log messages are called *log targets*. Administrators can create any number of log targets, each subscribed to separate categories of log messages or error events. It is possible to create log targets that are highly focused and thus provide rapid access to only the log messages or other events of interest. It is also possible to create log targets that capture a wide range of messages, providing a general context for processing events within the device.

### 6.1.4 Storing log messages

Log targets offer a number of methods for storing messages and for moving stored messages off of the device to other repositories for analysis. The methods for storing log messages fall into two categories: writing to a cache or file, or dispatching messages in real time to external servers.

#### Writing to a local file or cache

The log target system can write to a file on the local file system. These archive files are necessarily limited in size to eliminate the possibility of filling up the local storage system. The system can support rotating files so that messages are not lost when the file size limit is reached. After the rotated file is full, it can then be moved off of the device to another storage system for permanent keeping and analysis. Methods for automatically moving log files off of the device include FTP, Simple Mail Transfer Protocol (SMTP), and HTTP. It is also possible to write to files that are Network File System (NFS) drives, pointing to files that are stored on remote servers.

If the device offers hard-drive storage, the hard drives can be used for log storage. Even when using the hard drives, log archive files need to be moved off of the device at regular intervals.

### Writing to a remote server

The log target system can dispatch log messages immediately to remote servers, thus moving all storage off of the device. These servers can include syslog, syslog-ng, databases, and web applications. Consult the DataPower documentation for a full list of the available options.

## 6.1.5 Email pager

The DataPower device offers an email pager, which automatically sends email to a designated address whenever a critical event occurs in the default domain of the device. This feature provides an easy way to make sure that a person is notified whenever critical events occur. This feature is the same as a log target, which is subscribed to critical-level events, that sends messages via email to a remote destination.

## 6.1.6 Audit logging

By default, the DataPower device maintains an audit log, which is located in the default domain of the device. To view the contents of this log, select **Status** → **Audit Log**. Log entries contain information about changes to the configuration of the device. Example 6-1 provides a sample.

*Example 6-1 Audit log entries*

```
20110210T010950Z [conf][success] (SYSTEM:default:*:*): domain 'SDF_DEVUPDATE' -
Configuration added
20110210T010950Z [conf][success] (SYSTEM:default:*:*): domain 'SDF_DEVUPDATE' -
Configuration settings applied
20110210T010950Z [file][success] (SYSTEM:SDF_DEVUPDATE:*:*): Created directory
"config:"
20110210T010950Z [file][success] (SYSTEM:SDF_DEVUPDATE:*:*): Created directory
"cert:"
20110210T010950Z [file][success] (SYSTEM:SDF_DEVUPDATE:*:*): Creating file
"config:///SDF_DEVUPDATE.cfg"
20110210T010957Z [file][success] (admin:default:secure-shell:9.65.216.77): (config)#
delete "xa35://tmp/temp_03059"
20110210T011001Z [file][success] (SYSTEM:default:*:*): Creating file
"config:/temp_03156"
20110210T215321Z [file][success] (SYSTEM:default:*:*): Creating file
"config:/temp_03317"
20110211T212422Z [file][success] (SYSTEM:default:*:*): Creating file
"config:/temp_03497"
```

You can obtain the contents of an audit log by generating an error report. This report contains the audit log entries.

It is also possible to capture much of the same information by creating a log target in the default domain that is subscribed to the *audit*, *file*, and *user* events. Then, you can configure this log target to send the log messages off of the device as needed.

## 6.2 Benefits

A robust logging system provides enterprises with a number of benefits, such as the ability to comply with governmental regulations or implement an enterprise auditing policy.

DataPower logging features provide the following benefits:

- Help to track all device activity in its context
- Provide information that is needed during application development
- Provide records that are needed during normal operation
- Help isolate failures
- Maintain records of changes to the device configuration
- Provide immediate notification upon catastrophic events

## 6.3 Usage

The logging capabilities of the device offer a great deal of flexibility. The enterprise business requirements regarding logs and records determine the logging methods that are used for any given deployment. The DataPower device can support the following degrees of reliability in logging:

- Best effort event logging

  Log messages are generated and captured as events occur during normal message processing. In the event that the device needs the processing power and memory to process transactional messages rather than handling logging, the DataPower device will preempt the logging system in favor of transactional processes. Log messages can be lost as a result. The standard logging system employing log targets offers this best effort logging.

- Reliable logging

  The device holds up the processing of messages to ensure that the desired logs are created and delivered as needed to meet the business requirements. The device offers the log action, which is a processing policy action, to accomplish this task. The log action, when used in this way, does not employ the standard event-driven logging system, but rather it sends log messages off of the device immediately. This design makes logging part of the transaction processing, and the log action can include a copy of the transaction message in the generated log. This same objective can be reached by using a results action in the processing policy.

## 6.4 Event logging

The majority of logging systems that are implemented on DataPower use the standard event logging system. The standard event logging system employs log messages, log categories, and log targets. The following methods are used to implement the standard event logging system:

- Create any desired custom log categories
- Create any desired log targets
- Create any custom log message generators

We describe each of these methods next.

### 6.4.1 Create custom log categories

Administrators most often create custom log categories to support the ability to generate custom log messages, which are captured by focused log targets. This capability gives administrators and developers the ability to quickly view the desired log information.

Use the following procedure to create a log category:

1. Select **Administration** → **Configure Log Categories** from the main navigation menu.
2. On the Configure Log Category menu page that displays, which contains a list of all existing log categories, click **Add**.
3. On the page that displays, enter the name of the new custom category. Click **Apply** and then save your configuration.

### 6.4.2 Create log targets

Most of the key decisions regarding the logging information that needs to be captured on the DataPower system are made while configuring log targets. You implement these decisions, such as what logs to keep, when, where, and how to move logging information off of the device, and also what actions to take, if any, when a given event occurs, through the configuration of log targets.

Use the following procedure to create a log target:

1. Select **Administration** → **Manage Log Targets** from the main navigation menu.
2. On the Configure Log Targets menu page that appears, which contains a list of all existing log targets, click **Add**.
3. On the Configure Log Target page that displays, enter the name of the new log target.
4. Select the **Event Subscriptions** tab and click **Add**.
5. On the Edit Event Subscriptions window that opens, select an event category from the Event Category drop-down list box. You can also specify a priority level using the Minimum Event Priority drop-down list box.

   An *event subscription* designates a log category and also a priority (from debug up to emergency). The DataPower device offers a large number of categories, including any custom categories. Only messages that meet the minimum priority level will be captured by the log target.
6. Click **Apply to close the window** and then click **Apply** again to save your configuration.

In addition to event subscriptions, log targets offer the ability to create filters of various kinds. Filters restrict the messages that are captured by the log target. Filters can be any of the following types:

- Event filters

  Event filters either include only messages with the designated event code within them or exclude messages with the designated event code within them.
- Object filters

  Object filters include only messages that are published by the selected object class and name. The name can be a wildcard, including all objects of the selected class.
- IP address filters

  IP address filters include only those messages with the client IP addresses that are included in the filters that are set for this target.

Log targets can also execute a command-line interface (CLI) command upon the appearance of an event trigger. Events with a particular log message ID (such as `0x011300006`, which indicates failure to establish a back-side connection) trigger the execution of a given CLI command. Event triggers are typically used to immediately capture system state information, execute a packet capture, or generate an error report.

**Tip:** Each log target maintains a fixed queue of log events to process. If the arrival rate of messages exceeds this queue, the target might drop messages. Navigate to **Status** → **Logging Target** to view the number of processed, pending, and dropped events. If this number is large, examine the subscription list.

Administrators can create any number of log targets. More than one log target can subscribe to the same events.

### 6.4.3 Create log message generators

In certain cases, it is desirable to generate custom log messages that contain exactly the required information. You can create custom log messages at any time during the execution of a processing policy by using a transform action that executes a custom style sheet. Example 6-2 shows a custom log message.

*Example 6-2 Code to generate a custom log message*

```
<xsl:message dp:type="my_category" dp:priority="notice">
XYZ just happened during processing
</xsl:message>
```

This message will be caught by any log target that is subscribed to the my_category event type with a priority of notice or higher. This flexibility makes it possible to include exactly the desired information in a log message.

## 6.5 Transaction logging

To ensure that the system generates a log message containing the desired information and that this message is delivered successfully to an external repository, the processing policy that is used to process messages must include either a log action or a results action. Using either of these actions, it is also possible to include part or all of the message content at any stage of processing.

### 6.5.1 Log action

The log action sends the contents of its input context to the destination that is given in the configuration of the action. In addition to the input content, the log action adds additional information and wraps the entire message in a SOAP XML envelope. Example 6-3 shows example output from the log action.

*Example 6-3 Log action output*

```
<?xml version="1.0" encoding="UTF-8"?>
<SOAP-ENV:Envelope xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:dplog="http://www.datapower.com/schemas/log"><SOAP-ENV:Header><dplog:location-t
ag>Logg_rule_0_log_0</dplog:location-tag></SOAP-ENV:Header><SOAP-ENV:Body><log-entry
serial="1298043707619000" domain="WorldofFTP"><date>Fri Feb 18 2011</date><time
utc="1298043707619">10:41:47</time><type>tellus</type><class>mpgw</class><object>LogR
un</object><level
num="5">notice</level><transaction>1619282</transaction><client>9.32.115.115</client>
<message><S11:Envelope
xmlns:wsse="http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-wssecurity-secext
-1.0.xsd" xmlns:S11="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:tns="http://ws.cdyne.com/DemographixWS"
xmlns:xs="http://www.w3.org/2001/XMLSchema">
<S11:Header>
<wsse:Security>
<wsse:UsernameToken>
<wsse:Username>fred</wsse:Username>
<wsse:Password>flounder</wsse:Password>
</wsse:UsernameToken>
</wsse:Security>
</S11:Header>
<S11:Body>
      <tns:GetLocationInformationByAddress>
         <tns:AddressLine1>1 Alewife Center</tns:AddressLine1>
         <tns:City>Cambridge</tns:City>
         <tns:StateAbbrev>MA</tns:StateAbbrev>
         <tns:ZipCode>02140</tns:ZipCode>
         <tns:LicenseKey>0</tns:LicenseKey>
      </tns:GetLocationInformationByAddress>
</S11:Body>
</S11:Envelope></message></log-entry></SOAP-ENV:Body></SOAP-ENV:Envelope>
```

This action can use any supported protocol to send its payload to a destination, including HTTP, HTTPS, MQ, and Java Message Service (JMS).

**Tip:** If no destination value is provided, the log action sends its payload to the standard event logging system. To ensure reliability, supply a valid destination.

A processing policy containing this action will only continue forward if the log action can successfully send its payload to the destination given. If the action cannot succeed in this manner, an error occurs.

This action also waits for the configured amount of time (in this case, the default timeout value for the URL used) to receive a reply. If no reply is received, the processing policy then continues to completion. The action does not make the response available for further processing.

**Tip:** This action must not be marked asynchronous to ensure reliability.

### 6.5.2 Results action

The results action sends the content of its input context to a designated destination. Unlike the log action, this action does not include any additional information in its payload.

Like the log action, the results action causes an error if the attempt to send its payload to the configured destination fails. Like the log action, the results action waits for a response for the standard timeout interval of time, if the URL given for the destination expects a response (such as with MQ).

Unlike the log action, the results action causes an error if a response is expected and none is received within the timeout amount of time.

**Tip:** This action *must not* be marked asynchronous to ensure reliability.

## 6.6 Usage considerations

Consider the following items when using the DataPower logging system:

- Logging is segregated by application domains. Log targets can only subscribe to messages that are published by objects in the same application domain. The default system log in the default domain captures all log messages from all domains.
- Log categories are segregated by application domains. Any custom log categories that are created in one domain are not visible to any other domain, including the default domain.
- The total number of custom log categories that are created on a device is limited, including all application domains. For firmware versions 3.7.3 and earlier, there is an “appliance-wide” limit of 32 custom log categories across

all domains. For firmware versions 3.8.0 and higher, there is an "appliance-wide" limit of 175 custom log categories across all domains.

- The DataPower device can generate a large volume of log messages in a short amount of time when under load, making the log messages that are sent by the device to a remote server overload that server. When this situation happens, the DataPower device begins to slow down, as well.
- Event log messages cannot exceed 2 kilobytes (KB) in size. Messages that are larger than 2 KB are truncated.
- Using the log action or the results action in asynchronous mode can result in excessive resource utilization when the destination becomes unresponsive. *Avoid using asynchronous mode if possible.*
- It is possible to execute CLI commands on the device when particular log messages are caught by a log target with an appropriately configured event trigger. This capability allows administrators to automatically generate error reports, run packet captures, or even quiesce services with no human intervention. This capability is extremely useful during heavy load testing or in production environments.
- Certain DataPower devices offer hard-drive storage (an option). These hard drives can be used for log files. The persistent storage and larger capacities of the hard drives allow for the creation of larger log files on the device itself. If network latency or processing latency is a concern, consider using hard-drive storage for logging. Even when using a hard drive, log files must still be rotated.

## 6.7 Preferred practices

This section contains suggested methods for meeting the logging requirements for a range of use case scenarios.

### 6.7.1 Set log priority levels higher in production environments

The minimum event priority for all active log targets must be set to Warning or higher when a device configuration is moved to production. When log levels are set to Notice or lower in a high-load production environment, the resource demands of logging might become too great for the device to provide the requested level. As previously mentioned, the DataPower device places higher priority on message transactions than logging.

## 6.7.2 Use the default domain for device-wide logging

The default system log in the default domain can capture log messages from all domains on the device. Consider creating specialized log targets in the default domain to more readily identify problems that can cross domain boundaries. For example, when an MQ Queue Manager fails or an Open Database Connectivity (ODBC) connection fails with only a "`connection failure`" error message in the application domain, the default domain log can show any network, interface, Domain Name System (DNS), or other errors that might have affected the connection.

## 6.7.3 Suppress repeated log messages

Certain processes, such as load balancer health checks, generate a large number of identical log messages, thus flooding logs and consuming system resources. To avoid this condition, it is possible to suppress identical event messages from the same object over a set time period. When enabled, the log target records only one instance of the event until the suppression period expires.

To achieve this configuration, set the Identical Event Detection radio input to On (the default is Off). In the Event Suppression Period field that then appears, enter a value to indicate a suppression period (the default is 10 seconds). Only one instance of identical messages will appear in the logs every 10 seconds. Use a lower suppression period value if this value does not meet the enterprise requirement.

## 6.7.4 Employ a load balancer for critical log targets

To ensure the availability of log servers, employ a load balancer. The remote destination of any log target is then set to the address of the load balancer rather than to a single server.

Using a load balancer increases the availability of the logging servers, thus reducing the likelihood that the logging system will become backed up and slow down the DataPower device. A load balancer becomes particularly useful when the logging system uses TCP to deliver log messages to a destination server. If that server becomes unresponsive and the logging rate is high, the DataPower device can consume its protocol stack resources.

It is also possible to use a load balancer group, as defined on the DataPower device, to ensure the availability of log servers. In this way, no external balancer is required.

### 6.7.5 Select the appropriate syslog server

Syslog servers accept messages over two separate IP protocols: TCP and User Datagram Protocol (UDP). Although the use of the TCP protocol by syslog-ng servers ensures the delivery of each message over the network, this method can at times take more time than the rate of messaging allows. When this situation happens, consider using the older, UDP-based syslog service.

### 6.7.6 Test production logging capacity before deployment

It is good practice to establish the level of logging that can be supported in production environments before a configuration is deployed to production. When an error condition occurs in production environments, it might be necessary to set logging levels to debug to identify the problem. This setting generates large volumes of log messages in high-load production environments. If the production environment cannot handle such large log volumes, you might need another troubleshooting strategy.

### 6.7.7 Plan for confidentiality

If the DataPower device will process messages that might contain confidential information (such as consumer credit information, health records, or classified government information) and if any type of transaction logging is also required, plan for an appropriate logging methodology. Keeping persistent records of confidential information might violate the privacy and security laws in effect.

The event logging system offers the ability to encrypt log messages before the messages are sent off of the device, which might meet the privacy requirements that apply. For transaction logging, or any logging that contains a copy of all or part of the messages flowing through the DataPower device, it might be necessary to encrypt the message content before using an action to send the message off of the device.

### 6.7.8 Manage multiple-log target feedback loops

The use of multiple log targets in any configuration can cause the device to cascade log messages endlessly. A log target always suppresses its own events, but it will record events from other log targets. Under certain circumstances with multiple log targets, these events can create a positive feedback loop that can cause resource contention.

Select **Feedback Detection** when configuring the log target to suppress all log events from the logging subsystem and prevent resource contention.

7

# B2B configuration and administration

This chapter provides a brief introduction to the WebSphere DataPower Business-to-Business (B2B) Appliance and describes the challenges and preferred practices surrounding the configuration and administration of the B2B appliance.

There are many other configuration and administrative considerations with regard to using the B2B appliance; however, they are core DataPower challenges that are discussed in other chapters in this book. This chapter only addresses the functionality that is unique to B2B.

## 7.1 Introduction to B2B appliances

IBM recognizes the convergence between B2B integration (external integration) and application integration (internal integration) and understands that certain integration functions are needed at the edge of the network to support complex B2B flows and to provide greater flexibility for file processing and routing. For this reason, the B2B appliance provides the same integration capabilities as our integration appliance, allowing our clients to easily and seamlessly bridge external integration and internal integration flows between the DMZ and the protected network.

The WebSphere DataPower B2B Appliance builds upon the functionality in the WebSphere DataPower Application Integration Appliance by adding trading partner profile management, B2B transaction viewing capabilities, and industry standards-based B2B messaging protocols to the already robust integration capabilities of the core appliance. These three key capabilities are at the heart of the B2B appliance. They are designed in such a way that the B2B appliance is positioned extremely well to handle simple partner connections with data passing through directly to the end applications for further processing. If more complex data flows are required, the application integration capabilities of the B2B appliance can be used to perform data validation, transformation, rules-based enforcement, and content-based routing.

The WebSphere DataPower B2B Appliance extends application integration beyond the enterprise by supporting the following B2B functionality:

- Electronic Data Interchange-Internet Integration (EDIINT) AS1, AS2, AS3, and Electronic Business Message Service (ebMS) V2.0
- EDI, XML, and Binary Payload routing and transformation
- Electronic Business using eXtensible Markup Language (ebXML) Collaboration Partner Profile and Agreement (CPPA) V2.0
- MQ File Transfer Edition integration
- Partner Profile Management
- Plaintext email support
- Encrypted B2B payload persistence
- Hard Drive Archive/Purge policy
- Certificate Management (S/MIME Security)
- Multi-step processing policy
- B2B and MQ FTE transaction viewing with optional trading partner visibility
- Transaction event and acknowledgement correlation

- Transaction resend/replay capabilities

The B2B Gateway service is a configuration object that is responsible for processing and routing B2B data. Partner profiles are configuration objects that are capable of supporting multiple destinations; the profiles are associated with any number of B2B Gateway services. The B2B Viewer is used to view all transactions that pass through a B2B Gateway service.

Figure 7-1 depicts the components that make up the B2B Gateway Object in the XB60.

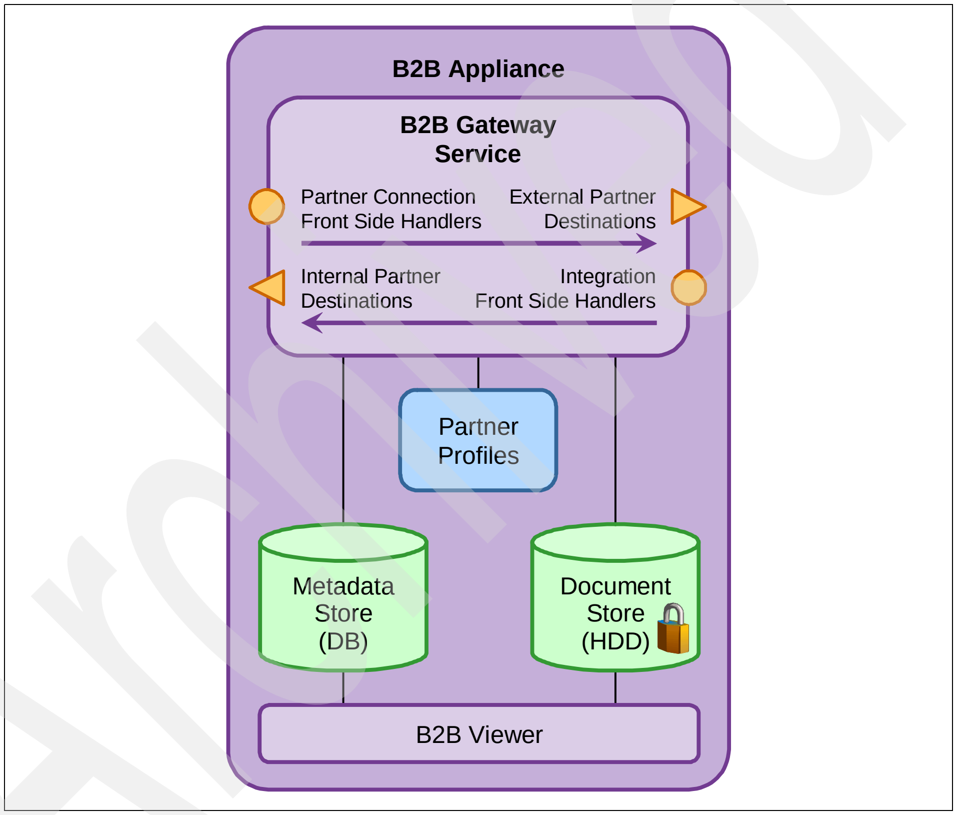

B2B Appliance
B2B Gateway Service
Partner Connection Front Side Handlers
External Partner Destinations
Internal Partner Destinations
Integration Front Side Handlers
Partner Profiles
Metadata Store (DB)
Document Store (HDD)
B2B Viewer

*Figure 7-1 B2B components*

## 7.2 B2B appliance benefits

The global economy, large outsourcing initiatives, and the virtual supply chain have blurred the boundaries of the enterprise and the distinction between public and private processes. As a result, internal application-to-application (A2A) and external business-to-business (B2B) technologies are converging. Many enterprises are seeking a single business integration platform to meet all of their internal and external B2B messaging and integration needs to reduce duplication of effort and increase the speed of “externalizing” internal processes. The appliance model enables strong B2B business value by accelerating the pace of innovative value-creating processes and strategic initiatives. You can utilize B2B services to quickly and securely connect to your external partners and integrate the partner connections to your application integration flows, all in a purpose-built hardware solution.

