Deployment Guide

Blackboard Learn$^+$

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1 INTRODUCTION

The Blackboard Learn+ System is a powerful learning and knowledge transfer environment that benefits students, faculty and campus Information Technology (IT) administrators. The Blackboard Learn+ System makes online learning environments easier to manage and administer. The Blackboard solution has been in existence for many years and has been deployed by many academic institutions throughout the world.

2 DEPLOYMENT GUIDE OVERVIEW

This deployment guide shows how to optimize a Blackboard Learn+ deployment by adding an A10 Networks Application Delivery Controller (ADC) AX Series device. The Blackboard solution is based on a multi-server installation of 64-bit Microsoft Windows 2008 Servers, with an A10 Networks AX Series deployed in front of the servers. The tested Blackboard solution is based on the "Advanced" sizing category as described in the Blackboard document "Configurations for Blackboard Learn+ Release 9.1".

The Advanced sizing configuration is designed for high-availability and high-performance deployments. The following diagram shows the network architecture used to test deployment of the AX Series for optimizing the Blackboard solution.

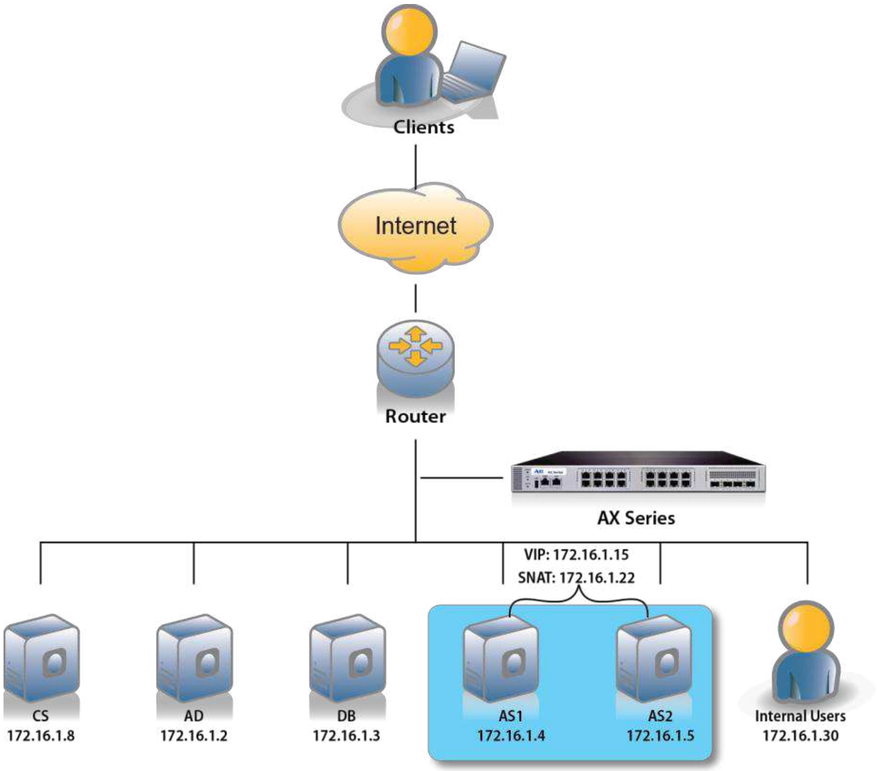


Figure 1: Blackboard deployment overview

2.1 BLACKBOARD SERVER ROLES

Blackboard servers can be deployed to fulfill the following roles:

- **CS - Collaboration Server –** Dedicated server that provides users the ability to use video and audio conferencing.
- **AD - Active Directory –** Deployment in which all Blackboard servers must be joined in a domain and in Active Directory Domain Services (ADDS).
- **DB - Database –** Server that provides database services for the Blackboard Learn$^+$ System. The following information is stored in the database: student credentials, class information, schedule information, and so on.
- **AS - Application Servers –** Server pool on which the core Blackboard Learn$^+$ System is installed. The application server contains features such as course management, calendaring, module management, and so on.