To take advantage of the improved business processes, flexibility, and IT efficiency that come with moving to B2B appliances, organizations require pervasive, scalable services and controls, robust security, and high service assurances in their infrastructures. Today, enterprises often find themselves struggling to deliver these critical requirements without having to handle prohibitive cost, complexity, and hard-to-manage infrastructures. Addressing these challenges requires a pragmatic approach; an approach that simultaneously recognizes the evolution of standards, the value of existing infrastructure investments, your organizational challenges, and how security and performance can be affected across applications. The WebSphere DataPower B2B Appliance meets these challenges by providing the following key benefits:

- Simplifies service-oriented architecture (SOA) deployment by integrating many core functions required for adopting B2B, SOA, or web services into a single, purpose-built device with ESB capability. The B2B appliance simplifies an overall B2B/SOA infrastructure.
- Designed to deploy easily into an existing environment as an in-line network device. You gain business value without having to change your network or application software. As a result, proprietary schemas, coding, or application programming interfaces (APIs) are not required to install or manage the device.
- Makes it easier for your partners and customers to do business with you through centralized and consolidated B2B trading partner and transaction management. It provides highly secure connectivity to trading partners over a wide range of protocols, reduces infrastructure costs, and increases the speed of getting new partners integrated, utilizing a configuration-driven approach that tackles today’s toughest B2B integration challenges.
- Improves the performance and scalability of your B2B deployment by easily integrating disparate transport protocols with no dependencies between inbound front-side and outbound back-side interfaces.
- Provides front-line defense for both inbound and outbound traffic with high levels of security assurance utilizing AAA Security with integration to a broad range of access control solutions and data security through a broad range of B2B messaging protocols.

- Utilizes WebSphere Transformation Extender on the device for transforming any message format with ultimate flexibility. Common WTX tooling is used to develop maps and compile them to run on the B2B appliance in a processing policy.
- Dynamically route based on any message content attributes, such as the originating IP, requested URL, protocol headers, and data within the message, such as SOAP Headers, XML, Non-XML content, and so on.
- Provides Service-Level Management (SLM) to protect your applications from over-utilization using frequency based on concurrency or based on messages per time period; take action when exceeding a custom threshold (Notify, Shape, or Throttle). Combine SLM with routing to make intelligent failover decisions when a threshold is exceeded.

Figure 7-2 depicts how the WebSphere DataPower B2B Appliance utilizes B2B services and A2A services together to provide a robust and complete B2B integration solution.

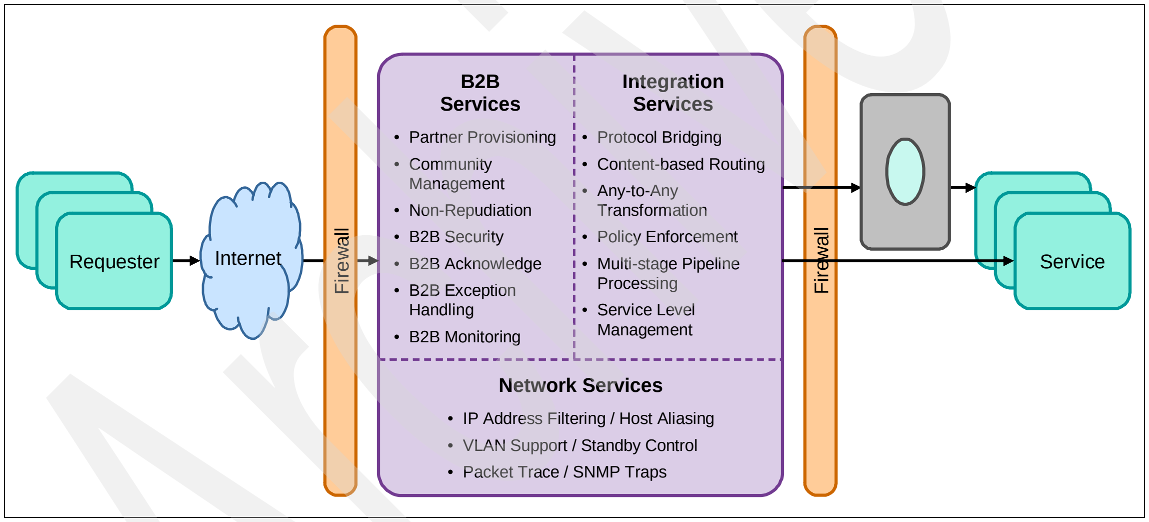


*Figure 7-2 B2B and A2A convergence*

## 7.3 Preferred practices

In this section, we describe the preferred practices that are associated with the configuration and administration of the B2B appliance. We briefly describe the preferred practices as they relate to capacity planning. We then explain several configuration and administration use cases with the preferred practices that are associated with each case.

### 7.3.1 Capacity planning

Files transferred through the B2B Gateway object are stored on the appliance hard disk and are eventually transferred to a permanent archive. Each B2B Gateway object can have a separate archiving policy, but all B2B Gateway objects together share space on the hard disk. Additionally, metadata that is extracted from each transaction is retained in a separate B2B persistence store on the hard disk.

The archive process removes both copies of messages and message metadata. Archived data cannot be imported into the appliance and cannot be viewed through the Transaction Viewer.

#### B2B payload storage

Up to 70 GB of space on the encrypted portion of the hard drive can be used to store copies of message documents. This space is shared across all B2B Gateway objects. Processing a message generally requires saving a copy of it as soon as it is received, plus a copy of the message after EDIINT or ebMS headers and any S/MIME compression and encryption have been handled. One or more copies of the Message Disposition Notification (MDN) might also be saved, particularly if asynchronous MDNs are in use.

**Storing B2B payloads:** B2B payloads can optionally be stored off of the device to either a Network File System (NFS) mount point or to an iSCSI device that is attached to the network.

#### Metadata storage

Metadata from each transaction is held on the appliance in the persistence store, which is on the unencrypted part of the hard disk. This space can be shared with configuration and log files if the appliance is otherwise configured to use the `local:///ondisk/` directory. The default setup does not use the hard disk for anything other than B2B message contents and metadata. The B2B Persistence object can be accessed by device administrators in the default domain. Its *Storage Size parameter* controls the size of the persistence store. The default is 1 GB to allow other use of the hard disk. You can safely increase the size to 64 GB.

**Important:** After this value is increased, it cannot be decreased. Consider whether you will need to use the appliance hard disk for anything else before increasing its size.

**Important:** During testing, transaction metadata appears to require about 4 KB per transaction. One transaction here includes an inbound or outbound file or B2B message. If an outbound message is sent that requests an asynchronous MDN, receipt of that MDN will be processed as a separate transaction that requires separate metadata storage.

## Calculating capacity

To properly plan for archiving and the persistence store size, you need to estimate the traffic characteristics for your appliance:

- How many documents do you expect to receive per day and over what number of hours (peak workload)?
- How large, on average, do you expect these documents to be?

### *Payload storage*

For illustrative purposes, assume 10,000 EDI messages per day with an average size of 10 KB. Therefore, you are expecting 100 MB of content per day. This capacity requires 360 MB of document storage per day, which equates to approximately 84 days.

This example requires the following storage capacities:

- 200 MB of stored data for these messages. There are two copies of each message: one copy for the “off the wire” message and one copy for the processed request.
- 40 MB (4 KB per message) for protocol responses.
- 120 MB for the raw MDN (4 KB per message), the HTTP request containing the MDN (4 KB per message), and the HTTP response containing the MDN (4 KB per message).

### *Metadata storage*

If the messages per day are split evenly between inbound and outbound and if every outbound message requests an asynchronous MDN, the space for metadata storage adds up to 15,000 transactions per day, which equates to 60 MB (15,000 x 4 KB) of metadata storage per day. At the default 1 GB persistence store size, the persistence store will fill in approximately 16 days. If the persistence store is increased to 64 GB, over 1,000 days of message metadata can be persisted.

Using the default persistence store size in this example, setting the *Archive Document Age* property to 7 days will remove document metadata from the persistence store before it fills.

### *WebGUI controls*

Each B2B Gateway object has an Archive tab. Each gateway can be independently configured to archive documents and metadata off of the appliance before purging, or each gateway can be configured to purge without archiving.

The Archive tab includes these relevant settings:

- Archive Minimum Size: Archiving will not occur unless this amount of data is stored in copies of the message content.
- Archive Document Age: Documents that were received at least this many days ago will be archived.
- Archive Minimum Documents: Archiving will keep at least this many documents on the appliance after archiving is completed; if fewer than this many documents have been received, archiving will not occur.
- Disk Use Check Interval: Specifies how often to check for documents to archive, defaults to hourly Maximum Disk Usage for Documents. Archiving will occur unconditionally if this amount of data is stored in copies of the message content.

### *Commands to monitor space*

You can use a pair of commands to monitor the disk space and the size of the persistence store.

From the command prompt, type the commands that are shown in Example 7-1.

*Example 7-1 Commands to monitor B2B drive space*

```
#top
#service show b2bp encrypted-space
#service show b2bp size
```

The **`service show b2bp encrypted-space`** command shows how much of the 70 GB of encrypted disk space that the message contents have used.

The **`service show b2bp size`** command shows how much space message metadata has used in the persistence store.

## 7.4 Use cases

In this section, we describe several common configuration use cases, their known limitations, and the preferred practices.

## 7.4.1 Active/passive high availability use case

You can deploy the WebSphere DataPower B2B appliance in an active/passive high availability (HA) configuration using the Standby Control functionality that is native to DataPower devices. Because all of the other services on the device do not persist any data or state information, they will process and pass through all information sent to each of the Front-Side Handlers (FSHs) associated with each of the services.

The B2B Gateway service on the primary device maintains the state for any B2B messaging protocols that are in use and persists metadata on the primary device for any data that it processes and then synchronizes the B2B metadata to the secondary device. In order for the synchronization of metadata to work between the two devices, one of the devices must be primary and the other device must be secondary.

The Standby Control configuration allows us to provide automatic failover to the secondary device in the event that the primary device fails and ensures that the B2B Gateway services on the secondary device are not receiving any data. Figure 7-3 on page 186 depicts a typical active/passive HA deployment.

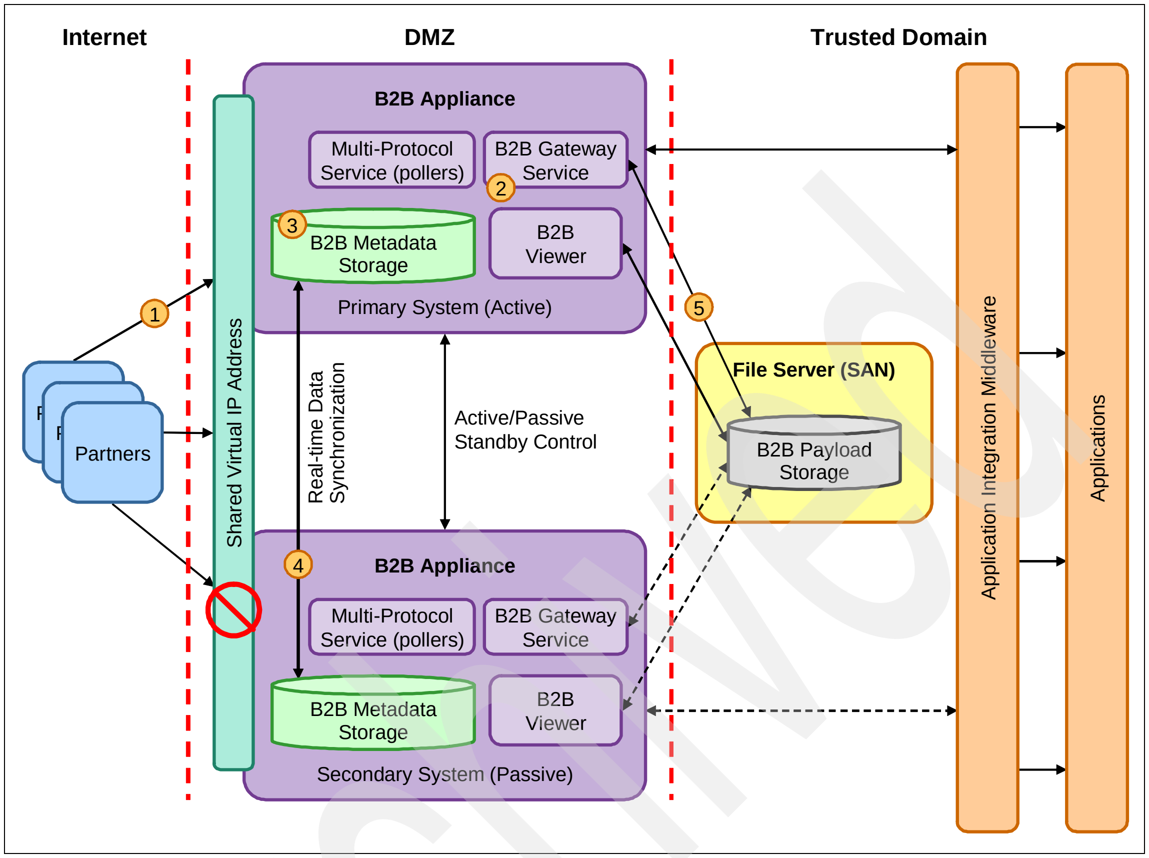
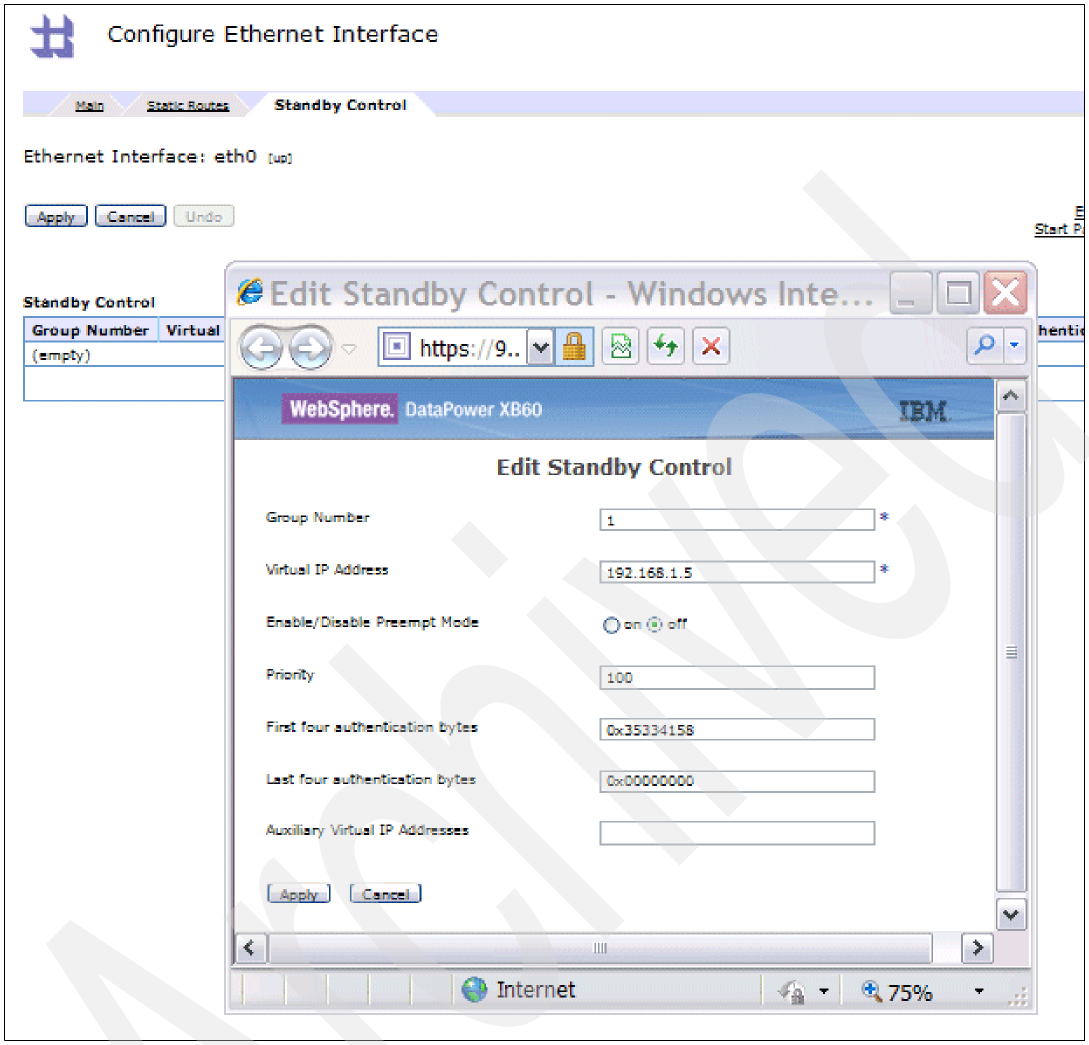


*Figure 7-3 Active/passive HA example*

You must configure Standby Control on the Ethernet adapter that is being used for data transfer with both the primary and secondary device, and you must set both devices in the standby group to a priority of 100. This setting will create a Virtual IP (VIP) address that is shared between the two devices in the standby group. The primary device receives data over the VIP, and if a failure condition arises, the secondary device takes over the VIP and starts to receive data.

Figure 7-4 on page 187 shows an example of the Edit Standby Control configuration page.


Configure Ethernet Interface

Main | Static Routes | Standby Control

Ethernet Interface: eth0 [up]

Apply | Cancel | Undo

Standby Control

| Group Number | Virtual |
|---|---|
| (empty) | |

Edit Standby Control - Windows Inte...

https://9..

WebSphere. DataPower XB60 IBM.

Edit Standby Control

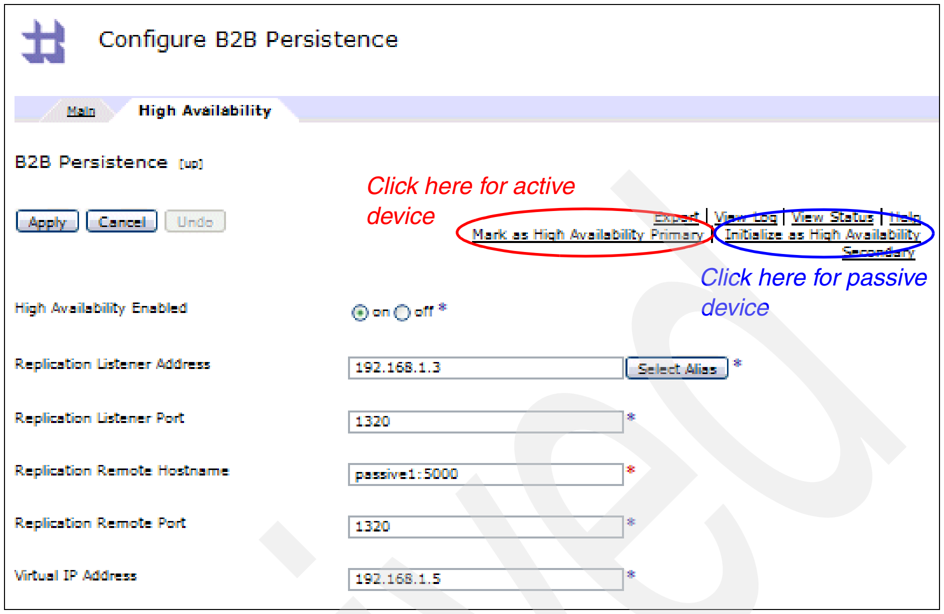
| | |
|---|---|
| Group Number | 1 * |
| Virtual IP Address | 192.168.1.5 * |
| Enable/Disable Preempt Mode | on [✓ off] |
| Priority | 100 |
| First four authentication bytes | 0x35334158 |
| Last four authentication bytes | 0x00000000 |
| Auxiliary Virtual IP Addresses | |

Apply | Cancel

Internet | 75%

Figure 7-4 Standby control configuration example

In addition to Standby Control, you must configure the B2B metadata store as primary on the active device and secondary on the passive device. Figure 7-5 on page 188 shows an example of the High Availability links in the Configure B2B Persistence page.