For additional deployment information for Blackboard Learn$^+$, refer to the following documents:

- *Blackboard Learn$^+$ 9.1 Installation Guide*
- *Blackboard Learn$^+$ 9.1 Performance Optimization Guide*
- *Blackboard Learn$^+$ 9.1 Release notes*

3 PREREQUISITES AND ASSUMPTIONS

Testing of the solution in this deployment guide was based on the following requirements and lab setup:

- The A10 Networks AX Series ADC must be running version 2.6.x or higher.
- The Blackboard Learn$^+$ 9.1 application was tested and deployed on Windows 2008 (64-bit) Enterprise Edition Server Operating System.
- Microsoft SQL Server 2008 R2 was installed.
- Java SE Development Kit (JDK) and Java Runtime Environment (JRE) are required on the application servers. For additional information about the requirements, refer to *Blackboard Learn$^+$ 9.1 Installation Guide*.

- The AX series was deployed in One-Arm Mode configuration. For details about other deployment modes, refer to the following: http://www.a10networks.com/elearning/002-Four_SLB_Modes.php

- Blackboard clients used in the testing were running the 64-bit Windows 7 Ultimate Operating System.

- The Blackboard application was tested with:

  - ♦ Microsoft Internet Explorer Version 9

  - ♦ Mozilla Firefox Version 8

4 BASIC CONFIGURATION

This chapter explains how the AX Series is deployed to use the AX Series to load balance the Blackboard Learn+ 9.1 Application Servers. This covers detailed instructions to configure real servers, service group, virtual services, and virtual servers in a basic functional Blackboard setup.

Note: *The following configuration will work for Windows and Unix installation load balanced as described in Blackboard Learn+ 9.1 Installation Guide.*

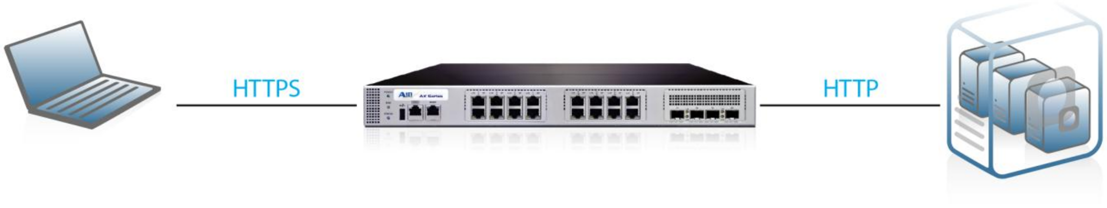


Figure 2: Basic setup overview

The basic setup configuration is the simplest functional solution using the AX Series device to load balance Blackboard traffic. AX features such as Source-IP NAT, Health Monitoring, and Cookie Persistence can improve Blackboard Application Server performance, uptime and scalability.

As stated on page 64 in the Blackboard setup guide, "session affinity must be based on the user's cookie". In the AX feature set, Cookie-based persistence is synonymous with Cookie-based session affinity (Blackboard terminology). Cookie-based persistence inserts a cookie into the HTTP header of the server reply to a client. This ensures that subsequent requests from the client will be sent to the same server or port. In this deployment guide, A10 Networks recommends the use of server-based persistence.

The AX Series offers advanced health monitoring for Blackboard Application Servers. The AX Series can be programmed to monitor different protocols such as HTTP, HTTPS, FTP and more. (For more information, refer to the *AX Series Graphical User Interface Reference*.)

The Source-IP NAT feature is required when the AX Series is deployed in One-Arm mode, where the AX Series Source NAT subnet must be the same as the Blackboard server subnet.

5 REQUIRED FEATURES

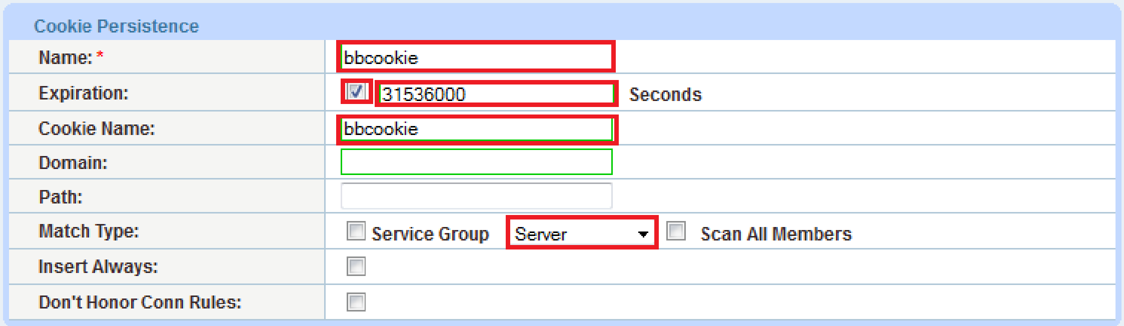
Blackboard deployment requires the following AX features:

- Cookie-persistence template
- Source-IP NAT pool
- Health monitor

5.1 COOKIE PERSISTENCE TEMPLATE

To configure Cookie Persistence in the AX Series:

1. Navigate to **Config Mode** > **Service** > **Template** > **Persistent** > **Cookie Persistence**.
2. Click **Add**.
3. Enter the following information:
   - **Name**: "bbcookie"
   - **Expiration**: Select the checkbox and enter "31536000".
   - **Cookie Name**: "bbcookie"
   - **Match Type**: Select the checkbox and select "Server" from the drop-down list.



Cookie Persistence

Name: *	bbcookie
Expiration:	☑ 31536000 Seconds
Cookie Name:	bbcookie
Domain:	
Path:	
Match Type:	□ Service Group Server ▾ □ Scan All Members
Insert Always:	□
Don't Honor Conn Rules:	□

Figure 3: Cookie-persistence template

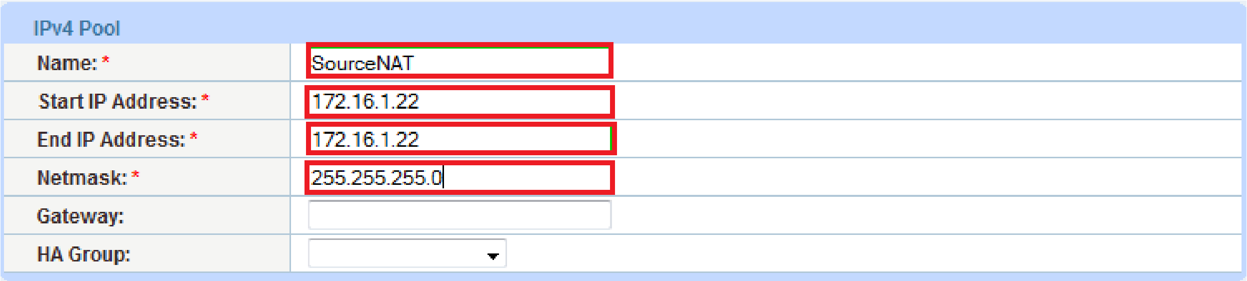
***Note:** The Match Type option ensures that requests from a particular user land on the same Blackboard Application Server.*

4. Click **OK**, then click **Save** to save the configuration.

5.2 IP-SOURCE NAT TEMPLATE

To create an IP Source NAT template:

1. Navigate to **Config Mode > Service > IP Source NAT > IPv4 Pool**.
2. Click **Add**.
3. Enter the following information:
   - **Name**: “SourceNAT”
   - **Start IP Address**: "172.16.1.22"
   - **End IP Address**: “172.16.1.22"
   - **Netmask**: "255.255.255.0"



IPv4 Pool

Name: *	SourceNAT
Start IP Address: *	172.16.1.22
End IP Address: *	172.16.1.22
Netmask: *	255.255.255.0
Gateway:	
HA Group:	