Configure B2B Persistence
Main
High Availability
Apply
Cancel
Undo
Export | View Log | View Status | Help
Mark as High Availability Primary
Initialize as High Availability Secondary
Select Alias
Click here for active device
Click here for passive device

B2B Persistence [up]

| | |
|---|---|
| High Availability Enabled | [✓ on] off * |
| Replication Listener Address | 192.168.1.3 * |
| Replication Listener Port | 1320 * |
| Replication Remote Hostname | passive1:5000 * |
| Replication Remote Port | 1320 * |
| Virtual IP Address | 192.168.1.5 * |

*Figure 7-5 B2B Persistence configuration example*

## Preferred practices

We have listed the preferred practices that are unique to this use case; however, any preferred practices that exist that relate to the DataPower platform and the deployment of the B2B appliance also apply:

- Store the B2B payload data for each B2B Gateway off of the device to a shared directory (NFS or iSCSI). Place the storage system either in the DMZ or a protected zone, depending on your security requirements. If you deploy the storage system in the protected zone, isolate one of the Ethernet controllers to the connection and open the appropriate ports through the inner firewall only from the B2B appliance.

  Use the same file location for all B2B Gateway services; each file persisted for non-repudiation is uniquely named and preceded with the serial number of the device.

- When configuring the B2B persistence High Availability tab, be sure to use the same virtual IP addresss (VIP) that you configured in Standby Control for the Ethernet interface that is being used for external connections.
- Do not configure pollers in the B2B Gateways of either the primary or secondary device. Configure pollers in a Multi-Protocol Gateway that outputs to the VIP that is being used for connections from external partners. This way, the metadata store on the secondary device does not receive active data from pollers.

- The B2B Gateways and Multi-Protocol Gateways (used for pollers) must be configured identically on both the primary and the secondary devices.
- If using a standby group on the Ethernet interface that is being used for the internal network connection, use a Multi-Protocol Gateway service to route all transactions originating from the internal network into the VIP that is associated with the B2B Persistence HA configuration. The best way is to set the output of the Multi-Protocol Gateway to point to the HTTP FSH in the B2B Gateway service.
- Share the same configuration between the two devices. Export the configuration from the primary device. Then, import it into the secondary device using deployment policies on the secondary device to change any settings that are specific to the secondary device (for example, host names, IP addresses, and so on). You can obtain more information about configuration management techniques and options in Chapter 9, “Configuration management and deployment” on page 201.

## Limitations

The limitations that are listed in this section are unique to this use case; however, any limitations that exist related to the DataPower platform or the deployment of the B2B appliance also apply:

- When B2B payloads are stored off of the device, they are not encrypted. It is the responsibility of the network security team to adequately protect all data that is stored on external storage area networks (SANs) and file servers.
- The passive device is idle until failover occurs. Ensure that the passive system configuration is identical to the primary system configuration. Any usage of the passive system will cause the configuration to be out of sync with the active system.
- This solution only provides failover. It does not provide additional throughput like an active/active configuration does.
- There will be a 1 to 3 second delay during the switchover to the secondary device, depending on the network latency of your network.
- Both the primary and secondary device must be installed on the same network subnet.
- Pollers must be configured outside of the B2B Gateway service in a pre-processing service that bridges the polling protocol to an HTTP.
- Multiple passive devices are not supported; this configuration only supports a two-device configuration.

## 7.4.2 XB60 active/active high availability use case

You can deploy the WebSphere DataPower B2B Appliance in an active/active HA configuration with a load balancer sending data to multiple devices. Because all the other services on the device do not persist any data or state information, they will process and pass through all information sent to each of the FSHs associated with each of the services. The B2B Gateway service maintains state for any B2B messaging protocols that are in use and persists metadata on each individual device for any data that it processes. Figure 7-6 depicts a typical active/active HA deployment.

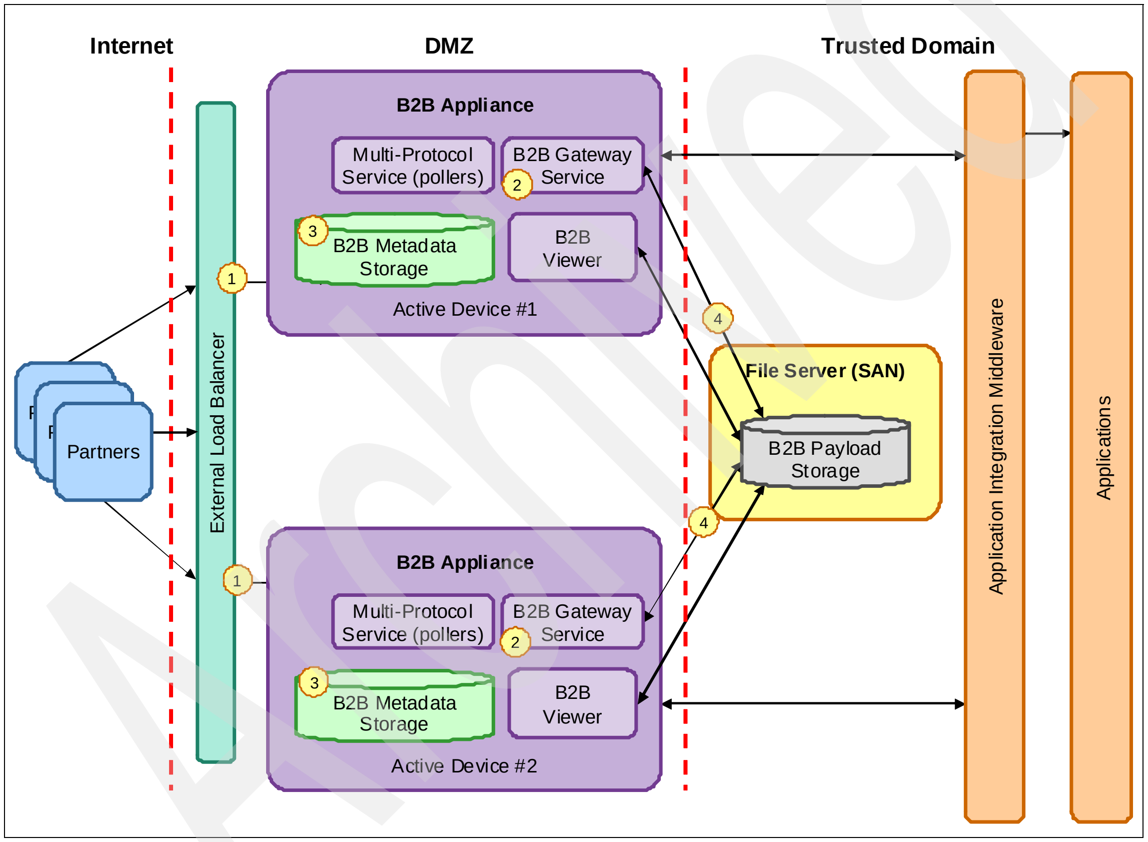


*Figure 7-6 Active/active deployment example*

## Preferred practices

We have listed the preferred practices that are unique to this use case in this section; however, any best practices that exist that relate to the DataPower platform and the deployment of the B2B appliance also apply:

- You must store the B2B payload data for each B2B Gateway off of the device to a shared directory (NFS or iSCSI). You can place the storage system either in the DMZ or protected zone depending on your security requirements. If deployed in the protected zone, isolate one of the Ethernet controllers to the connection and open the appropriate ports through the inner firewall only from the B2B appliance.

  Use the same file location for all B2B Gateway services; each file persisted for non-repudiation is uniquely named and preceded with the serial number of the device.
- Archive B2B Gateway transactions often by using the automated archive capabilities of each B2B Gateway service. If any device fails, the metadata on that device will not be accessible until you restore the machine or place the hard drives into a replacement device.
- Share the same configuration among all active nodes. Export the configuration from the primary device and import it into the secondary device using deployment policies on the secondary device to change any settings that are specific to the secondary device (for example, host names, IP addresses, and so on). You can obtain more information about configuration management techniques and options in Chapter 9, “Configuration management and deployment” on page 201.
- The B2B payload portion of the local hard drives is encrypted at the time of first initialization. If using an active/active deployment and storing the B2B payloads externally, disable the encryption on the local drive so that it can be used for other functions. You can obtain information about how to disable the Advanced Encryption Standard (AES) encryption in the B2B appliance documentation.

## Limitations

We list the limitations that are unique to this use case in this section. However, any limitations that exist that relate to the DataPower platform or deployment of the B2B appliance also apply. When passing data from a load balancer to the multiple FSHs that are associated with any B2B Gateway service configured on each device, consider the following limits and suggestions:

- When B2B payloads are stored off of the device, they are not encrypted, it is the responsibility of the network security team to adequately protect all data that is stored on external SANs or file servers.

- The MDN state is not monitored across multiple devices. When using B2B messaging protocols, you must use only synchronous MDN requests or no MDNs at all for outbound message flows. Each device monitors the state of the MDN request and performs an action (reject or resend) if the MDN is not received in the specified period of time.

  AS2 and ebMS have the option of using synchronous MDNs, AS1 and AS3 do not.

  Binary or raw EDI or XML files do not use MDNs and thus are not affected.

  Inbound flows can support synchronous MDN requests from partners, because the state of the MDN request is monitored at the sending B2B gateway; the same device that received the MDN request will always process the MDN request.

- Metadata from the B2B Gateway service cannot be stored off of the device, nor does it synchronize with the metadata store on any other devices when using an active/active deployment. So, if you use the B2B Viewer as the primary source to view the state of your transactions, you must monitor the transactions on each device separately.

  DataPower has robust logging capabilities that allow you to use custom log categories, event subscriptions, log targets, and multiple steps to generate the desired events (if they do not already exist). It then send the logs and events to a third-party monitoring tool that can consume log data (for example, syslog server, monitoring applications, and so on), which decreases the operational effect of having the metadata stored on multiple devices.

  You can obtain more information about logging in Chapter 6, “Logging” on page 163.

8

# Development life cycle

This chapter describes the considerations and activities that are associated with a typical DataPower solution life cycle.

Successful implementation is a key objective for projects in the technology industry. However, implementation is also the phase of a project that is associated with the highest level of risk. It requires planning, testing, and forethought to minimize the chance of a failed launch.

As a result, significant effort has been made within the software industry to produce standardized frameworks that outline the development, testing, and release life cycles for projects to minimize this risk. These frameworks or methodologies are implemented by many IT organizations and share common development, deployment, and testing principles.

This chapter discusses the features, considerations, and preferred practices for implementing DataPower appliances within a life cycle-based implementation. It includes the following topics:

- Organizational structure
- Software development life cycle
- DataPower life-cycle stages

## 8.1 Organizational structure

One of the initial challenges for organizations that are new to DataPower technology is the definition of roles and responsibilities for development, deployment, and management tasks.

A common misconception is that the “all in one” nature of the device necessitates a single group or individual owning and executing all aspects of the development and management life cycle. It is possible for a single group to own the end-to-end responsibility for executing all DataPower solution tasks; however, the breadth of knowledge that is required across technology disciplines makes this type of structure impractical within most organizations.

DataPower development, management, and operational roles can be defined in much the same way as they are in traditional software-based solutions. Using traditional roles is useful, because most companies that release software projects have already identified groups or individuals with the following high-level responsibilities:

- Software design
- Infrastructure and network design
- Security design
- Software development
- Project management
- Quality assurance
- Operations

For example, an organization building and deploying a DataPower solution might allocate tasks as listed in Table 8-1 on page 195.

Table 8-1 Responsibilities and tasks that are associated with a DataPower solution

| Role | Typical responsibilities |
|---|---|
| Architect | ► Designs high-level integration and security<br>► Identifies system components |
| Security officer | ► Establishes security policies for integration projects<br>► Audits application and infrastructure design for security exposure |
| Developer | ► Configures DataPower appliance messaging services and policies<br>► Manages DataPower devices in the development environment |
| Network administrator | ► Allocates and assigns IP addresses for DataPower appliance network cards<br>► Implements firewall rules, load balancing rules, and network segregation |
| System operator | ► Installs and sets up initial DataPower appliance<br>► Creates DataPower domains and user accounts |
| Quality assurance lead | ► Tests execution<br>► Manages DataPower appliance domains that are assigned to quality assurance (QA) |

Although the actives that are related to DataPower appliance management, configuration, and implementation are distributed easily within the organization, it is prudent to establish a single team that will be responsible for overseeing all DataPower appliance deployments. This group is the subject matter experts or “center of excellence” within the company and can provide advice on the functional capabilities, limitations, and future direction for DataPower appliance projects.

In the absence of a defined DataPower appliance team that can gauge the suitability of using the appliance for new projects, it is important to establish guidelines for use within the enterprise. Guidelines help to avoid implementations that do not adhere to the original design intent of the product or that conflict with the organization’s desired role for the DataPower device.

For example, a DataPower specialist group might identify that an XML transformation can be off-loaded from a back-end system to a DataPower appliance. The group can provide a rough estimate of the cost in time and effort to implement the solution. The same group might also advise an application team not to deploy a solution that requires an unsupported custom TCP/IP protocol.

## 8.2 Software development life cycle

The software development life cycle (SDLC) describes the set of activities that must take place for a software solution to be implemented or released. There are many methodologies and practices that define the order and types of activities in a life cycle. In this section, we describe two of the SDLC categories.

### 8.2.1 Sequential life-cycle model

A *sequential* life cycle defines a series of activities that must be executed in order and prior to the release of a software project. Steps within the process might be repeated, but an activity can commence only when the previous stage's activities are complete. The usual characteristics of a sequential life-cycle model are long running, monolithic planning, design, and development stages. The waterfall model of software development is a classic example of a sequential life-cycle model (see Figure 8-1).

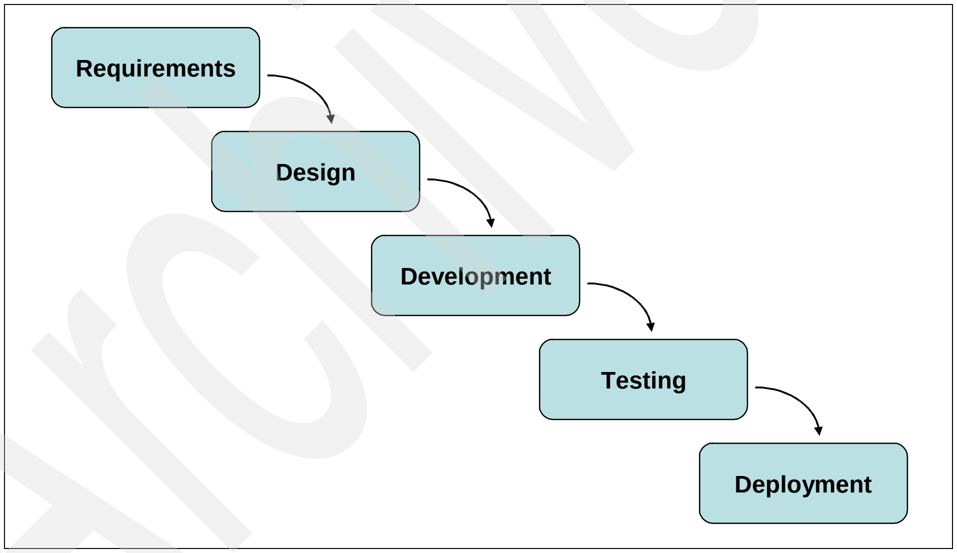


*Figure 8-1 The waterfall SDLC model*

### 8.2.2 Iterative life-cycle model

In contrast to the sequential life-cycle model, an *iterative* life cycle model does not require a life-cycle stage to be completed before embarking on the subsequent step. In most cases, iterative models prescribe partitioning a project into smaller *subprojects* or *phases* that can be deployed into a release environment iteratively. In theory, this model results in faster implementation of feature subsets and less rigidity in solution design and implementation. The *Rational Unified Process* (RUP), as shown in Figure 8-2, is a popular example of an iterative development model.

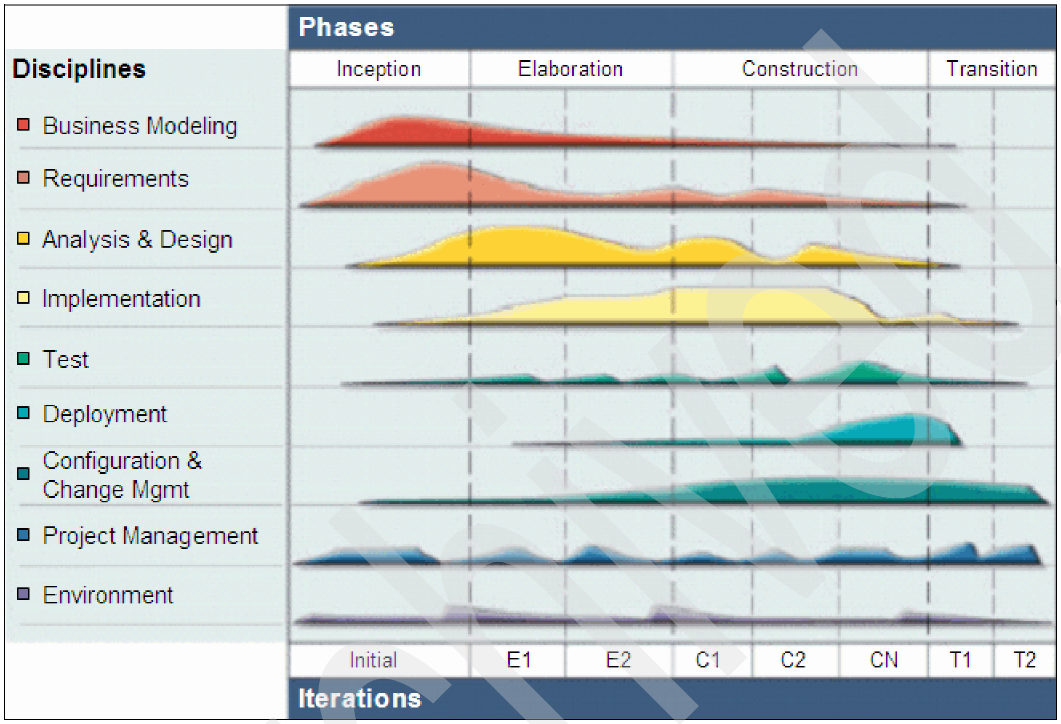


*Figure 8-2 The Rational Unified Process (RUP)*

### 8.2.3 Choosing a life-cycle model

You can implement DataPower appliance projects within both iterative and sequential life cycles. The device provides functionality that is well suited to the controlled deployment of configuration and assets. Organizations need to be comfortable adopting either style of life-cycle model for projects that include DataPower components.

## 8.3 DataPower life-cycle stages

When planning a DataPower appliance project, it is important to identify all the tasks that are related to implementation in order to properly estimate the project cost and allocate resources. Typically, DataPower tasks are similar to tasks for software projects; however, they tend to be much shorter due to the appliance-based nature of the product.

Although a detailed discussion of the specific activities that are associated with DataPower development is beyond the scope of this book, project managers can expect the high-level tasks that we discuss in this section to be executed in a conventional DataPower project.

## 8.3.1 Physical installation

Colloquially referred to as “racking and stacking,” physical installation is required only if an existing DataPower device is not available for use within the organization. This task includes the following activities:

- Install the device in development, testing, and production data centers
- Provision power and network connectivity
- Configure the initial system and network, which requires physical access to the device

Roles for this task include the network administrator, systems operator, and operations personnel.

## 8.3.2 Solution design

Every organization has its own design culture and architectural guidelines; however, the following activities are usually performed when designing a DataPower solution component:

- Identify the integration and security functions that must be implemented to meet the specified requirements
- Conduct a feasibility study to determine if all integration and security functions can be met with existing DataPower hardware and firmware
- Identify the type of DataPower service objects that will support the solution

Roles for this task include the architect and developer.

## 8.3.3 Operational design

In addition to designing a functional solution, it is important to consider all the nonfunctional aspects of the DataPower appliance installation that we describe in this book. Operational design activities usually include these tasks:

- Create a design for system-level monitoring of the device
- Create a domain management strategy

- Identify operational and deployment tasks that must be automated

Roles for this task include the architect and operations staff.

## 8.3.4 Development

For DataPower users, development usually entails configuration through the web-based graphical user interface (WebGUI) and the construction of the associated artifacts. The actual development activities vary from project to project, but in most cases development includes the following activities:

- Configure messaging listeners and services (for example, HTTP Front-Side Handlers (FSHs) and Web Service Proxy (WS-Proxy) Services)
- Configure messaging policies that define how to manage or manipulate in-flight messages
- Construct integration and security artifacts, such as Extensible Stylesheet Language (XSL) templates
- Test the solution during development

The role for this task is the developer.

## 8.3.5 Testing

The testing or quality assurance (QA) stage in a DataPower solution is identical to a software project testing stage. The only difference for a DataPower project is that the solution is deployed on hardware instead of a software platform. As with any project, testing includes the following activities:

- Construct test cases
- Execute test cases
- Record issues

The role for this task includes quality assurance personnel.

## 8.3.6 Deployment

Throughout this book, we describe strategies for configuration and firmware deployment. At a high level, DataPower deployment includes the following tasks:

- Deploy the firmware
- Deploy the configuration
- Configure the environment

The role for this task includes the operations staff.

9

# Configuration management and deployment

This chapter covers the practicalities of managing and deploying DataPower configurations within modern IT environments. We describe the following specific aspects of configuration management and deployment:

- Utilizing revision control systems
- Developing deployment packages
- Considerations for parallel development
- General deployment strategies

**Additional information:** For additional information about DataPower configuration and deployment, see the IBM WebSphere DataPower Information Center:

`http://publib.boulder.ibm.com/infocenter/wsdatap/v3r8m2/index.jsp`

## 9.1 Configuration management

You can configure DataPower device integration and security solutions easily using the WebGUI. In addition, the device is designed to support rapid creation of messaging policies. However, this type of hands-on configuration is recommended only for environments in which changes can be made with no risk of affecting existing services. Most commonly, this type of configuration is performed in development and test environments, never in production environments. As with software-based solutions, you need to migrate DataPower appliance configurations from the development environment to the testing and production environments in a controlled and repeatable manner.