Figure 4: Source NAT pool

4. Click **OK**, then click **Save** to save the configuration.

***Note:** For One-Arm mode deployments, IP-Source NAT must use the same subnet as the Blackboard Application Servers.*

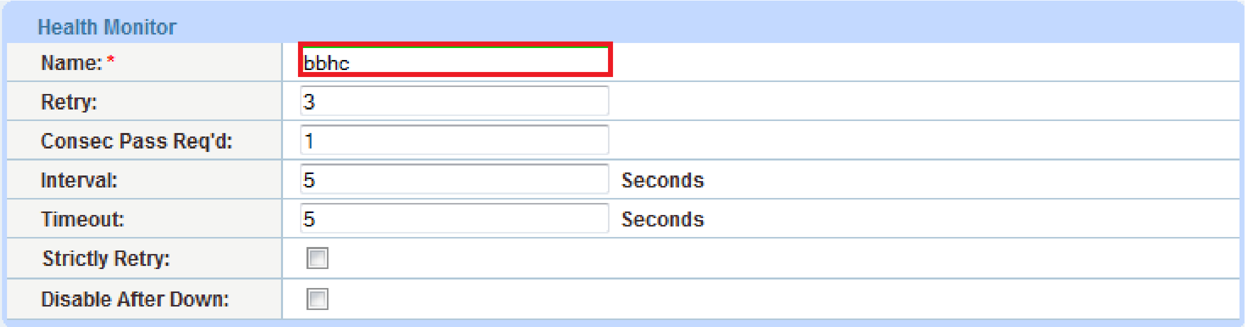
5.3 HTTP HEALTH MONITOR

To configure an HTTP health monitor:

1. Navigate to **Config Mode > Service > Health Monitor > Health Monitor**.

2. Click **Add**.

3. Enter the following **Name**: "bbhc"



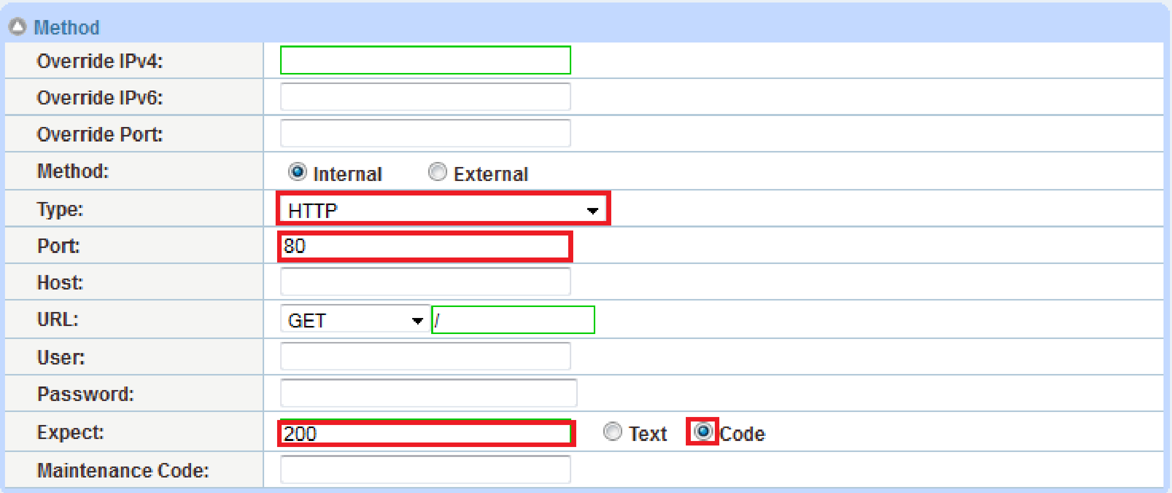
Health Monitor

Name: *	bbhc	
Retry:	3	
Consec Pass Req'd:	1	
Interval:	5	Seconds
Timeout:	5	Seconds
Strictly Retry:	□	
Disable After Down:	□	

Figure 5: Health monitor

4. In the Method section, enter or select the following information:

- **Type**: "HTTP"
- **Port**: "80"
- **Expect**: Enter “200” and select the **Code** checkbox.



Method

Override IPv4:	
Override IPv6:	
Override Port:	
Method:	● Internal ○ External
Type:	HTTP ▾
Port:	80
Host:	
URL:	GET ▾ /
User:	
Password:	
Expect:	200 ○ Text ● Code
Maintenance Code:	

Figure 6: Health monitor method

5. Click **OK**, then click **Save** to save the configuration.

6 ACCELERATION, SECURITY AND OPTIONAL OPTIMIZATION FEATURES

This section explains how to configure acceleration and optimization features using templates, which can be applied to HTTP/HTTPS virtual services. The Blackboard deployment uses the following AX Series acceleration and optimization features:

- aFleX scripting tool for creating HTTP-to-HTTPS redirect script
- Blackboard Security with Transparent SSL Encryption
- RAM Caching
- Connection Reuse
- HTTP Compression