### 9.1.1 Revision control

A key aspect of any software configuration management (SCM) process is revision control. *Revision control* provides an auditable repository of the assets that are implemented into a target environment and allows an organization to maintain a history of the changes that are applied. SCM tools are particularly important for organizations that practice iterative software development life cycle (SDLC) methodologies in which there are often multiple versions and releases of software to manage at the same time.

Many SCM tools are available on the market today. Most organizations have a favorite (or in certain cases a mandated) SCM tool. An effective SCM tool provides support for file versioning, parallel development, audit trails, and integration with development and deployment tools. IBM Rational ClearCase® is an example of a popular software configuration management tool that provides this type of functionality.

It is important to note that multiple SCM tools can be in use at the same time within a single organization. For example, a development team might use a robust enterprise product for the control of source code, and an operations team might maintain a homegrown tool for control of compiled application releases. This type of variation is often a result of the differences in function, budgets, and culture among the teams.

Regardless of the specific product that is chosen, DataPower appliance deployments benefit from the use of an SCM. It is strongly recommended that organizations use SCM tooling for any non-trivial implementations.

The following categories of DataPower configuration can benefit from change control:

- System-level configuration

- Development assets
- Deployment packages

### System-level configuration

As a general rule, system-level configuration covers configuration that is defined within the *default* domain of the device. For example, the network card configuration, device name, Network Time Protocol (NTP) settings, Domain Name System (DNS) settings, and Role-Based Management (RBM) settings are all system-level configuration items that an administrator needs to store in a revision control system. This type of configuration is the least likely to change over time, but it is worthwhile storing this information in a change repository in case a device ever needs to be replaced or reconfigured from an initial state.

A revision control process for system-level data can be as primitive as the use of a spreadsheet in which all the relevant system information is stored. However, a simpler and more reliable method is to use the *Backup Configuration* function to retrieve a compressed file that contains the system-level settings of the device. This backup file can then be stored and versioned as a file within an SCM tool.

In addition, as of firmware version 3.8.1, DataPower administrators can perform a secure backup of the device that includes all the cryptographic key material from the file system. This feature makes it easier to maintain a complete backup of the device for the purposes of failure recovery.

### Development assets

Development assets on a DataPower appliance project include the XML, Extensible Stylesheet Language Transformation (XSLT), WebSphere Transformation Extender, Web Services Description Language (WSDL), and XML Schema Definition (XSD) files that are used within a *processing policy*. Although these assets can be exported from the device as part of a system backup or domain export, it is prudent to manage each file individually within an SCM tool so that changes to the files can be tracked atomically. This tracking allows for individual files to be versioned as changes are made during the development stage and before the entire project reaches the checkpoint or is labeled for release into the next SDLC stage.

### Deployment packages

Although revision control of the atomic development assets is useful in a development environment, it is more practical to manage a complete deployment package when migrating to testing and production environments. In the DataPower appliance context, this type of management means using the Export Configuration function to generate a compressed package and storing the entire package in the repository. This function provides the deployment team with a history of deployment packages within the repository and ensures that a domain can be returned to a versioned state by importing the appropriate package.

Most DataPower appliance configurations have dependencies on external flies to process messages (XML, XSLT, WSDL, and so forth). If these files are stored off the device, it is useful to provide a package or a revision control system (RCS) checkpoint that contains both the DataPower appliance configuration and the associated files for deployment, as illustrated in Figure 9-1.

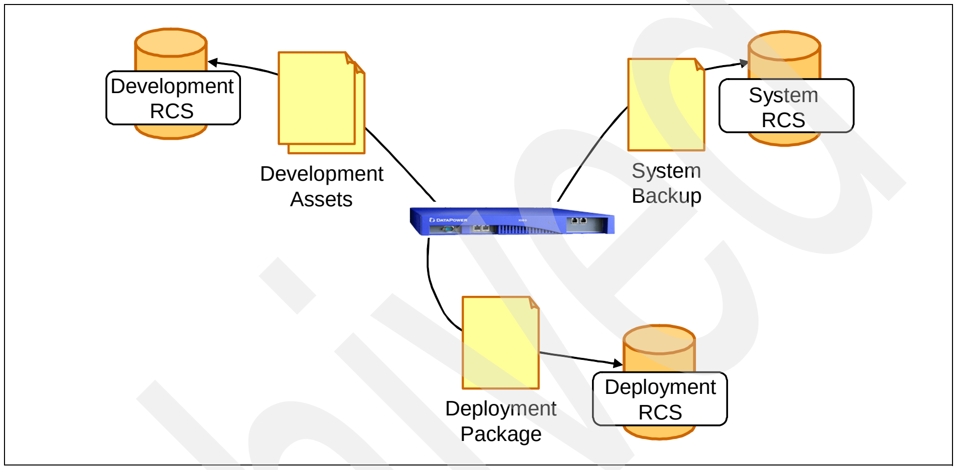


*Figure 9-1 Three categories of revision control*

An advantage of using a revision control repository is the level of control over change that it provides. As with software development, projects that use code and build repositories can use these systems to ensure that only tested and audited configuration packages and files are deployed in controlled environments. For example, a typical end-to-end DataPower implementation might entail the following activities:

1. The development team creates and tests a DataPower configuration that meets the business requirements for the project, as shown in Figure 9-2 on page 205.

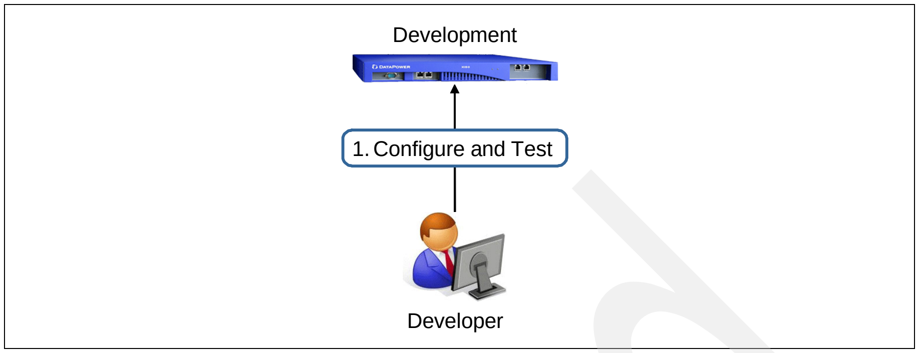


*Figure 9-2   Configure and test*

2. During development, developers check in individual XSLT, WSDL, and XSD files to the development code repository, as shown in Figure 9-3.

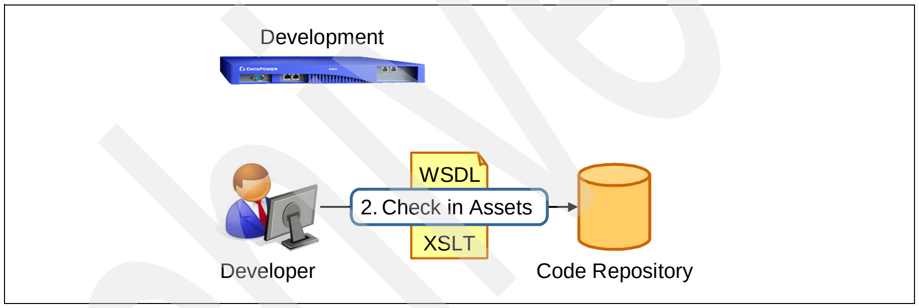


*Figure 9-3   Check in assets*

3. After development is complete, the team leader exports the working DataPower configuration along with the associated files and checks in the package to the build repository and uses 1.0 as the checkpoint for the projects, as shown in Figure 9-4.

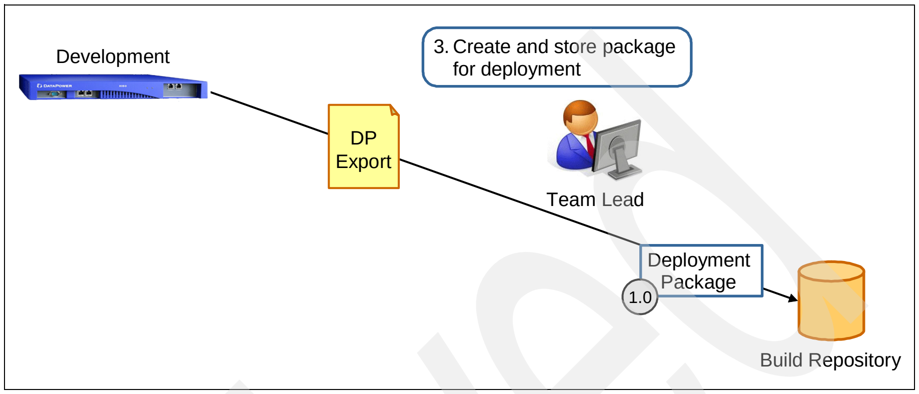


*Figure 9-4 Create and store package*

4. The deployment team retrieves the 1.0 project from the build repository and deploys it into the quality assurance (QA) environment, as shown in Figure 9-5.

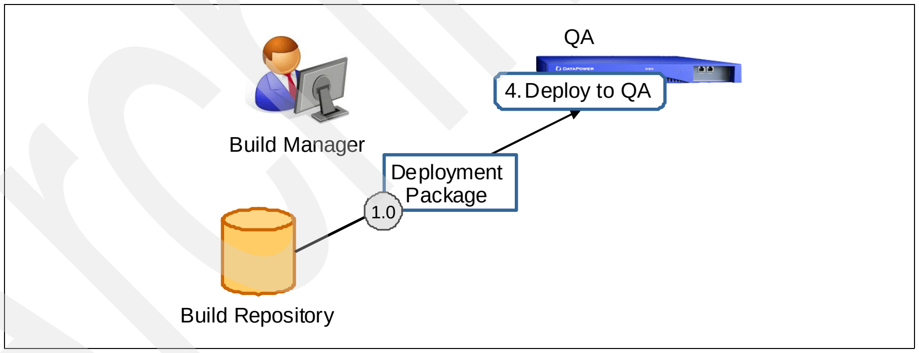


*Figure 9-5 Deploy the package*

5. The QA team tests the 1.0 project and identifies a functional issue, as shown in Figure 9-6.

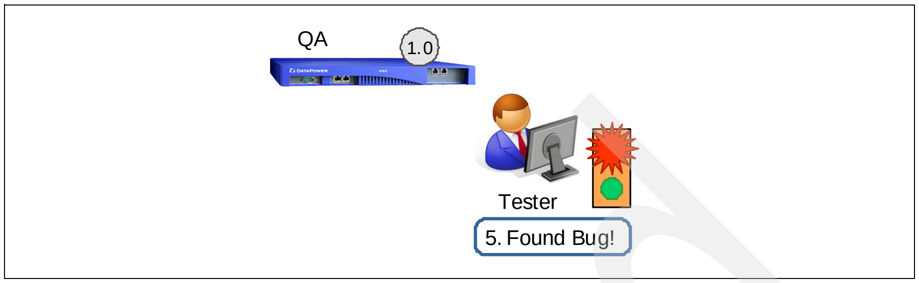


*Figure 9-6 QA tests the package*

6. The development team resolves the issue. The team leader checks in a new version of the configuration to the build repository with the label 1.1 as the checkpoint for the package, as shown in Figure 9-7.

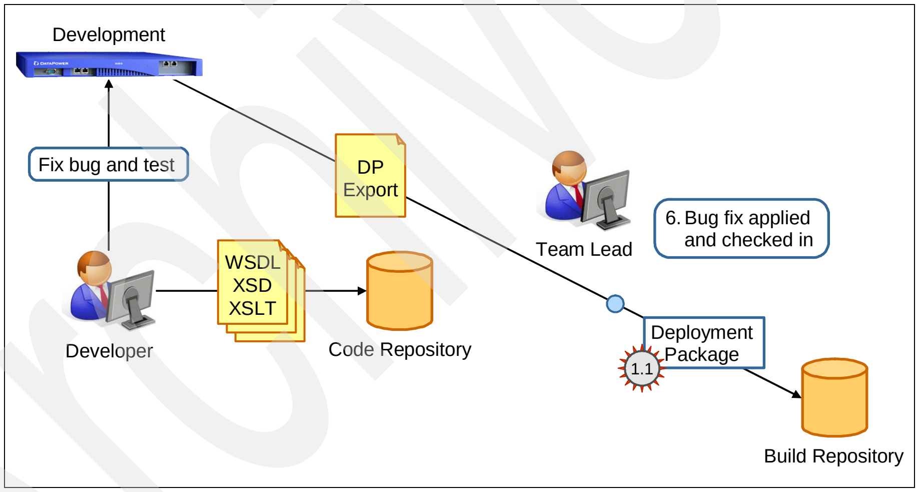


*Figure 9-7 Resolving the issue*

7. The QA team tests the newly deployed 1.1 configuration, and the newly deployed 1.1 configuration passes the testing (the “green light”), as shown in Figure 9-8.

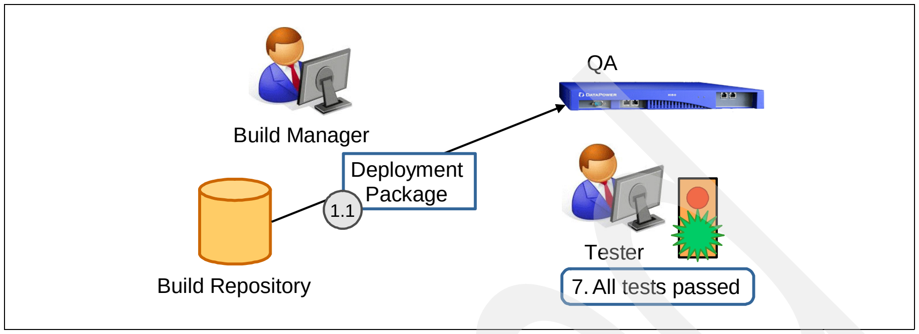


*Figure 9-8 QA tests the new deployment package*

8. The project manager notifies the deployment team that the package is now ready for implementation to production, and a change window is scheduled, as shown in Figure 9-9.

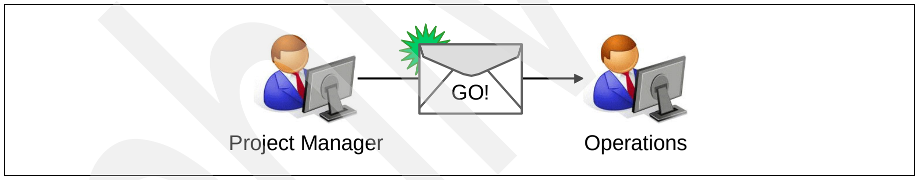


*Figure 9-9 Package ready for implementation*

9. The deployment team retrieves the 1.1 version of the configuration from the build repository and deploys it into production, as shown in Figure 9-10.

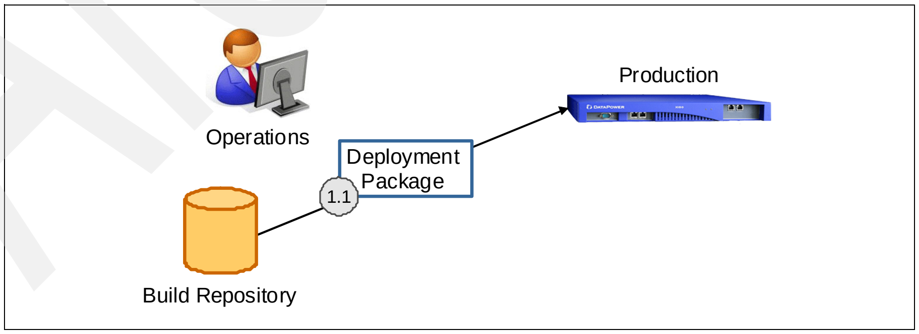


*Figure 9-10 Package is deployed into production*

In this manner, the development team can make configuration changes only on its own devices. And, the testing and production teams have absolute certainty about the changes that are applied to their respective environments. A full history of releases is maintained, and previous builds can be retrieved and examined, if required.

For a detailed description of a DataPower appliance change management cycle, consult the developerWorks® article, "Managing WebSphere DataPower Device configurations for high availability, consistency, and control, Part 2: Application promotion strategies," which is available at this website:

http://www.ibm.com/developerworks/websphere/library/techarticles/0904_rasmussen/0904_rasmussen.html

## 9.1.2 Parallel development

With the rise of larger development teams, iterative life cycle methodologies, and tighter project time lines, developers commonly work in parallel on the same development components within a software project. Early versions of SCM tools allowed only a single developer to "lock" a file when working on it, forcing other developers to wait until changes were checked in to the repository before making their own modifications. See Figure 9-11.

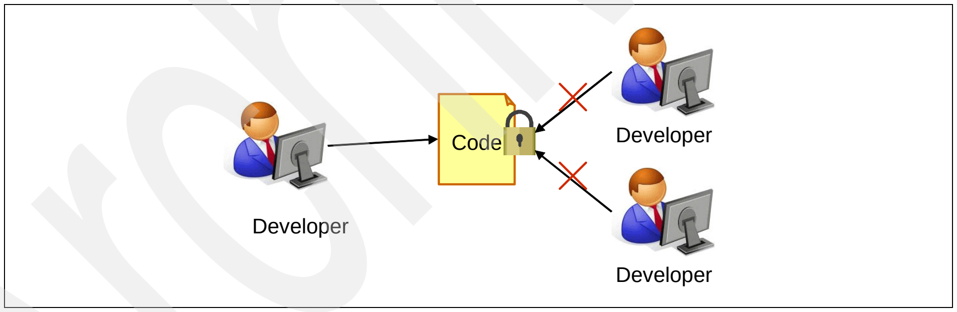


*Figure 9-11 A traditional lock-based SCM method*

However, most tools now support *parallel development* through the advent of code branching, textual merging, and in many cases the elimination of the lock concept entirely, as shown in Figure 9-12 on page 210.

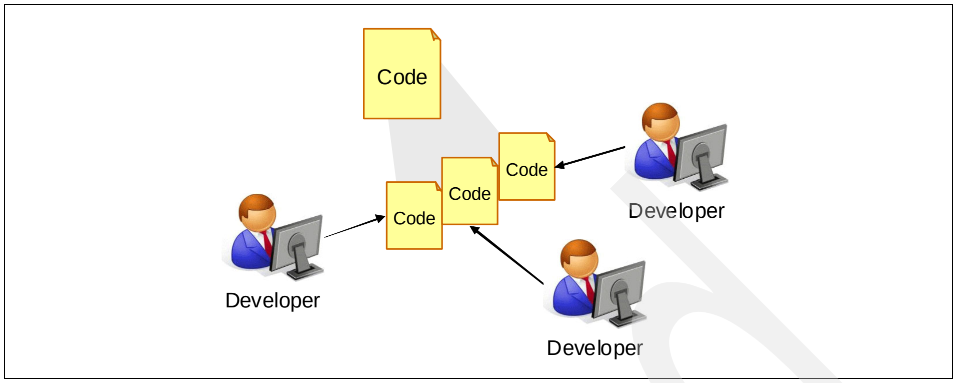


*Figure 9-12 An SCM method that supports parallel development*

In practice, parallel development requires a significant amount of planning and foresight to avoid spending inordinate amounts of time resolving merge-related conflicts and bugs. However, when executed properly, the organization can realize a large time savings for development and release activities.

The classic target of parallel or concurrent development is source code files. For example, in a C++-based software development project, multiple developers might need to modify the same C++ source code file at the same time and resolve conflicts when checking the file back in to the source code repository.

Although the practice of concurrent development can work well for traditional software development projects, applying this practice to DataPower appliance development can be a challenge. With the DataPower appliance, the configuration instructions for messaging and security policies are not contained within atomic text-based files. Instead, the DataPower device allows users to export the configuration as an XML file contained within a compressed package, which makes it difficult to apply most of the automated merge and resolve functionality on which concurrent development projects rely.

In fact, most DataPower users find that the advantages of parallel software development do not translate well to an appliance-based solution. The configuration of a DataPower device takes less time to implement, requires fewer developers, contains fewer code problems ("bugs"), and changes far less than traditional code-based development. These advantages result in a shorter development life cycle, which offers far less return on the cost of managing a parallel development practice.

However, if desired, it is still possible to apply a parallel development style to the practice of configuring DataPower devices. The file-based assets, such as XSLT, XSD, and XML files, on which DataPower configurations rely, can be developed in parallel easily and do not present a challenge for a build manager. The real complexity arises in managing parallel development of the services, processing policies, and listener objects that are associated with the DataPower web graphical user interface (GUI)-based configuration.

One approach allows individual developers to work in their own domains with a configuration that is exported from the SCM tool. Environment-specific values, such as IP addresses and ports, might need to be modified for each domain, but the actions and the order of operations within the processing policy remain the same.

Upon completion of a change, the developer is responsible for merging any changes made to the configuration with the official version before checking in the change to the SCM tool. This method entails maintaining a build management or integration test domain for testing merges to ensure that they have not broken the configuration. Configurations can be merged with the import and export facilities that are provided within the device or through a textual merge of the exported DataPower configuration file; however, both approaches will likely require manual correction to address any conflicts or unintended errors that arise after the merge. Figure 9-13 illustrates the use of domains and merging to support a parallel development methodology.

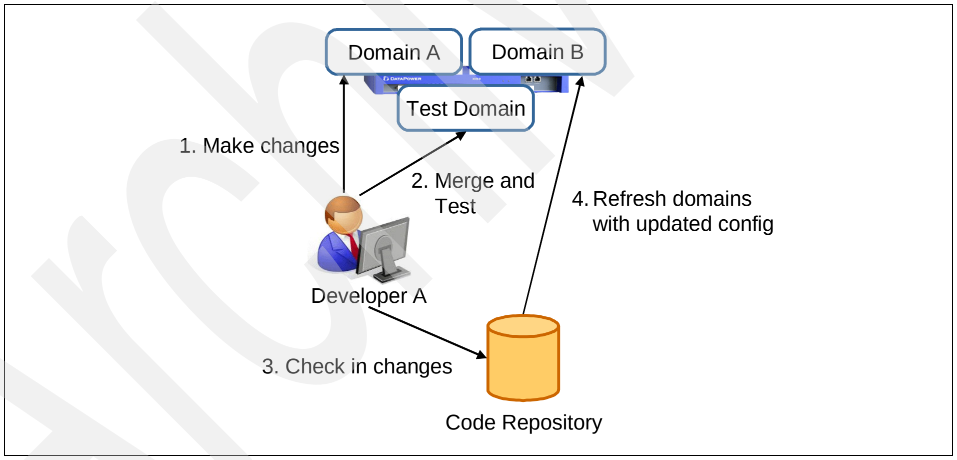


*Figure 9-13 Parallel development methodology support*

Although it is technically possible to develop DataPower appliance solutions in this manner, it is rare to see an organization take this approach in the long term. Teams that have strong roots in parallel development often start by implementing complex processes and tooling to support parallel development of DataPower appliance solutions but abandon these processes after they gain a better understanding of the realities of appliance-based development. Although transformations, schemas, and XML-based registries are likely to change with a certain level of frequency and might require the involvement of many people, the configuration of DataPower processing policies and listener objects tends to change with less frequency and is usually best performed by a single individual.

## 9.2 Deployment

Deploying a DataPower appliance configuration into a production or testing environment is an important step in the life cycle and must always be executed in a well-thought-out manner. Although the DataPower appliance is designed and built to support rapid changes to configurations during development, it is important to deploy those changes in a way that is both repeatable and reversible. Fortunately, the device provides built-in functionality to facilitate controlled deployment of configuration packages.

### 9.2.1 Upgrading an existing implementation

A fundamental decision for deploying a configuration to an existing application domain is deciding whether to start with an empty domain or to deploy the new configuration on top of an existing configuration. This decision has ramifications for how configurations are exported, how they are imported, and how devices are managed.

#### Starting from an empty application domain

An advantage of starting with an empty application domain is the assurance that only the objects and settings that have been exported from the development environment will be active after the import. However, this approach presents the following disadvantages:

- Removing the existing configuration adds to the complexity of the deployment process.
- Assets within the domain might be specific to the environment and will not be contained in the deployment package (for example, private and public key files, deployment policy objects, and log target configuration).
- DataPower configuration objects cannot be deleted if they are in use.

As described in Chapter 3, “Domains” on page 61, domain deletion is an asynchronous task and was not originally designed as a mechanism for deployment. Instead, the recommendation is to overwrite the existing configuration with a new configuration. However, in cases where the new configuration differs significantly from the existing version, it often makes sense to start from the beginning rather than reconcile two dissimilar configurations.

In these situations, a reasonable approach is to create a new domain rather than replacing the existing domain. For example, assume that a configuration exists in a domain named `ESB_1_0`. Furthermore, assume that the requirements have changed extensively and that the configuration is revamped. In this case, we might consider creating a new domain named `ESB_1_1` and importing the configuration into this newly created empty domain.

Ultimately, your organization might choose to move forward with domain deletion or a domain reset as part of the deployment process. If this is the case, ensure that the device is removed from active use before executing the deletion. Starting with firmware version 3.8.1, DataPower products provide a quiesce function that gracefully disables a configuration object. See 9.2.5, “Hot deployment” on page 225 for details.

### Overwriting the existing configuration

Overwriting an existing DataPower configuration with a newer configuration might be perceived as risky by teams that have their roots in software deployment. This perception is because, traditionally, variations in server environments and application instances increase the risk of unexpected issues.

For example, a Java class that exists in production but not in the tested development code can wreak havoc when the application is started. However, on the DataPower appliance, this risk is greatly diminished. To understand the implications of overwriting a DataPower appliance configuration, it is important to first understand the structure and relationships of DataPower configuration objects.

*Figure 9-14 A DataPower Multi-Protocol Gateway service object*

The Multi-Protocol Gateway, Web Service Proxy (WS-Proxy), Business-to-Business (B2B) Gateway, Low Latency Messaging, and XML Gateway are all service objects within DataPower configurations. Without these top-level service objects, no messages can be processed, routed, or handled. *Service objects* define relationships to many other configuration objects, in particular Front-Side Handlers (FSHs), XML Managers, and processing policies, as shown in Figure 9-15 on page 214.

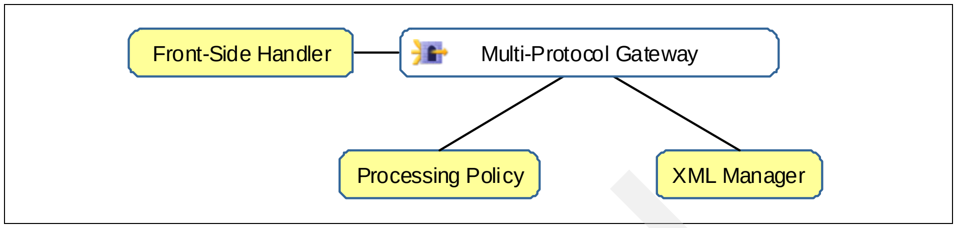


*Figure 9-15 A service object with child configuration objects*

The FSH object defines how messages are received on the front side of the appliance. For example, an HTTPS FSH defines the IP, Port, and Secure Sockets Layer (SSL) credentials that the device uses when listening for incoming messages. Among other things, the XML Manager object defines the rules and limits for XML parsing. Finally, the processing policy describes what happens when messages are received through the processing actions that are defined in its child, the processing rule object. See Figure 9-16.

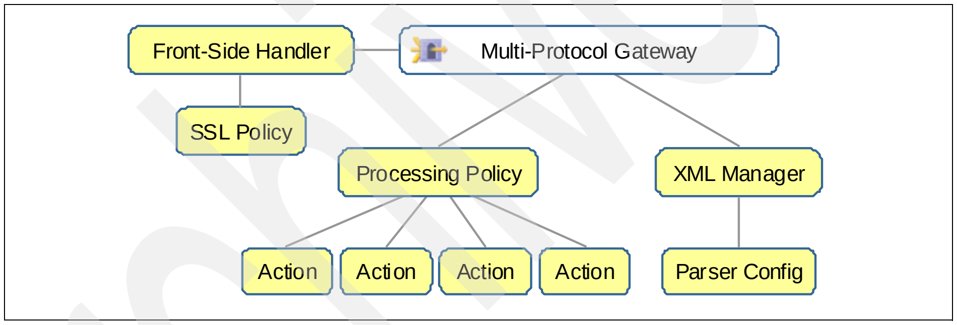


*Figure 9-16 A service object with third-generation descendants*

The beauty of this design is that an object can become an active part of message processing only if it has a relationship with a parent service or one of its descendents. Thus, orphaned objects cannot affect message processing. In other words, if a configuration object is inadvertently orphaned and left in a domain after a change is applied, the orphaned object has little chance of affecting the new configuration. See Figure 9-17 on page 215.

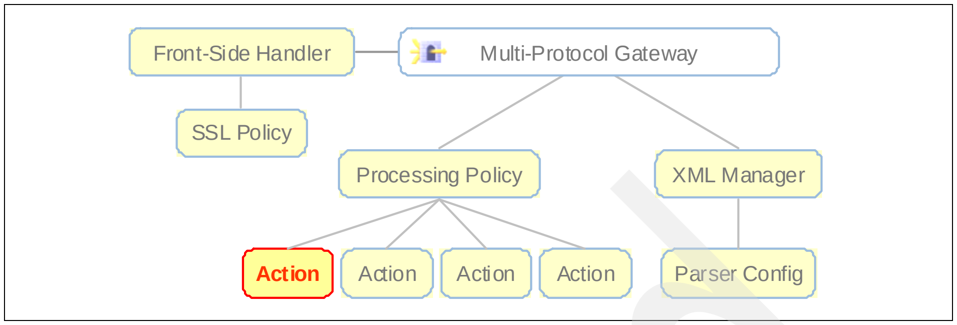


*Figure 9-17   An orphaned configuration object*

To further reduce the risk of introducing a defect when overwriting an existing deployment, organizations can consider the following actions:

- Maintain an application domain in a nonproduction environment that is structurally identical (that is, the same objects, relationships, and definitions as the production configuration with parameters that correspond to the environment).
- Deploy the new configuration in this preproduction environment to ensure that there are no unexpected issues.
- Use the DataPower *Compare Configuration* function to compare the running configuration and the compressed package to be deployed (see the *DataPower Administrator's Guide* for details). This function allows an operations team to identify any unexpected changes or to compare the results with a list of expected changes provided by the application team.

## 9.2.2 Managing environment-specific values

Certain configuration values within a DataPower appliance solution differ, depending on the environment to which it is deployed. For example, a DataPower appliance implementation that protects a back-end web service can route messages to the URL `http://mylaptop:8080/test` in development but needs to route messages to `http://realserver:8443` in the production environment. The challenge for a DataPower operations team is to ensure that a deployed configuration will work within the target environment while avoiding any damage to the integrity of the tested solution.

The following DataPower configuration values typically need to be modified due to environmental dependencies:

- Back-end destination addresses
- External server addresses (including MQ servers, IBM Tivoli Access Manager, and Simple Network Management Protocol (SNMP) servers)
- Front-Side Handler listener addresses for inbound messages
- Locations for XML, schema, XSLT, and other external files
- Security material (including private keys and keytabs)
- Custom variables that drive environment-specific behavior (for example, a flag that is used to indicate the verbosity of error messages is set to `terse` in a production environment)

Overall, the controlled modification and management of environment values are common requirements for DataPower administrators, and there are multiple solutions available. Both DataPower appliance configurations and operating environments differ greatly from one user to the next. Thus, it is important to find a solution that fits the organization's own needs.

The risk, complexity, and flexibility of each type of value management solution are good indicators of the solution suitability. Often, it makes sense to combine strategies to obtain the best fit.

### Host name resolution

*Host name resolution* is a method of resolving a host name to a physical TCP/IP address. For example, in a web browser, the host name `www.ibm.com` is resolved to its physical IP address of `129.42.60.216`.

Name resolution is a simple yet effective way of resolving destination values to environment-specific addresses. For example, if a configuration defines a service with a back-end destination address of `http://backend-server:8080/in`, the `backend-server` host name can be resolved to a physical IP address for the hosting environment (assuming that the resolution rules themselves are environment-specific).

The Domain Name System (DNS) protocol is the standards-based mechanism that DataPower appliances and almost all computer systems use for host name resolution. The protocol is superficially a client/server messaging protocol and requires the implementation of a DNS server in the operational environment.

A DataPower appliance that needs to resolve a host name for a TCP/IP-based connection issues a DNS name resolution request to the defined DNS server and uses the IP address that is returned to create the connection. By configuring each DataPower device point to a DNS server that returns an environment-specific IP address, an administrator can avoid making changes to the DataPower configuration package.

Alternatively, the administrator can define name resolution rules in the Host Alias section of the default domain on the appliance. The Host Alias operates similarly to the DNS protocol, except there is no call made to a DNS server. Instead, the DataPower device uses the local name resolution table to resolve the host name to a physical address.

Although name resolution has many advantages, it is limited in scope and addresses only the problem of resolving differences in physical IP destinations. It is not a solution for managing differences in ports, URIs, or object values. For example, name resolution is not the solution for replacing the development back-end destination of `http://backend:8080/test` with `http://backend:8443` in production, because the port and URI need to be modified in addition to the IP address.

## Post-deployment modification

Another way of compensating for environmental differences is to modify the DataPower configuration values after deploying the original version. For example, if the back-end destination `http://mylaptop:8080/test` needs to be modified to point to `http://realserver:8443`, the value itself can be updated to point to the correct destination after the configuration is installed on the device.

When taking this approach, it is crucial that post-deployment changes be made in a repeatable, auditable, and reliable way. This method implies that a form of automation is necessary and that the replacement values must be stored and versioned in a repository.

An advantage of applying post-deployment modification is the scope of functionality that is available. Any value in the DataPower domain can be modified, created, or deleted. However, if not implemented properly, modifying a deployed configuration can have disastrous results.

It is extremely important that the value modification solution is well-thought-out in order to mitigate the risk of introducing unexpected problems into a critical environment. Due to the level of diligence required, it is often the case that post-deployment value modification solutions have a fair degree of complexity in planning, creating, and maintaining the solution.

## Pre-deployment modification

The opposite of post-deployment modification is the modification of a configuration package before it is deployed to the target device, which can take one of the following forms:

- Modification of values on a DataPower device prior to export (for example, a development team might replace a back-end destination value of `http://mylaptop:8080/test` with `http://www.service.com/op1` prior to exporting the configuration from the device)
- Modification of the deployment package after exporting it from the device (for example, the use of an XSLT transformation to replace the back-end destination in the `export.xml` file that is contained in the export package)
- Modification of a remote configuration file (see Chapter 3, "Domains" on page 61 for additional information)

Pre-deployment and post-deployment modification share many of the same characteristics. They both have high degrees of flexibility but also carry the risk of introducing new defects and, thus, tend to be more complex solutions. However, one key difference is that modification of a configuration before deployment allows an organization to have a single asset that represents a deployment package for a particular environment.

In addition to the risks involved when changing configuration, it is important to remember that there is no support, documentation, and official guidance for modification of a configuration file after it is exported from the device. Although the `export.xml` file that represents the configuration tends to be fairly intuitive, users who decide to modify it need to reverse engineer the configuration data and must accept the risk that the structure and content of the file can be changed without any notice.

**Important:** There is no official guidance or support for the direct modification of a configuration file. The actual structure of a configuration file can change without notice.

## Deployment Policy object

The Deployment Policy object is designed and developed specifically to address the issue of modifying fine-grained DataPower configuration values for environments. Therefore, it provides easy to use and deep functionality for the modification of values and can be referenced when importing a configuration package.

The Deployment Policy object is a powerful tool and is easy to use, but it was not designed to support the modification of coarser-grained configuration objects. When judging the suitability of the deployment policy, it is worth remembering that it can only act on name-value pairs. For example, assume that a DataPower configuration contains a `Matching Rule` action for requests that end in the URI `/Jay`, as shown in Example 9-1.

*Example 9-1 XML representation of a Matching Rule action for /Jay*

```
<Matching name="MyMatchingRule" xmlns:...
   <mAdminState>enabled</mAdminState>
   <MatchRules>
      <Type>url</Type>
      <HttpTag/>
      <HttpValue/>
      <Url>/Jay</Url>
      <ErrorCode/>
      <XPATHExpression/>
      <Method>default</Method>
   </MatchRules>
   <MatchWithPCRE>off</MatchWithPCRE>
   <CombineWithOr>off</CombineWithOr>
</Matching>
```

A deployment policy can be created to modify the URL property of the matching rule so that it changes to the value `/Ratna`, as shown in Figure 9-18.

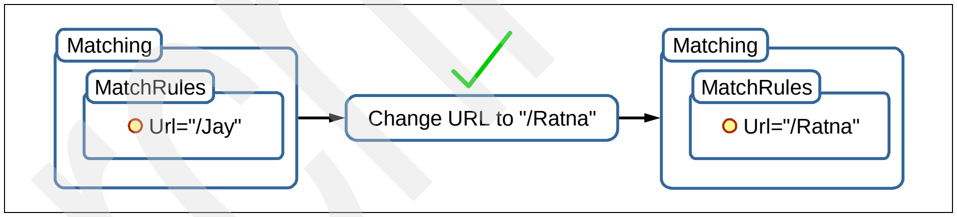


*Figure 9-18 A valid deployment policy for the URL property*

This deployment policy rule is valid because the URL is a simple name-value property that is contained within the Matching Rule action. After applying the deployment, the DataPower configuration file looks similar to the XML snippet that is shown in Example 9-2.

*Example 9-2 XML representation of the Matching Rule action after modification*

```
<Matching name="MyMatchingRule" xmlns:...
   <mAdminState>enabled</mAdminState>
   <MatchRules>
      <Type>url</Type>
      <HttpTag/>
      <HttpValue/>
      <Url>/Ratna</Url>
      <ErrorCode/>
      <XPATHExpression/>
      <Method>default</Method>
   </MatchRules>
   <MatchWithPCRE>off</MatchWithPCRE>
   <CombineWithOr>off</CombineWithOr>
</Matching>
```

However, it is *not* possible to create a deployment policy that can add new MatchRules to the action (that is, it is not possible to add a rule to match on `/Ratna` in addition to the `/Jay` match). This configuration is not possible with the deployment policy, because a MatchRule is a complex configuration item with multiple name-value pairs. See Figure 9-19.

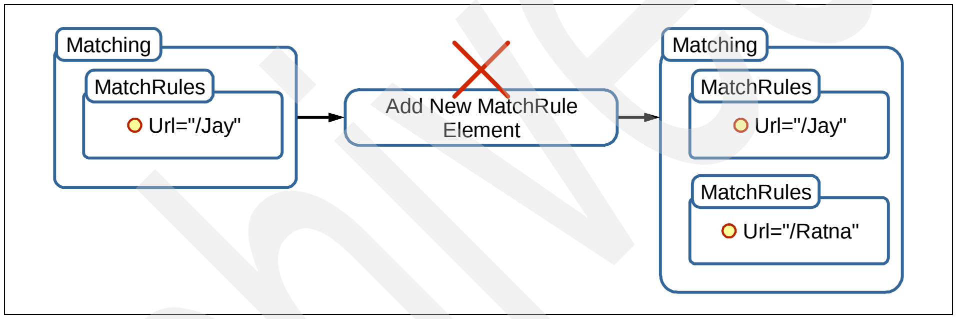


*Figure 9-19 Deployment policies cannot be applied to complex content*

Prior to the addition of the Deployment Policy object in DataPower firmware, administrators had to employ the modification methods described previously. However, Deployment Policies must be the first option for any administrator looking for a straightforward solution to environment variability when host name resolution is not enough.

### Externalizing values

A final method for dealing with environment-specific values is to externalize the data from the DataPower appliance. For example, a DataPower processing policy package can reference an XML-based routing table that contains a list of back-end destinations. If this routing table file is retrieved from an external source (such as a web server), the DataPower configuration can be deployed without any changes as long as the appropriate resource file is available.

One of the major advantages of this approach is that these values can now be modified without making any changes to the DataPower processing policy or service objects. In fact, this design pattern in general is useful, and it is an easy way to minimize the amount of change that is required on the device itself.

It is important for the external files to be stored in a revision control system along with the associated DataPower configuration so that the environment can be recreated when necessary. In addition, be aware that DataPower policies must be configured to use externalized values. No action (without modification) automatically performs this function.

You might want to consult John Rasmussen's developerWorks article titled "Managing WebSphere DataPower SOA Appliance configurations for high availability, consistency, and control, Part 1" for an in-depth example of externalizing configuration values through the use of an XML "identity document." This article is available at this website:

http://www.ibm.com/developerworks/websphere/library/techarticles/0801_rasmussen/0801_rasmussen.html

## Choosing the best method

All of the methods of managing environment variables that we described in this chapter are used successfully in real DataPower appliance deployments. Development and operations teams need to select the method that fits their own set of requirements based on the configuration that will be deployed and the types of values that need to be modified.

To aid in selecting an appropriate replacement method, administrators can use Table 9-1, which summarizes each scheme according to its risk of introducing defects to the configuration, the complexity of implementing the solution, and its flexibility for handling configuration values:

*Table 9-1 Replacement method risk levels*

| Replacement method | Risk | Complexity | Flexibility |
|---|---|---|---|
| **Host name resolution** | Low | Low | Low |
| **Post-deployment modification** | Medium | Medium | High |
| **Pre-deployment modification** | High | High | High |
| **Deployment policy** | Low | Low | Medium |
| **Externalizing values** | Low | Medium | Low |

## 9.2.3 Handling public key infrastructure material

In many cases, DataPower devices are implemented to protect a back-end system or to secure communications with a remote system. Often in these scenarios, public key infrastructure (PKI) public and private key files are loaded onto the DataPower appliance for use at run time. Although a public certificate is intended to be distributed freely, the corresponding private key must be guarded closely. If the wrong person obtained the key, the secure nature of the integration is compromised and the entire solution is at risk of a malicious attack.

Although DataPower products are not designed to offer an enterprise solution for storing and securing private key material, they store private key files in an encrypted, write-only file system for internal use. Thus, after a private key file is uploaded, imported, or created on a DataPower device, it is almost impossible to view or download that cryptographic material.

The following scenarios provide an exception to this rule:

- If the public and private key pair is created on the appliance itself, there is an option to store both the public and private key files in the `temp:` directory of the appliance file system. All contents of the `temp:` directory are deleted automatically after a domain restart, firmware reload, or system restart event.
- The 3.8.1 firmware version supports a conversion function that allows an administrator to export a private key off the device in openSSH public key authentication format, which is primarily useful for sFTP connection handling.
- The 3.8.1 firmware version introduces the secure system backup function that includes key files within a secure backup package.
- DataPower devices that contain the optional hardware security module (HSM) can support the extraction of private keys.