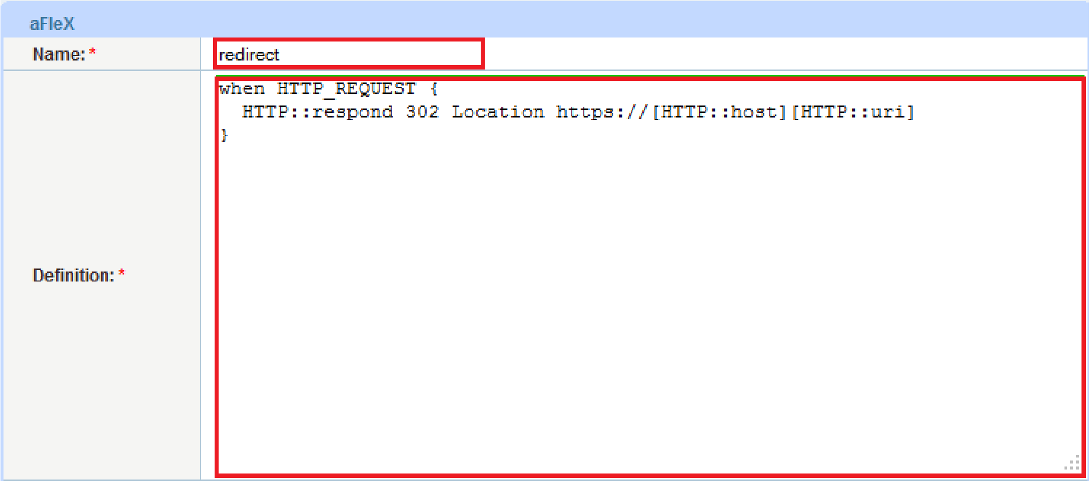
6.1 AFLEX HTTP-TO-HTTPS REDIRECT SCRIPT

The aFleX Scripting tool enables advanced, highly-flexible and efficient Layer 7 traffic management. Using an aFleX script to redirect HTTP to HTTPS enables the Blackboard server HTTP (unsecure) traffic to be redirected to HTTPS (secure). This provides added security to the Blackboard application servers.

To configure the aFleX script in the AX GUI:

1. Navigate to **Config Mode > Service > aFleX**.
2. Click **Add**.
3. Enter the **Name** "redirect".
4. Enter the aFleX script in the **Definition** field.
    a. Note: You can copy-and-paste it from this document!

```
when HTTP_REQUEST {
  HTTP::respond 302 Location https://[HTTP::host][HTTP::uri]
}
```



aFleX

Name: * redirect

Definition: *

```
when HTTP_REQUEST {
  HTTP::respond 302 Location https://[HTTP::host][HTTP::uri]
}
```

Figure 7: aFleX script

5. Click **OK**, then click **Save** to save the configuration.

6.2 BLACKBOARD SECURITY WITH TRANSPARENT SSL ENCRYPTION

This section describes how to secure the Blackboard solution with the AX Series. Since the Blackboard solution does not support HTTPS traffic, Blackboard security can be enhanced with transparent SSL encryption. The AX Series can enhance client access by enabling HTTPS/SSL traffic for incoming requests.

The following features will secure the Blackboard Application Servers and should be implemented in every Blackboard deployment to secure communication between client and server.

Note: On page 85 of the *Blackboard Learn+ Setup Guide* states that the Learn+ system does not support "SSL acceleration" or "SSL offload" feature. A10 Networks has a workaround to enable the Blackboard limitations with the following instructions.