**Private keys:** It is essential that private key files are stored in a reliable, secure repository within your organization. The DataPower appliance is not a key storage or distribution system and must not be used as a key repository.

At one time, managing the redeployment of private key files for DataPower disaster recovery was a challenge for administrators. However, the recent improvements that are provided in firmware version 3.8.1 make the process much easier. Now, administrators can simply export the entire contents of the device, including the private key material and store the package in a reliable repository. The key files remain secure, because the backup package is encrypted using the public certificate that is specified by the user. For specific details about the secure backup function, consult the *Administrator's Guide* in the online IBM DataPower Information Center.

Although this approach solves the issue of key deployment for backup and recovery, those organizations that choose to deploy configurations by first deleting the target application domain need a mechanism for redeploying the private key files to the DataPower appliance. One solution is to avoid deleting the application domain and instead to adopt a policy of overwriting changes, as described in “Overwriting the existing configuration” on page 213. If this method is not possible, an administrator can either re-import cryptographic material or store the files in the `sharedcert:` directory.

### Re-importing private key material

If desired, private key and public certificate files can either be re-imported to the device manually through the WebGUI, or the process of importing can be implemented with automation. Regardless of the method that is chosen for importing the key files, the real challenge is ensuring that the keys are stored securely while still being accessible to the deployment team.

It is recommended that administrators work closely with their organization’s security team to ensure that any key material deployment solution does not introduce unnecessary risk to the solution.

### Using the sharedcert: directory for key material

A more practical option is to store the key material in the `sharedcert:` directory of the default domain. This directory is a special DataPower directory that can be written to only from the default directory but is shared across all of the application domains on the device. As with the `cert:` directory, the `sharedcert:` file system is encrypted and is write-only so that key material cannot be downloaded from the DataPower device.

Because the `sharedcert:` directory is shared across all domains, special care must be taken with the names of the files to ensure that there are no conflicts. It is also advisable that key and certificate files are password-protected due to the fact that they will be accessible within all domains.

As described in “Deployment Policy object” on page 218, you can use a deployment policy to manage the differences in private key file locations from one environment to the next.

## 9.2.4 Checkpointing configurations for backing out changes

Administrators of critical systems and components must have a way to back out changes after the changes are applied in case an implementation goes wrong. A decision to back out or roll back a change might be the result of a functional issue, a conflict in the environment, or a management decision to back out a change due to an unexpected effect on the business. Regardless of the reason for backing out the changes, most project teams will have a plan in place, and in certain cases, the back-out plan might be more complex than the original implementation plan.

DataPower appliances provide a Configuration Checkpoint feature to support an easy method of immediately reverting to a previously saved domain configuration. The checkpoint function allows an administrator to save a copy of the running DataPower configuration to the local file system.

**Configuration checkpoint:** The configuration checkpoint function on the DataPower appliance is not designed to be a persistent repository of configuration states. Administrators who want a robust solution to manage DataPower change history need to consider using a software configuration management tool, such as Rational ClearCase, to store and manage versions of DataPower configurations.

Deployment teams can use the checkpoint feature in their implementation process in the following manner:

1. Perform a checkpoint of the existing running configuration of the target domain.
2. Import a new configuration package into the target domain.
3. If a back-out is required, roll back to previously checkpointed configuration.

See Figure 9-20.

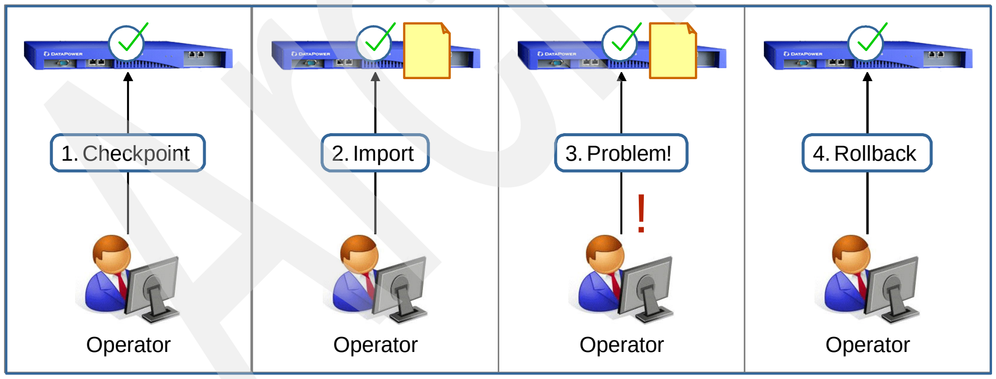


*Figure 9-20 Checkpointing configurations*

Provided that the team had the forethought to use a checkpoint, the rollback feature can be a time-saver when backing out a project change. For details about the use of the domain checkpoint functionality, consult the *Administrator's Guide* in the DataPower product documentation set.

### 9.2.5 Hot deployment

A *hot deployment* is the act of deploying a change to a system component when it is still live. Although it is technically possible to import a configuration into a DataPower device when it is serving traffic, the results are often unpredictable. The immediate risk is that the import process will fail if an attempt is made to update an object that is currently handling a transaction. The additional risk is that the act of updating live configuration objects can inadvertently affect the processing of a message.

The safest way to update the configuration on a DataPower device is to ensure that it is no longer processing messages or transactions. Most operations teams achieve this state by removing the device from active service through the modification of the network routing infrastructure or by implementing changes during designated service hours. This method is normal practice for most system updates and is not unique to the practice of DataPower deployment.

In addition, the release of firmware version 3.8.1 introduces a new quiesce feature that lets DataPower administrators drain configuration objects of transactions so that the configuration objects can be safely modified or deleted. The quiesce function can also be used to stop a service and FSH from accepting new message requests. For example, an operations team might build a deployment script that first sends a quiesce command to a Web Service Proxy object and its FSH to ensure that there are no transactions being processed prior to performing a configuration import.

You can obtain details about the quiesce feature in the *Administrator's Guide* within the IBM DataPower Information Center.

## 9.3 Preferred practices

As with any complex highly-configurable device, certain ways of accomplishing specific tasks are simply better than others. This section provides a list of tips and recommendations that have, in most circumstances, proven to be “preferred practices.” That said, they are not laws and might not be the best method in all situations.

- Quiesce domain traffic (using domain quiesce or other means) before making updates to ensure that all message processing jobs are completed.
- Use a single administrative user per domain when applying configuration changes to a DataPower appliance to help to avoid conflicts when changes are made by multiple users within a single domain.

- Avoid committing many configuration changes all at once, particularly when heavy data traffic is flowing.
- Ensure that the firmware of the DataPower devices being targeted for deployment are the same version or higher than the firmware version that was used for the development of the original configuration export.
- Test and validate configurations after changing or deploying.
- For production or critical domains and devices, schedule a maintenance window so that a controlled migration and test process can be performed before returning the system to active service.
- Track the versions of the configuration so that changes can be verified and implementations can be rolled back to a known version, if necessary.

10

# Appliance management and automation

In this chapter, we describe the DataPower interfaces that can be used for management and configuration tasks, with a special focus on automation.

We describe the following topics:

- Overview of task automation
- Security considerations
- WebGUI
- XML management interface
- WebSphere Appliance Management Toolkit API
- Command-line interface (CLI)

## 10.1 Task automation

*Task automation* refers to the replacement of a manual task with a set of automated steps that can be executed repeatedly with minimal human interaction. For example, a scheduled file transfer task can be executed by a human operator, but it is often implemented in an automated system, instead.

By design, DataPower appliances provide multiple administrative interfaces that support the automation of management, monitoring, and configuration functions. The DataPower appliance can fit into most existing operational and management environments and any task that is executed via the WebGUI can also be automated.

These automation possibilities are limited only by the user's desire to reduce hands-on operations.

### 10.1.1 The case for automation

Modern organizations prefer repeatable, automated processes to manual processes, because they provide the following benefits:

- Reduce the number of issues resulting from human error
- Restrict access to critical systems
- Reduce the need for resources with specific system and process expertise
- Reduce operational time and cost

#### Reducing human error

Occasional errors are both inevitable and unavoidable when using a computer system. While most systems provide user interfaces that are designed to accommodate a small percentage of errors through deletion, undo, and back-out functionality, the effect of human error when making changes to critical systems can be catastrophic. Examples of human error resulting in disasters are pervasive throughout history and pose a legitimate risk to any system.

Reducing the steps that are involved in human-computer interaction to a set of defined instructions that can be executed with a specific set of variables minimizes the amount of human interaction and, in turn, minimizes the overall risk to an organization.

#### Repeatable processes

A benefit of building an automated system is a set of defined instructions that are both repeatable and auditable. Having a truly repeatable process means that behavior is predictable, and the results achieved when testing a process are more valuable because the risk of variation is minimal. Repeatability implies improved predictability, which is an important factor when planning changes to systems or environments that are of a critical nature.

## Restricting access

Not only does automation allow organizations to reduce the number of errors resulting from human operation, automation also allows organizations to restrict the type of access that is allowed to critical systems. For example, a human operator with an administrator account can invoke a broad range of management functions, while a human operator with access to an automation system can only invoke the functions that have been automated. Provided that the automation system itself is secured, an automated system provides a reduction in the risk that unauthorized changes will be made to the target system.

A side benefit of automation is that management and monitoring functionality can be rolled out to users who are not normally provided with direct access to the system due to the criticality or secure nature of the target system.

## Reducing specialization

Reducing the level of human interaction can also mean reducing the level of specialization that is required to operate a system. For example, a user might require a certain level of product experience and skill to retrieve memory and CPU utilization from a group of production servers. This dependency on skilled resources limits the availability of the information and can ultimately increase the overall cost for the maintenance of the system.

Instead, automating the task of retrieving system metrics to a simple script or program reduces task complexity and, in turn, reduces the need for a specialist to be available. Automation can be further extended to take this raw data and present it to nontechnical users in a more meaningful way, further reducing the dependence on highly skilled, specialized operators.

## Reducing time and cost

Perhaps the biggest motivation among systems operators and developers is the time and cost that can be saved by automating monotonous and repetitive tasks. Automation for these types of tasks is usually the easiest to justify and can provide large cost savings for the overall maintenance of a system, especially in environments where multiple systems need to be managed or monitored in the same way.

### 10.1.2 The case against automation

Deciding which tasks to automate often means determining if the up-front effort that is required to implement an automation script or system is worth the value that is associated with automating the task or process. This decision is ultimately a quantitative judgement call; however, a few scenarios exist that are generally not good cases for automation.

#### One-off tasks

It might seem obvious that tasks destined to be executed only once or twice are not candidates for automation. There are occasions where a lack of foresight can result in a wasted investment of effort for a task that rarely gets executed. An example is a script that creates user accounts for an environment that will only have a single account. It is important to gain an understanding of the frequency with which a task might be executed prior to spending the effort required to automate it.

Nevertheless, automating a one-off task might be justified in environments where the criticality of the system requires that all management and monitoring commands must be automated to avoid any chances of human error.

#### Scope creep and high levels of complexity

Automation systems that grow too complex can ultimately become more costly to manage and maintain than the manual tasks that they originally replaced. This type of automation often starts as a simple script to meet a specific set of requirements and grows to become unmanageable through *scope creep*.

For example, assume that an automation component is built to dynamically generate a DataPower configuration to encrypt messages. At inception, this script might provide immediate value by reducing the time that is required for the middleware team to release an encrypted messaging proxy and by minimizing the level of expertise that is required. However, if new users demand additional options to meet their own specific requirements, the complexity of the script will rise until it becomes more complex than the original activity that it was meant to simplify.

Maintaining the fine balance of providing comprehensive functionality while ensuring that the solution is not overly complex requires vigilance on the part of the automation team. It is worthwhile reviewing automated solutions at regular intervals to ensure that they still deliver the value for which they were designed and implemented.

## 10.2 Security considerations for automation

Implement the automation of DataPower management and monitoring functionality in a secure manner whenever possible. Implementing automation without considering security increases the risk of malicious and unintentional modification of a running configuration and can have a major effect on critical and secure deployments.

Although DataPower integration products always require authentication for any management task (including functions that are executed through the automation interfaces), a poorly designed automation system can diminish the secure nature of DataPower device management.

For example, assume that a build manager is assigned the task of regularly monitoring the system metrics of a DataPower device that is hosted in a development environment. In order to address the requirement and save the effort of manually retrieving the data, the build manager builds a script that queries the system metrics of the device and appends the results to a local file (Figure 10-1). In order for the script to be called regularly, the build manager deploys the script on a development server so that it can be executed every 30 minutes. Because the build manager is not actually manually running the script, the build manager hard-codes the administrator user name and password into the script so that the authentication requirement can be successfully fulfilled.

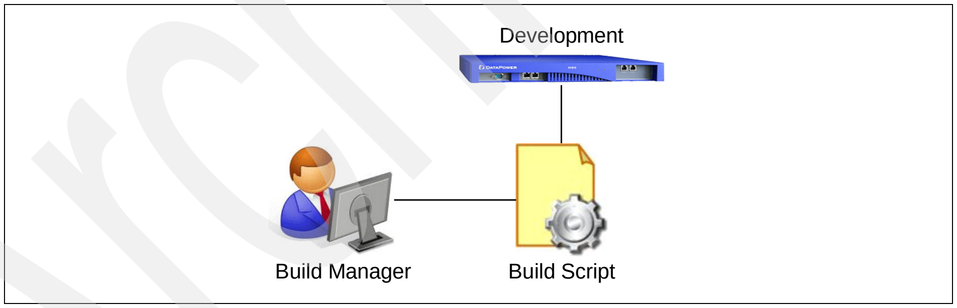


*Figure 10-1 An automated build system*

In this scenario, there are a few potential risks that the build manager might have inadvertently exposed (see Figure 10-2 on page 232):

- The script has a hard-coded password in it, which means that anyone who gains access to the script is privy to the authentication data that is required to log in to the appliance.
- If other users are able to access to the script, they might be able to create additional user accounts or modify the configuration by simply changing the commands that are contained in the script.

- If the network has not been segregated with IP firewalls, a typographical error in the device destination can affect a production or testing device.

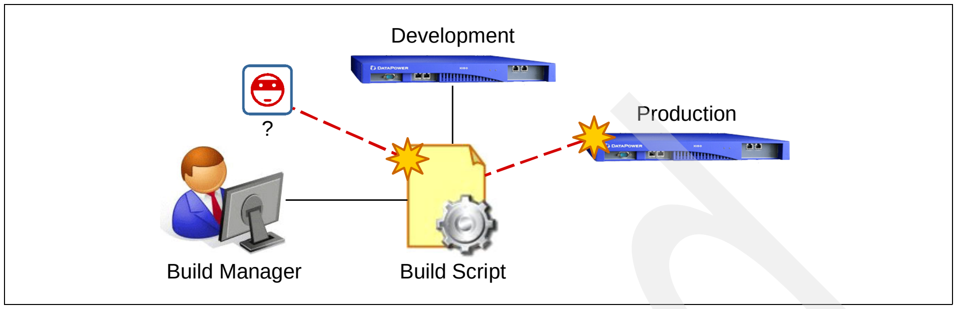


*Figure 10-2 Worst case scenario for an insecure automated system*

Follow these simple steps to ensure that implementing an automation system does not add increased risk to a DataPower deployment:

- Whenever possible, prompt for passwords rather than hard-coding them.
- Ensure that automation scripts are stored and executed in a secure system with restricted access.
- Create a unique user name on the DataPower appliance for the automation component to use.
- Ensure that critical DataPower appliances are deployed in segregated networks. If this approach is not possible, at least use separate authentication credentials to avoid accidentally modifying a production system.

## 10.3 XML management interface

The XML management interface (XMI) is the backbone for all XML message-based administration on the appliance. It allows a DataPower administrator to set the system-level properties for XML management communication and the authentication and security rules that will be enforced. All of the XML message-based administrative protocols use the XMI and inherit its physical and security characteristics (see Figure 10-3 on page 233).

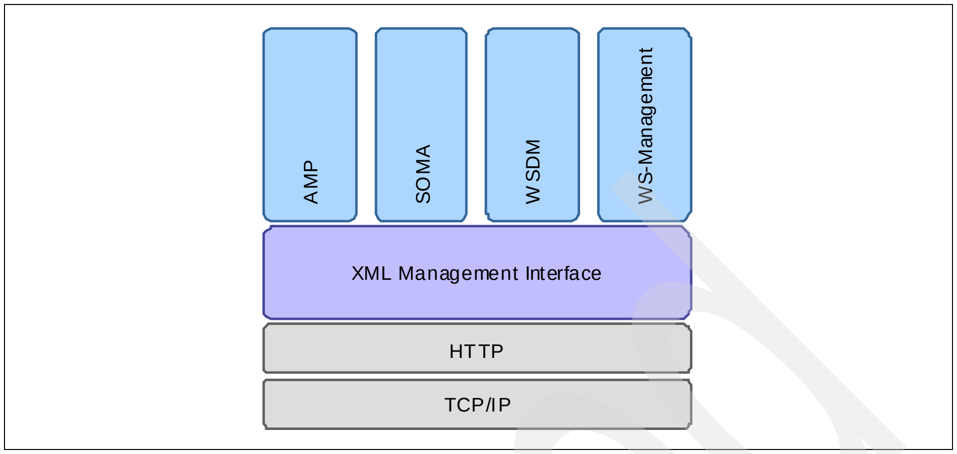


*Figure 10-3 XMI and messaging protocols*

When enabled, the XMI performs these functions:

- Binds to a specified TCP/IP port and listens for messages
- Enforces Secure Sockets Layer (SSL) connection rules according to an SSL Proxy configuration object
- Identifies the type of XML management message based on the URI

For example, assume that an automation system sends an XML-based management message to a DataPower device, as shown in Figure 10-4 on page 234. For this scenario, the following steps occur:

1. The automation system connects to the XMI at the TCP/IP IP address and port that have been defined by the administrator.
2. The automation system conforms to the security policies that have been set for the XMI. For example, the DataPower management interface enforces the use of SSL, by default.
3. The automation system posts a SOAP/XML message to the XMI with a URI indicating the type of message protocol that will be used. In this example, the client uses the URI `/service/mgmt/amp/1.0`, indicating that an AMP 1.0 message is being transmitted.
4. The XMI parses the SOAP/XML message, and if it is valid, passes it on to the appropriate message processor, which, in this case, is AMP.
5. After executing the management command, a response message is passed back to the management client.

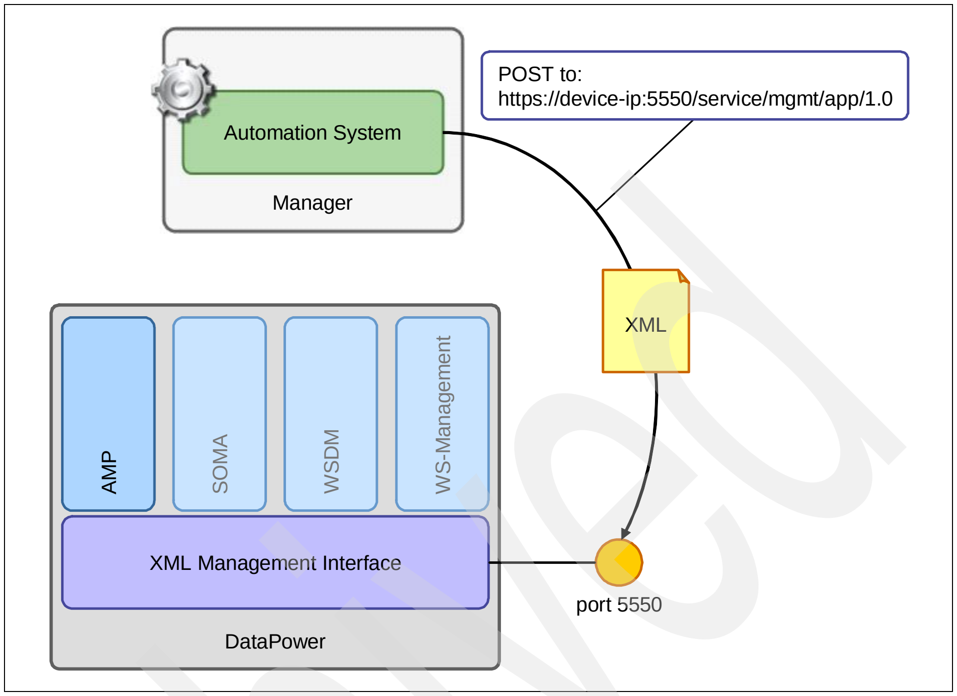


*Figure 10-4 Automation system using XMI for an AMP message*

You can obtain specific instructions for configuring the XMI in the *DataPower Administration Guide* and in the *WebSphere DataPower SOA Appliance: The XML Management Interface,* REDP-4446-00, IBM Redpaper™.

## 10.3.1 Authentication

As with all DataPower administrative interfaces, automation systems that utilize the XMI must provide credentials for authentication. XMI authentication uses the same credential store and Role-Based Management (RBM) rules as the CLI and WebGUI. The administrative user name and password are transmitted over a secure HTTPS connection via basic access authentication.

The HTTP basic authentication scheme works by setting an HTTP header named "Authorization" with a base64-encoded value containing the user name and password strings. The intent of the base64 encoding is not to obfuscate or encrypt the user name/password string. Instead, the credential string is encoded to ensure that the escaping of special characters is not required. It is vitally important to transmit HTTP basic access authentication over a secure connection to ensure that the user name and password data are encrypted during transmission. The XMI relies on the HTTPS protocol to protect the sensitive credential data that is passed during authentication. Example 10-1 shows the format of an HTTP basic access authentication header.

*Example 10-1 Format of HTTP basic authentication header*

```
Authorization: Basic encoded-credential
```

Prior to encoding, the user name and password string is formatted, as shown in Example 10-2. Example 10-2 shows how to format the user name and password string prior to encoding.

*Example 10-2 Format of user name and password prior to base64 encoding*

```
username:password
```

**Credential strings:** If you manually create your credential string for encoding, make sure that there are no CR or LF characters at the end of the credential string. An encoded string that ends with “Cg” is a strong indication that the cleartext string ended with a newline character.

For example, to authenticate with the XMI using the user name `Ashy` and password `supplies`, concatenate the user name and the password separated by a colon, as shown in Example 10-3.

*Example 10-3 A raw credential string*

```
Ashy:supplies
```

Next, the raw credential string is encoded using the base64 algorithm to produce an encoded version of the credentials, as shown in Example 10-4.

*Example 10-4 The base64 encoded credential*

```
QXNoeTpzdXBwbGllcw==
```

Finally, the HTTP header is set as specified in the HTTP access authentication scheme with the base64-encoded credential data and a token, as shown in Example 10-5.

*Example 10-5 The completed HTTP authorization header*

```
Authorization: Basic QXNoeTpzdXBwbGllcw==
```

The HTTP Basic Authentication scheme is a well-known and popular standard for transmitting credentials. Most tools, programming languages, and scripting platforms already provide facilities for generating the HTTP headers required based solely on user name and password credentials, thus minimizing the effort that is required to build an automation solution.

#### *Troubleshooting XMI authentication*

You can resolve most XML management authentication issues by enabling the internal logging setting within the Troubleshooting Panel in the default domain.

## 10.3.2 Appliance Management Protocol (AMP)

The Appliance Management Protocol (AMP) is an IBM specification that is designed to be the primary solution for XML-based automation of DataPower appliance management functions. Although AMP was originally designed and developed for intra-device communication, it is now being heralded as the ideal messaging protocol for automated management of DataPower appliances.

AMP is particularly useful for managing firmware and configuration in multiple-system deployments and exposes a comprehensive API of high-level management functions.

### Usage

AMP is exposed on the DataPower appliance as a web service with a Web Services Description Language (WSDL) that describes the service, operation, and message elements for AMP commands. The `app-mgmt-protocol.wsdl` and associated `app-mgmt-protocol.xsd` files are available for download and are located on the appliance's file system within the `store:` directory.

AMP request messages are transmitted to the XMI over the HTTPS protocol, and response messages are returned over the same interface. The formats of the request and response messages are described in the WSDL and are designed to be used by WSDL-aware tools to quickly generate AMP messages. The sample AMP message that is shown in Example 10-6 illustrates a request message that retrieves the list of domains from a DataPower appliance.

*Example 10-6 AMP message to retrieve existing domains*

```
<env:Envelope xmlns:env="http ...omitted... agement/1.0">
   <env:Header/>
   <env:Body>
      <ns:GetDomainListRequest/>
   </env:Body>
</env:Envelope>
```

After receiving the preceding AMP request message, the DataPower appliance will return a response that is shown in Example 10-7 on page 237.

*Example 10-7 AMP response for GetDomainListRequest*

```
<env:Envelope xmlns:env="http ...omitted... agement/1.0">
   <env:Body>
      <amp:GetDomainListResponse xmlns:amp ...omitted... agement/1.0">
         <amp:Domain>default</amp:Domain>
         <amp:Domain>Rashmi</amp:Domain>
         <amp:Domain>favourite</amp:Domain>
      </amp:GetDomainListResponse>
   </env:Body>
</env:Envelope>
```

The AMP API provides a set of useful operations for administering firmware, determining global settings, and administering domain configurations. However, it does not provide full coverage of all of the DataPower administrative and system functions.

For additional details about the AMP, consult the *Administrator's Guide* that is contained within the IBM WebSphere DataPower Information Center.

### Advantages of using AMP

Using AMP provides these possible benefits:

- AMP has been identified by IBM as the strategic messaging protocol for automating DataPower management functions.
- Self-descriptive WSDL operations and message elements make it easier to generate request messages and parse response messages.

### Disadvantages of using AMP

Using AMP has these potential disadvantages:

- The range of commands is currently limited to higher-level device and domain contexts.
- Limited support is available for monitoring. See Chapter 4, "Simple Network Management Protocol monitoring" on page 81 for a detailed discussion about monitoring.

## 10.3.3 SOAP Management Interface (SOMA)

The SOMA messaging protocol was originally the only available method for managing and monitoring DataPower appliances using XML messages. Although AMP has now been identified as the primary XML administrative protocol, the SOMA protocol is still useful for the fine-grained management and monitoring of DataPower configuration objects.

A key difference between AMP and SOMA is that IBM makes no guarantee that SOMA operations and message formats will remain the same between firmware releases. Therefore, automation systems need to be regression-tested as part of a firmware upgrade process if they utilize SOMA operations. In practice, the SOMA protocol has changed little from release to release; however, it is important to understand that changes to the SOMA API are a realistic possibility.

### Usage

As with AMP, the SOMA messaging protocol is implemented as a web service with WSDL and XML Schema Definition (XSD) files describing the service that is available for download from the DataPower device's internal file system.

Two versions of the SOMA API are available on the 3.8.1 version of firmware that is located in the `store:` directory:

- `xml-mgmt.wsdl`
- `xml-mgmt-2004.wsdl` (deprecated)

The `xml-mgmt-2004.wsdl` file is an older version of the service interface, and it is included for backward compatibility only. Administrators need to use the `xml-mgmt.wsdl` service description file when creating SOMA request messages.

In addition, the SOMA service utilizes the following schema files, which are located within the `store:` directory:

- `xml-mgmt-base.xsd`
- `xml-mgmt-ops.xsd`
- `xml-mgmt.xsd`

These schema documents describe the structure of SOMA messages, the available operations, and the enumerated values that may be used to populate request messages.

Example 10-8 shows a SOMA request message that retrieves the memory utilization on a particular DataPower appliance.

*Example 10-8 SOMA request message*

```
<env:Envelope xmlns:soapenv="http ...omitted... management">
   <env:Header/>
   <env:Body>
      <man:request domain="default">
         <man:get-status class="MemoryStatus"/>
      </man:request>
   </env:Body>
</env:Envelope>
```

Given the SOMA request that is identified in Example 10-8 on page 238, the appliance responds with a message similar to the message that is in Example 10-9.

*Example 10-9   SOMA response message*

```
<env:Envelope xmlns:env="http://schemas.xmlsoap.org/soap/envelope/">
   <env:Body>
      <dp:response xmlns:dp="http ...omitted...agement">
         <dp:timestamp>2010-06-29T15:03:45-04:00</dp:timestamp>
         <dp:status>
            <MemoryStatus xmlns:env="htt ...omitted... velope">
               <Usage>14</Usage>
               <TotalMemory>4149440</TotalMemory>
               <UsedMemory>581088</UsedMemory>
               <FreeMemory>3568352</FreeMemory>
               <ReqMemory>643912</ReqMemory>
               <HoldMemory>220724</HoldMemory>
            </MemoryStatus>
         </dp:status>
      </dp:response>
   </env:Body>
</env:Envelope>
```

The power of SOMA is its broad range of administrative functions. Almost every function exposed through the WebGUI and CLI interface is also available within the SOMA catalog, making it an ideal interface for fine-grained task automation.

However, due to the wide variety of administrative commands that are supported, the operations themselves tend to be defined abstractly, and it can be difficult to identify the correct syntax to achieve a desired result. Users might need to consult the `xml-mgmt.xsd` file (available on the DataPower appliance file system) for specific enumeration values when using the following SOMA operations.

## Advantage of using SOMA

Using SOMA provides extensive support for DataPower management and monitoring functions.

### Disadvantages of using SOMA

Using SOMA has these potential disadvantages:

- The names, format, and behavior of operations might change.
- WSDL is extremely generic, resulting in additional effort to create request messages.

## 10.3.4 WSDM and WS-Management

Web Services Distributed Management (WSDM) is an OASIS standard that describes a vendor-neutral and platform-neutral method for management of systems and resources. It is built on the foundation of other WS-* standards, including WS-Addressing, WS-ResourceProperties, WS-BaseNotification, and WS-Topics.

The WSDM standard is split into two major categories: Management Of Web Services (MOWS) and Management Using Web Services (MUWS). The intent is for MUWS to be used for manageable resources (for example, the management of a printer), while MOWS extends MUWS with additional functionality for managing web services.

The WS-Management standard is a competing industry standard for the management of services and devices with SOAP-based messaging. Microsoft was a founding member of the WS-Management standard before it was passed on to the Distributed Management Task Force (DMTF). The WS-Management standard is typically used in Microsoft products.

For DataPower devices, these management interfaces are mainly used for monitoring system and web service metrics. You can obtain detailed information about the WSDM interface in the *DataPower Administrator's Guide*.

### Advantage of using WSDM and WS-Management

Using WSDM and WS-Management provides ease of integration with generic management tools that support the standards.

### Disadvantage of using WSDM and WS-Management

WSDM and WS-Management implementations provide a limited scope of information about the device and the exposed services.

## 10.4 WebSphere Appliance Management Toolkit API

The WebSphere Appliance Management Toolkit is a client-side package that can be used to programmatically make XML Management calls to a DataPower device (Figure 10-5). It has been designed to minimize the level of effort that is required to manage devices through the XMI by encapsulating all of the transport and message creation details and exposing a simple-to-use Java API. The WebSphere Appliance Management Toolkit is available as a set of Java jar packages and can be embedded within any Java-based application.

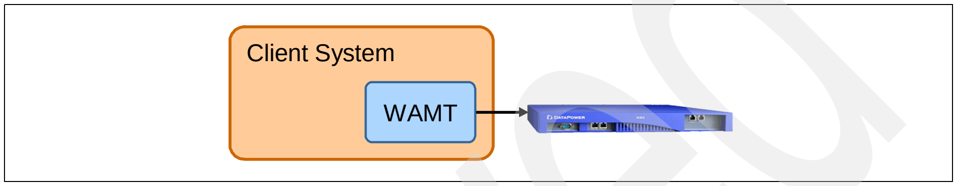


*Figure 10-5 WebSphere Appliance Management Toolkit API*

The value of the WebSphere Appliance Management Toolkit is in its set of coarse-grained operations that represent typical DataPower management functions. In the background, WebSphere Appliance Management Toolkit calls the set of finer-grained management functions that comprise the AMP and SOMA messaging protocols within the XMI; however, these details are hidden from a WebSphere Appliance Management Toolkit user.

In addition to the set of client APIs, the WebSphere Appliance Management Toolkit provides Java classes to programmatically manage pools of DataPower devices and persisting artifacts, configurations, and firmware in a storage repository. These features provide an incredibly powerful platform for the management of DataPower systems, configuration, and firmware.

While the feature set is deep, the WebSphere Appliance Management Toolkit is not actually intended for manual use, and there is no GUI or human operator interface provided. Instead, all WebSphere Appliance Management Toolkit calls are made within a Java virtual machine (JVM).

### 10.4.1 Usage

The WebSphere Appliance Management Toolkit API can be used by any application or system that is capable of invoking the Java classes that are provided in the WebSphere Appliance Management Toolkit jar packages:

- Custom Java GUI applications
- Third-party management applications with Java-based extensibility

- ANT build tasks
- Jython scripts
- Non-Java applications that leverage a Java Native Interface (JNI) bridge. See `http://www.ibm.com/developerworks/java/tutorials/j-jni/` for details about using JNI.

WebSphere Appliance Management Toolkit operations are particularly useful for developers, administrators, and build managers who want a custom, automated DataPower management solution. A classic example of WebSphere Appliance Management Toolkit usage is the creation of an ANT task that uploads files to a device as part of a build management script.

The WebSphere Appliance Management Toolkit library automatically takes advantage of the management subscription capability that is provided in AMP. Therefore, the risk of conflicts lessens when duplicate WebSphere Appliance Management Toolkit-based managers operate on the same device.

Users can consult the javadoc that is included with the WebSphere Appliance Management Toolkit package for a complete reference of the available operations. At a high level, the WebSphere Appliance Management Toolkit management functions are similar to the functions that are exposed by AMP and include operations for domain management, disaster recovery, and device synchronization.

## 10.4.2 WebSphere Appliance Management Toolkit advantages

Using WebSphere Appliance Management Toolkit provides these benefits:

- Transport, messaging, and finer-grained operations are hidden.
- WebSphere Appliance Management Toolkit covers a complete range of high-level firmware, system, and configuration management functions.

## 10.4.3 Disadvantages

Using WebSphere Appliance Management Toolkit has these potential disadvantages:

- WebSphere Appliance Management Toolkit requires a JVM-based solution.
- The abstraction of DataPower API calls can result in less flexibility for the user.

## 10.5 Command-line interface automation

The command-line interface (or CLI) is a terminal-based interface that allows a DataPower operator to create, manage, and monitor appliance configurations. It is usually accessed through the Secure Shell (SSH) protocol; however, it can also be accessed via Telnet or a direct serial connection.

Although the CLI was not originally designed or intended to be used for automation, it is possible to script shell commands that mimic human command entry and parse the response that is provided by the appliance to systematically determine the result of the issued command.

**CLI:** The CLI is not designed for automation, and there is no guarantee that the interface will remain the same. Users must be aware that it is possible for the support, syntax, and results of commands to differ between firmware releases.

### 10.5.1 Authentication

The CLI uses the same authentication scheme and credential store as the XML Management and WebGUI management interfaces. Users must enter their user name and password in order to be authenticated by the DataPower appliance prior to executing any management commands.

Although the SSH protocol defines an authentication schemas part of the protocol, the DataPower appliance does not use the user name that is passed by SSH for authentication. Instead, the appliance validates any user name to establish the initial SSH session and will then prompt the user for a DataPower user name and password.

### 10.5.2 Range of commands

CLI commands cover the entire range of management, monitoring, and administrative functionality. A catalog of CLI commands is available in the *DataPower Command Reference Guide*.

### 10.5.3 Usage

As part of the initial DataPower installation, an operator needs to access the CLI via a direct serial port connection. During this time, the operator assigns an IP address to one or more of the network cards and chooses to enable the WebGUI and SSH management interfaces. Upon completion of this initial setup, all CLI management needs to be done remotely via the SSH protocol. There is also an option to expose the CLI over the Telnet protocol; however, this option is not a recommended approach due to the non-secure nature of Telnet.

The manual usage of the CLI is straightforward, and network administrators are comfortable with the syntax due to the similarity to the IP-level device consoles. Automation of the CLI is usually implemented using UNIX or Linux shell scripting, and most network administrators are comfortable creating scripts that can transmit SSH commands and retrieve response data. For example, the following script in Example 10-10 prompts a user for a password, logs in to a remote DataPower appliance, and retrieves memory usage statistics.

*Example 10-10 Sample CLI script*

```
#!/bin/sh
# Prompt for password without linebreak
echo -ne "Enter password: "

# Disable character echo to hide password during entry
stty -echo
read password
# Reenable character echo
stty echo

# Transmit login and show mem command to the DataPower
#  appliance and display results on console.
cat <<EOF | ssh DATAPOWER_UAT
mem_script_user
$password
show mem
exit
EOF
```

On execution, the preceding script returns a result that is similar to Example 10-11.

*Example 10-11 Output of sample CLI script*

```
>./showmem.sh
Enter password: (unknown)
Unathorized access prohibited.
login: Password:
Welcome to DataPower XI50 console configuration.
Copyright IBM Corporation 1999-2010

Version: XI50.3.8.0.2 build 181168 on 2010/01/21 09:51:37
```

```
Serial number: 13002C1

xi50#
    Memory Usage: 14 %
    Total Memory: 4149440 kbytes
     Used Memory: 598201 kbytes
     Free Memory: 3551239 kbytes
Requested Memory: 670956 kbytes
     Hold Memory: 232011 kbytes

xi50# Goodbye.
>
```

### 10.5.4 Advantages of using the CLI

Using the CLI provides these benefits:

- The DataPower CLI is a great fit for administrators who are comfortable with command-line-based management.
- All DataPower functionality is available through the CLI.

### 10.5.5 Disadvantages of using the CLI

Using the CLI has these potential disadvantages:

- The CLI was not designed to support automation.
- Command syntaxes might change, and commands might be deprecated between firmware releases.
- CLI usage requires specific skill sets that might not be applicable to all DataPower administrators.

## 10.6 WebSphere Application Server Network Deployment Appliance Manager Version 7

Users of WebSphere Application Server Network Deployment Version 7 can take advantage of the Appliance Manager capability of the WebSphere Application Server ND Manager. This administrative function utilizes the AMP API and provides a graphical user interface view for managing configuration and firmware sets targeted at multiple DataPower devices.

For more information about the WebSphere Application Server ND Appliance Manager, refer to the WebSphere Application Server Network Deployment V7 Information Center. Search on "`DataPower application manager overview`" and select **WebSphere DataPower appliance manager**.

### 10.6.1 Advantages of using the WebSphere Application Server ND Appliance Manager

Using WebSphere Application Server Network Deployment Version 7 provides these benefits:

- WebSphere Application Server Network Deployment Version 7 provides a GUI-based view of DataPower firmware and configuration management.
- Operators who are familiar with WebSphere Application Server administration are already familiar with the look and feel of the console.

### 10.6.2 Disadvantages of the WebSphere Application Server ND Appliance Manager

Using WebSphere Application Server Network Deployment Version 7 has these potential disadvantages:

- WebSphere Application Server Network Deployment Version 7 requires an IBM WebSphere Application Server ND license.
- WebSphere Application Server Network Deployment Version 7 is limited to AMP functionality.

CLI usage requires specific skill sets that might not be applicable to all DataPower administrators.

## 10.7 IBM WebSphere Appliance Management Center

IBM WebSphere Appliance Management Center V4.0 provides capabilities for centrally managing and monitoring groups of WebSphere DataPower appliances. WebSphere Appliance Management Center is intended for deployments with two or more WebSphere DataPower appliances and it can also span multiple deployment environments (for example, development, test, production, and disaster recovery).

WebSphere Appliance Management Center serves as the control point for the life-cycle management of firmware and configurations across one or more groups of appliances. Also included with the IBM WebSphere Appliance Management

Center is IBM Tivoli Composite Application Manager Agent for DataPower, which can be used to monitor key metrics from multiple appliances in a central location.

IBM WebSphere Appliance Management Center V4.0 offers these key features:

- Disaster recovery of appliances
- Support for managed groups of various appliance models and firmware levels for greater flexibility
- Support for new managed domain tasks and the configuration and firmware deployments, providing fine-grained control of the environment
- Management of deployment policies for WebSphere DataPower appliances, both individually or in managed sets, providing full life-cycle management across deployment environments
- Easy-to-use multiple platform installer
- Support for multiple generations of WebSphere DataPower appliance platforms and firmware versions
- Enhanced monitoring capability with default settings for critical WebSphere DataPower appliance key performance indicators (KPIs)
- Easy-to-use and navigate user interface, including support for separate user roles
- Seamless integration into the IBM Tivoli Monitoring infrastructure

IBM WebSphere Appliance Management Center V4.0 supports the following IBM WebSphere appliances:

- WebSphere DataPower XML Accelerator XA35 (9235 model only)
- WebSphere DataPower XML Security Gateway XS40 (9235 model only)
- WebSphere DataPower Integration Appliance XI50 (9235 model only)
- WebSphere DataPower Integration Blade XI50B
- WebSphere DataPower Integration Appliance XI50 for zEnterprise
- WebSphere DataPower B2B Appliance XB60
- WebSphere DataPower Low Latency Appliance XM70
- WebSphere DataPower Integration Appliance XI52
- WebSphere DataPower B2B Appliance XB62

WebSphere Appliance Management Center supports DataPower appliances with firmware V3.7.3, or later.

## 10.8 Summary

Modern technology groups have an expectation that operational tasks that are related to the management and deployment of applications will be automated. DataPower devices offer many administrative interfaces in support of automation and can fit well into existing automation environments.

The skill sets of the team, the tooling that is available, and the functions that are required often dictate the specific interface and message protocol that will be used.

A

# Custom Role-Based Management authentication and credential mapping

The DataPower built-in Role-Based Management (RBM) capabilities are robust and can accommodate most enterprise needs for securing access to the appliance. However, certain organizations might rely on a proprietary infrastructure for governing access to the appliance. In this case, you can extend the built-in RBM functionality using Extensible Stylesheet Language Transformation (XSLT).

You can customize two phases of the RBM process:

- Authentication
- Credential mapping

The key to customizing these steps is a clear understanding of the input and output contexts for the custom XSL templates. This appendix provides the necessary details to create either a custom authentication or credential mapping XSLT.

## Authentication phase

The authentication phase is responsible for determining whether a user is granted access to the WebGUI or the command-line interface (CLI). A custom authentication XSLT is responsible for inspecting the user's identity and providing a credential in return.

A custom XSL has the freedom to do whatever it needs to do to determine the authenticity of the identity and can use the entire library of DataPower XSL extension functions to make this determination.

### Input context

The input context to a custom authentication XSL contains the user's extracted identity (shown in Example A-1).