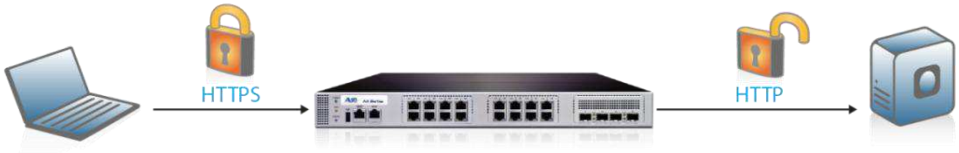


Figure 8: Securing Blackboard servers

6.2.1 SSL CERTIFICATE

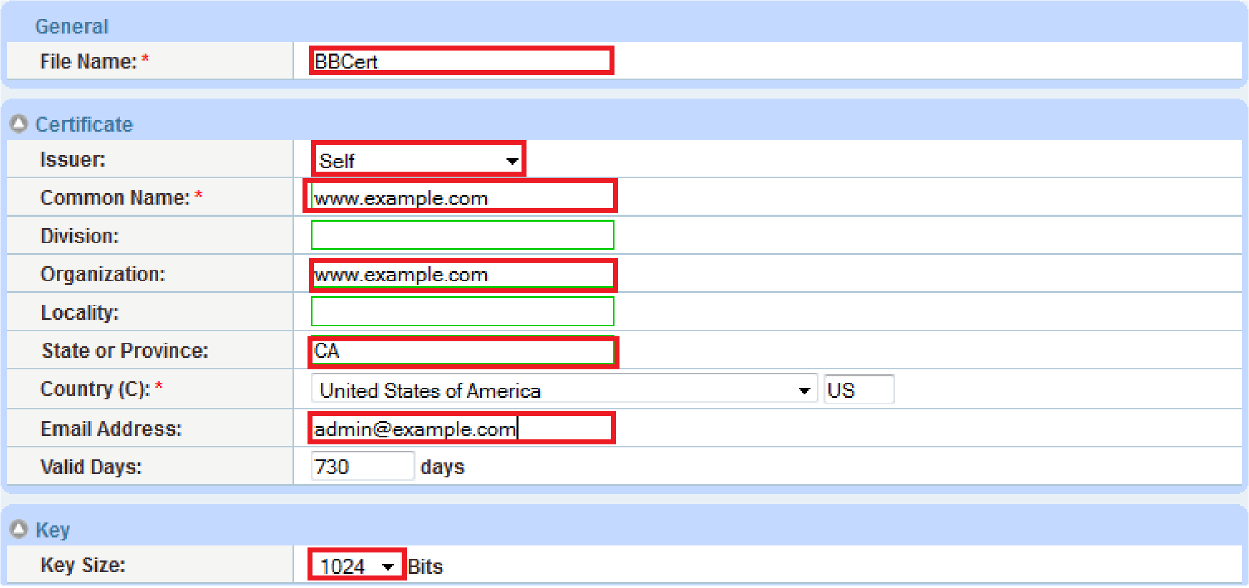
The following procedure creates a self-signed certificate on the AX device. The certificate will be presented to users who send requests to the Blackboard Application Server.

Notes:

- The following procedure describes how to create a self-signed certificate. The AX Series also supports import of certificates signed by a Certificate Authority (CA). A CA-signed certificate allows users to quickly verify that the website visited is operated by someone listed in the domain registration contact information.
- There are some disadvantages to using a self-signed certificate, as users may disregard the manual verification and acceptance process, and perhaps disregard the website if the self-signed certificate comes from an unknown source. Typically, self-signed certificates are often used in lab or test environments.
- The procedure provides only sample values for the common name and other identification information. When creating the certificate, make sure to use the values that apply to your organization.

To create a self-signed certificate:

1. Navigate to **Config Mode** > **Service** > **SSL Management** > **Certificate**.
2. Enter or select the following information:
   - ♦ **File Name**: “BBCert”
   - ♦ **Issuer**: "Self"
   - ♦ **Common Name**: "www.example.com"
   - ♦ **Organization**: "www.example.com"
   - ♦ **State**: "CA"
   - ♦ **Email Address**: "admin@example.com"
   - ♦ **Key Size**: "1024"



General

File Name: *	BBCert

Certificate

Issuer:	Self
Common Name: *	www.example.com
Division:	
Organization:	www.example.com
Locality:	
State or Province:	CA
Country (C): *	United States of America US
Email Address:	admin@example.com
Valid Days:	730 days

Key

Key Size:	1024 Bits

Figure 9: SSL certificate configuration

3. Click **OK**, then click **Save** to save the configuration.

To apply the SSL Certificate:

1. Navigate to **Config Mode** > **Service** > **Template** > **SSL** > **Client SSL**.
2. Click **Add**.
3. Enter or select the following information:
   - **Name**: "BB-SSL"
   - **Certificate Name**: "BBCert"
   - **Key Name**: "BBCert"
4. Click **OK**, then click **Save** to save the configuration.

6.2.2 HTTP REDIRECT-REWRITE

The following procedure configures an HTTP application template to redirect HTTP requests to HTTPS requests.

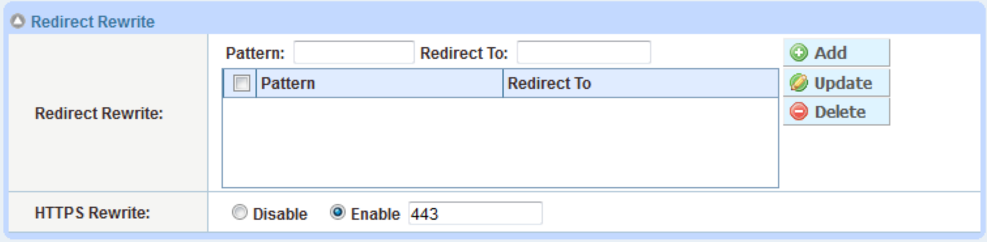
1. Navigate to **Config Mode** > **Template** > **Application** > **HTTP**.
2. Click **Add**.

3. Enter the **Name** "redirectrewrite".

4. Click the down arrow next to **Redirect Rewrite** to display the configuration section shown below.

5. Next to **HTTP Rewrite**, select **Enable** and enter “443”.

Note: *The Pattern and Redirect To fields rewrite the matching URL string (Pattern) to the specified value (Redirect To) before sending the redirects to clients. This is optional.*



HTTPS Rewrite: ○ Disable ● Enable 443

Figure 10: Redirect-rewrite configuration

6. Click **OK**, then click **Save** to save the configuration.

6.2.3 AFLEX SCRIPT TO REWRITE ABSOLUTE LINKS

This feature transparently converts an HTTP web application to HTTPS. To configure the rewrite of absolute links, create an aFleX script as follows:

1. Navigate to **Config Mode > Service > aFleX**.

2. Click **Add**.

3. Enter the Name "transparentssl".

4. In the **Definition** field, enter the following script. Make sure to use your Blackboard domain name where indicated instead of “www.example.com”, as explained below.

Note: *This script is also available on the A10 Networks VirtualADC website* (a username and password are required to access the site)*:*

```
# Force servers to not reply with compression.
# (Compression can be enabled on the AX device.)
when HTTP_REQUEST {   HTTP::header remove Accept-Encoding
}
# Collect HTTP response if the response time is text-based.
when HTTP_RESPONSE {
  if { [HTTP::header "Content-Type"] starts_with "text" } {
HTTP::collect
```

```
    }
  }
  # Rewrite absolute links. Replace www.example.com with your
  # organization’s domain name.
  when HTTP_RESPONSE_DATA {
      set payload_length [HTTP::payload length]
    HTTP::payload replace 0 $payload_length [string map
  {"http://www.example.com" "https://www.example.com "} [HTTP::payload]]
    HTTP::release
  }
```

Note: *Make sure to replace the domain name in the example with your Blackboard domain. In the example above, the domain used is “www.example.com".*

5. Click **OK**, then click **Save** to save the configuration.

6. After configuring the HTTPS service (later in this guide), you can apply this aFleX script to it. (Refer to *Load Balancing Configuration* and *Binding Features to the VIP*.)

6.3 RAM CACHING

RAM Caching is an AX feature that stores dynamic and static HTTP/HTTPS objects in the AX Series random-access memory (RAM). The HTTP objects are cached following the initial HTTP request. Subsequent client requests for the same objects are served from the AX device’s RAM cache. This provides faster client download for HTTP/HTTPS objects and improves Blackboard Application Server performance and scalability. RAM Caching also cuts down on the time required to transfer HTTP/HTTPS objects, such as Blackboard images, JavaScript and CSS style sheets.