*Example A-1 Input context to custom RBM authenticate XSL template*

```
<identity>
   <entry type="http-basic-auth">
      Results of Extract Identity Here
   </entry>
<identity>
```

To illustrate, if user `fred` logged in to the WebGUI and provided a password of `myPassword`, the input context to the custom style sheet looks similar to Example A-2.

*Example A-2 Example input context for WebGUI login*

```
<identity>
    <entry type="custom" url="webgui:///map/map-ei-login.xsl">
        <username>fred</username>
        <password sanitize="true">myPassword</password>
        <kerberos-apreq sanitize="true"/>
        <cert sanitize="true">*No certificate provided*</cert>
        <dn/>
    </entry>
</identity>
```

## Output context

The output context provides RBM with the authenticated user's credential or null if the authentication failed.

## Credential mapping phase

The credential mapping phase is responsible for mapping an identity credential to a list of access policy strings.

### Input context

The input context to a custom credential mapping XSL contains the authenticated credential and includes the XML that is shown in Example A-3.

*Example A-3 Input context for custom credential mapping*

```
<credentials>
   <entry type="credType">
      <!-- credential from authentication -->
   </entry>
</credentials>
```

To illustrate, if user `sarah` is successfully authenticated against a Lightweight Directory Access Protocol (LDAP), the input context looks like the XML that is shown in Example A-4.

*Example A-4 Sample input context with LDAP credentials*

```
<credentials>
   <entry type="ldap">
      cn=sarah,ou=members,ou=datapower,dc=ibmdemo,dc=com
   </entry>
</credentials>
```

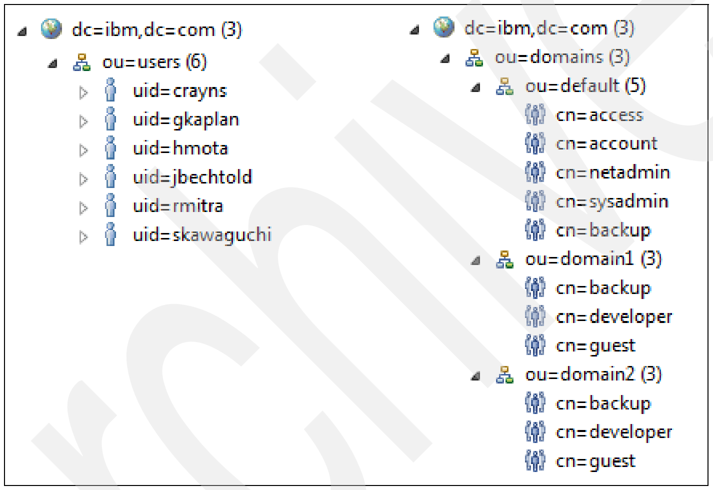
### Output context

The output of the credential mapping phase must be a list of access policy strings, as described in "Access policy statements" on page 9.

## Example: Multiple LDAP group membership

In this scenario, an organization decides to use an LDAP server to manage DataPower users and their associated access privileges (or roles). Users are first authenticated against the LDAP. If successful, the LDAP then is queried to determine the user's roles (represented as LDAP group membership). For maximum flexibility and fine-grained access control, a single user can belong to more than one group. For example, a user might be a developer in domain1 and domain2, and a network administrator in the default domain.

Figure A-1 shows the LDAP organization. The left subtree shows how users are organized, and the right subtree shows how domains and roles are organized. An organizational unit (ou) is used to represent a DataPower domain and a group of names (`groupOfNames`) is used to represent the various access roles.



```
dc=ibm,dc=com (3)
    ou=users (6)
        uid=crayns
        uid=gkaplan
        uid=hmota
        uid=jbechtold
        uid=rmitra
        uid=skawaguchi
```

```
dc=ibm,dc=com (3)
    ou=domains (3)
        ou=default (5)
            cn=access
            cn=account
            cn=netadmin
            cn=sysadmin
            cn=backup
        ou=domain1 (3)
            cn=backup
            cn=developer
            cn=guest
        ou=domain2 (3)
            cn=backup
            cn=developer
            cn=guest
```

*Figure A-1 LDAP structure*

Table A-1 shows the various roles and their domain restrictions.

*Table A-1 DataPower roles and their domain restrictions*

| Role | Description | Restrictions |
|---|---|---|
| sysadmin | Access to everything except network interfaces | Default domain only |
| netadmin | Network configuration | Default domain only |
| account | User accounts and user groups | Default domain only |
| access | Access policies and existing domains | Default domain only |
| developer | Configuring services | None |

| Role | Description | Restrictions |
|---|---|---|
| backup | System and domain backup | None |
| guest | Read-only access | None |

An XML file is used to define the various roles and their access policies. Example 10-12 shows a fragment of the sample `rbmTemplates.xml` file. If a template has a privileged attribute equal to true, it can be associated only with the default domain. You can access the complete file in this book's associated download files. Refer to Appendix B, "Additional material" on page 259 for information about how to download the associated files.

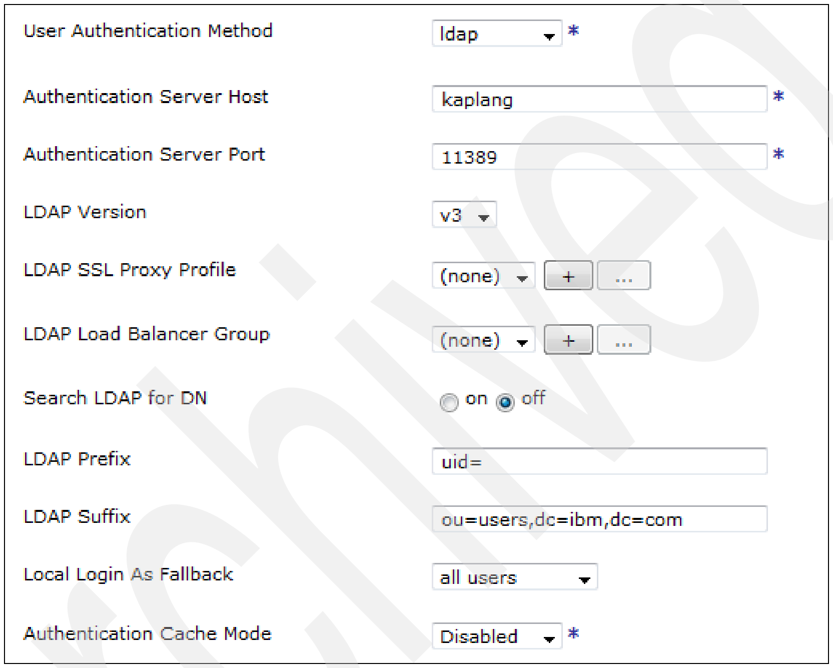
*Example 10-12 Partial listing of rbmTemplates.xml file that defines various roles*

```
<rbm-templates>
   <rbm-template name="developer" privileged="false">
      <access-policy>*/DOMAIN_ID/*?Access=rwadx</access-policy>
   </rbm-template>

   <rbm-template name="guest" privileged="false">
      <access-policy>*/DOMAIN_ID/*?Access=r</access-policy>
      <access-policy>*/DOMAIN_ID/access/change-password?Access=x</access-policy>
   </rbm-template>

   <rbm-template name="backup" privileged="false">
      <access-policy>*/DOMAIN_ID/access/change-password?Access=x</access-policy>
      <access-policy>*/DOMAIN_ID/config/backup?Access=x</access-policy>
      <access-policy>*/DOMAIN_ID/config/remove-chkpoint?Access=x</access-policy>
      <access-policy>*/DOMAIN_ID/config/rollback-chkpoint?Access=x</access-policy>
      <access-policy>*/DOMAIN_ID/config/save-chkpoint?Access=x</access-policy>
      <access-policy>*/DOMAIN_ID/login/ssh?Access=x</access-policy>
      <access-policy>*/DOMAIN_ID/login/telnet?Access=x</access-policy>
      <access-policy>*/DOMAIN_ID/login/web-mgmt?Access=x</access-policy>
      <access-policy>*/DOMAIN_ID/status/chkpoints?Access=r</access-policy>
   </rbm-template>

   <rbm-template name="access" privileged="true">
      <access-policy>*/*/access/change-password?Access=x</access-policy>
      <access-policy>*/*/access/radius?Access=rwad</access-policy>
      <access-policy>*/*/access/rbm?Access=rw</access-policy>
         .
         .
         .
   </rbm-template>
```

```
</rbm-templates>
```

## Step 1: Authentication

Because DataPower has built-in support for LDAP-based authentication, no customization is required. Figure A-2 shows an example of the configuration settings to authenticate the user against the LDAP server.



| | |
|---|---|
| User Authentication Method | ldap * |
| Authentication Server Host | kaplang * |
| Authentication Server Port | 11389 * |
| LDAP Version | v3 |
| LDAP SSL Proxy Profile | (none) |
| LDAP Load Balancer Group | (none) |
| Search LDAP for DN | on [✓ off] |
| LDAP Prefix | uid= |
| LDAP Suffix | ou=users,dc=ibm,dc=com |
| Local Login As Fallback | all users |
| Authentication Cache Mode | Disabled * |

*Figure A-2 RBM settings for LDAP authentication*

## Step 2: Credential mapping

Credential mapping is specialized for this organization and requires a custom XSLT that maps the user's credential (returned from the LDAP) to a list of access policy strings. You can obtain the complete sample `customRbmMapping.xsl` in the download files for this book. Refer to Appendix B, “Additional material” on page 259 for information about how to download the files. Example A-5 provides an overview of how the XSL template works.

*Example A-5 Required steps to map the user credential to access policy strings*

```
query the LDAP server for a list of groups to which the user belongs;
for each group found
   parse the group’s DN to determine domain name and user role;
   if the domain = ‘default’, privileged = ‘true’ else ‘false’;
   find any template with name=role and matching privilege;
   if a template was found
      for each access-policy within the template
         replace the domain placeholder with the actual domain name;
         write the access policy string to the output context;
      end-for
   end-if
end-for
```

The output from the XSLT is the list of access policy strings for the user’s role or roles. Example A-6 shows the output for a user who is authorized to perform backups in `domain1` and a developer in `domain2`.

*Example A-6 Sample output from the custom mapping XSLT*

```
*/domain1/access/change-password?Access=x
*/domain1/config/backup?Access=x
*/domain1/config/remove-chkpoint?Access=x
*/domain1/config/rollback-chkpoint?Access=x
*/domain1/config/save-chkpoint?Access=x
*/domain1/login/ssh?Access=x
*/domain1/login/telnet?Access=x
*/domain1/login/web-mgmt?Access=x
*/domain1/status/chkpoints?Access=r
*/domain2/*?Access=rwadx
```

## Development considerations

This section provides guidance to help with the development of XSL templates for custom RBM processing.

### Use a loopback service for testing

Use a stand-alone service, such as an XML Firewall or Multi-Protocol Gateway, to develop and test XSL templates. For example, create a loopback XML Firewall that has a single transform action that executes your XSLT. This method allows you to take advantage of the transaction probe so that you can see exactly what is happening inside the appliance. This method is also especially useful when performing LDAP queries or off-box service calls, because you can see the results of these actions. Configure RBM to use the XSLT only after the XSLT works properly.

### Enable local login as fallback

Enabling local login as fallback assures that you can access the appliance using local users and groups in the event that the new RBM settings do not work as planned. This fallback is critical, especially during the development and testing phase. If this login is not set, it is possible to become completely locked out of the device. Also, make sure that there is at least one locally defined user that has administrative privileges (such as `admin`).

### Do not enforce RBM on the CLI until the changes are proven

Leaving the CLI out of the mix during the development phase allows you to gain access to the appliance through the CLI to reset RBM if necessary. Enable RBM on the CLI only after the new RBM settings are tested and proven to work on the WebGUI.

### Use multiple browsers during development and testing

It is convenient to use one browser as an administrator and another browser to test that the configuration works properly. This method requires separate browser types for each task, because sessions are generally shared within the same browser type. For example, use Firefox as the administrative browser and Internet Explorer for the login testing. This method further helps to ensure that you maintain access to administrative functionality while testing.

### Disable caching

Make sure to disable caching during the development and testing phases. By default, DataPower caches RBM results. After the solution is deployed, you can re-enable caching.

### Using <xsl:message> for final troubleshooting

After RBM has been set to use a custom XSL, you will lose access to the transaction probe; therefore, all troubleshooting will rely on the DataPower logs.

### Enable RBM logging

On the Troubleshooting tab, you can enable RBM logging. Enabling RBM logging provides more details about the steps that occur during the RBM processes.

B

# Additional material

This book refers to additional material that can be downloaded from the Internet as described in the following sections.

## Locating the Web material

The Web material associated with this book is available in softcopy on the Internet from the IBM Redbooks Web server. Point your Web browser at this website:

`ftp://www.redbooks.ibm.com/redbooks/SG247901`

Alternatively, you can go to the IBM Redbooks Web site at:

**ibm.com**/redbooks

Select **Additional materials** and open the directory that corresponds with the IBM Redbooks form number, SG247901.

## Using the Web material

The additional Web material that accompanies this book includes the following files:

| *File name* | *Description* |
|---|---|
| **createUserGroups.txt** | Script to create user groups |
| **customRbmMapping.xsl** | Map user credentials to access policies |
| **rbmTemplates.xml** | Roles and access policies |

### Downloading and extracting the Web material

Create a subdirectory (folder) on your workstation, and extract the contents of the Web material `.zip` file into this folder.

# Abbreviations and acronyms

| | |
|---|---|
| **A2A** | application-to-application |
| **ACL** | access control list |
| **AMP** | Appliance Management Protocol |
| **API** | application programming interface |
| **ARP** | address routing protocol |
| **AS** | Applicability Statement |
| **AS1, AS2** | applicability statement 1, 2 |
| **ATG** | Advanced Technology Group |
| **B2B** | business-to-business |
| **CA** | certificate authority |
| **CIDR** | Classless Inter-Domain Routing |
| **CLI** | command-line interface |
| **CPPA** | Collaboration Partner Profile and Agreement |
| **DC** | data collector |
| **DHCP** | dynamic host configuration protocol |
| **DMTF** | Distributed Management Task Force |
| **DMZ** | demilitarized zone |
| **DNS** | Domain Name System |
| **DP** | DataPower |
| **ebMS** | Electronic Business Message Service |
| **ebXML** | Electronic Business using eXtensible Markup Language |
| **ECN** | explicit congestion notification |
| **EDIINT** | Electronic Data Interchange-Internet Integration |
| **ESB** | enterprise service bus |
| **GSSAPI** | Generic Security Service API |
| **GUI** | graphical user interface |
| **HMAC** | Hashing for Message Authentication |
| **HSM** | hardware security module |
| **HSRP** | hot standby router protocol |
| **IBM** | International Business Machines Corporation |
| **ICMP** | Internet Control Message Protocol |
| **IETF** | Internet Engineering Task Force |
| **ITSO** | International Technical Support Organization |
| **JNI** | Java Native Interface |
| **JVM** | Java virtual machine |
| **KPI** | key performance indicator |
| **LDAP** | Lightweight Directory Access Protocol |
| **LOB** | line of business |
| **LPAR** | logical partition |
| **MAC** | media access control |
| **MD5** | Message Digest 5 |
| **MIB** | management information base |
| **MOWS** | management of Web services |
| **MPGW** | Multi-Protocol Gateway |
| **MTU** | maximum transmission unit |
| **MUWS** | management using Web services |
| **NIC** | network interface card |
| **OID** | object identifier |
| **PCRE** | Perl-compatible regular expression |
| **PKI** | public key infrastructure |
| **RADIUS** | Remote Authentication Dial-In User Service |
| **RBM** | Role-Based Management |
| **RUP** | Rational Unified Process |
| **SAF** | System Authorization Facility |
| **SCM** | software configuration management |
| **SDLC** | software development life cycle |
| **SLA** | service-level agreement |
| **SLAAC** | Stateless Address Autoconfiguration |
| **SLM** | server-level monitoring |

| | |
|---|---|
| **SLM** | service-level management |
| **SNMP** | Simple Network Management Protocol |
| **SNMPv1** | SNMP version 1 |
| **SNMPv2** | SNMP version 2 |
| **SNMPv3** | SNMP version 3 |
| **SOA** | service-oriented architecture |
| **SOAP** | simple object access protocol |
| **SOMA** | SOAP Management Interface |
| **SPNEGO** | Simple and Protected GSSAPI Negotiation Mechanism |
| **SSH** | Secure Shell |
| **SSL** | secure sockets layer |
| **SSO** | single sign-on |
| **TTL** | time-to-live |
| **VIP** | virtual IP address |
| **VLAN** | virtual LAN |
| **WAMT** | WebSphere Appliance Management Toolkit |
| **WebGUI** | web-based graphical user interface |
| **WPA** | Warehouse Proxy Agent |
| **WSDL** | Web Services Description Language |
| **WSDM** | Web Services Distributed Management |
| **WSM** | Web Services Management |
| **WSN** | Web Services Navigator |
| **WTX** | workstation technology extended |
| **XMI** | XML management interface |
| **XML** | eXtensible Markup Language |
| **XSD** | XML Schema Definition |
| **XSL** | Extensible Stylesheet Language |
| **XSLT** | eXtensible Stylesheet Language Transformations |

# Related publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this book.

## IBM Redbooks publications

The following IBM Redbooks publications provide additional information about the topic in this document. Note that several publications referenced in this list might be available in softcopy only.

- *DataPower SOA Appliance Service planning, Implementation and Best Practices,* SG24-7943
- *WebSphere DataPower SOA Appliance: The XML Management Interface,* REDP-4446-00
- *IBM WebSphere DataPower SOA Appliances Part I: Overview and Getting Started*, REDP-4327-00
- *IBM WebSphere DataPower SOA Appliances Part II: Authentication and Authorization*, REDP-4364-00
- *IBM WebSphere DataPower SOA Appliances Part III: XML Security Guide*, REDP-4365-00
- *IBM WebSphere DataPower SOA Appliances Part IV: Management and Governance*, REDP-4366-00

You can search for, view, or download IBM Redbooks publications, Redpapers, web docs, draft publications, and additional materials, as well as order hardcopy IBM Redbooks publications, at this Web site:

**ibm**.com/redbooks

## Other publications

These publications are also relevant as further information sources:

- *IBM WebSphere DataPower SOA Appliance Handbook,* IBM Press © 2008, ISBN 9780137148196

## Online resources

These Web sites are also relevant as further information sources:

- Monitoring WebSphere DataPower SOA Appliances

  http://www.ibm.com/developerworks/websphere/library/techarticles/1003_rasmussen/1003_rasmussen.html

- Managing multiple DataPower Appliances with the WebSphere Appliance Management Toolkit, Part 1: Introduction to the WebSphere Appliance Management Toolkit

  http://www.ibm.com/developerworks/websphere/library/techarticles/1011_burke/1011_burke.html

- Managing multiple DataPower Appliances with the WebSphere Appliance Management Toolkit, Part 2: Scripting with the WebSphere Appliance Management Toolkit

  http://www.ibm.com/developerworks/websphere/library/techarticles/1102_burke/1102_burke.html

- Extending WebSphere DataPower with centralized appliance management

  http://www.ibm.com/developerworks/websphere/techjournal/0809_roytman/0809_roytman.html

- Managing WebSphere DataPower SOA Appliance configurations for high availability, consistency, and control, Part 1

  http://www.ibm.com/developerworks/websphere/library/techarticles/0801_rasmussen/0801_rasmussen.html

- Managing WebSphere DataPower SOA Appliance configurations for high availability, consistency, and control, Part 2: Application promotion strategies

  hhttp://www.ibm.com/developerworks/websphere/library/techarticles/0904_rasmussen/0904_rasmussen.html

- WebSphere DataPower SOA Appliance performance tuning

  http://www.ibm.com/developerworks/webservices/library/ws-dpperformance/index.html

- Managing WebSphere DataPower SOA Appliances via the WebSphere Application Server V7 Administrative Console

  http://www.ibm.com/developerworks/websphere/library/techarticles/1003_das/1003_das.html

- WebSphere DataPower SOA Appliances developerWorks library

  http://www.ibm.com/developerworks/websphere/zones/businessintegration/dp.html

- Capacity Planning for WebSphere DataPower B2B Appliance XB60

  http://www-01.ibm.com/support/docview.wss?uid=swg21329746
- WebSphere DataPower V3.8.2 Information Center

  http://publib.boulder.ibm.com/infocenter/wsdatap/v3r8m2/index.jsp

## Help from IBM

IBM Support and downloads

**ibm.com**/support

IBM Global Services

**ibm.com**/services

# Index

IBM

Redbooks

DataPower SOA Appliance Administration, Deployment, and Best Practices

(0.5” spine)
0.475”<->0.875”
250 <-> 459 pages

# DataPower SOA Appliance Administration, Deployment, and Best Practices

**Demonstrates user administration and role-based management**

**Explains network configuration, monitoring, and logging**

**Describes appliance and configuration management**

This IBM Redbooks publication focuses on operational and managerial aspects for DataPower appliance deployments.

DataPower appliances provide functionality that crosses both functional and organizational boundaries, which introduces unique management and operational challenges. For example, a DataPower appliance can provide network functionality, such as load balancing, and at the same time, provide enterprise service bus (ESB) capabilities, such as transformation and intelligent content-based routing.

This IBM Redbooks publication provides guidance at both a general and technical level for individuals who are responsible for planning, installation, development, and deployment. It is not intended to be a "how-to" guide, but rather to help educate you about the various options and methodologies that apply to DataPower appliances. In addition, many chapters provide a list of suggestions.

SG24-7901-00 ISBN 0738435708