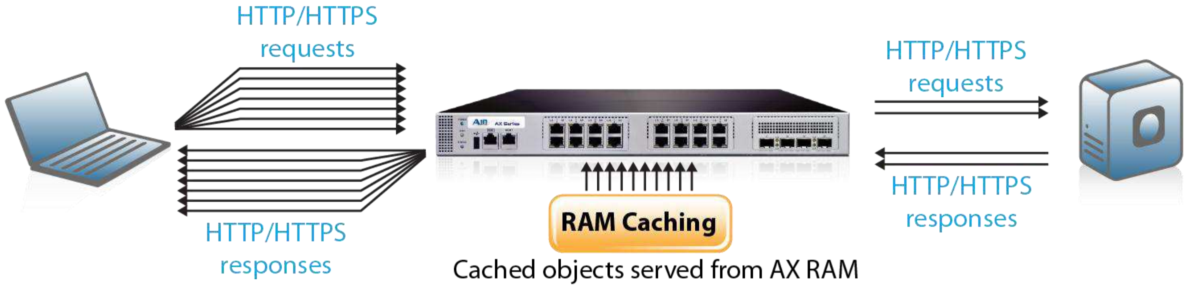


Figure 11: RAM Caching feature

To create a RAM Caching template:

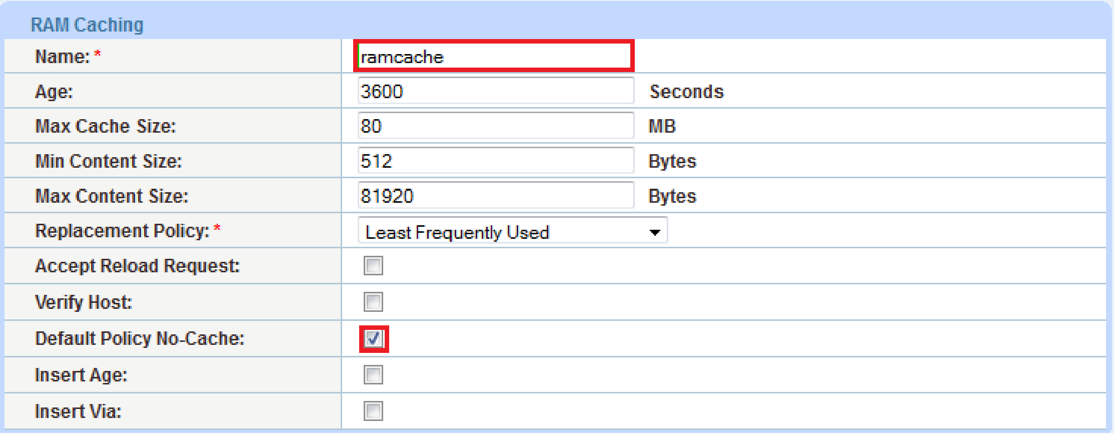
1. Navigate to **Config Mode** > **Service** > **Template** > **Application** > **RAM Caching**.

2. Click **Add**.

3. Enter or select the following values:

    - **Name**: "ramcache"
    - **Default Policy No-Cache**

Note: *Use default values for the other options.*



RAM Caching

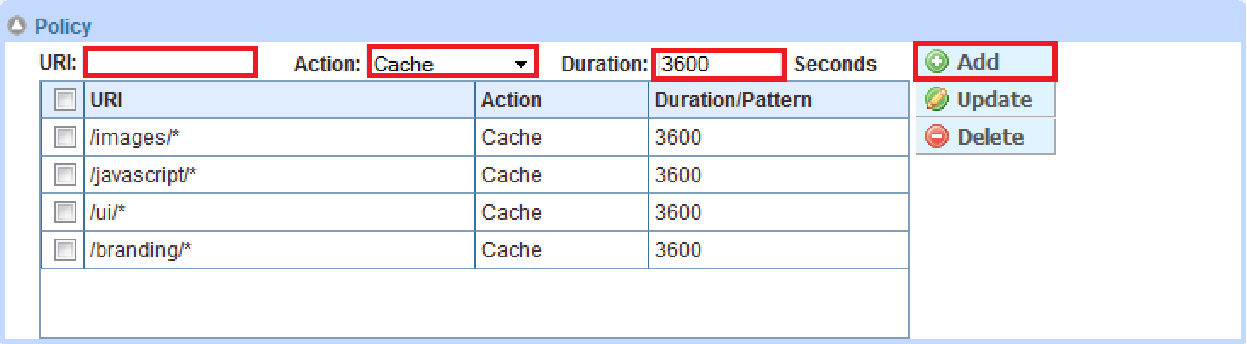
Name: *	ramcache	
Age:	3600	Seconds
Max Cache Size:	80	MB
Min Content Size:	512	Bytes
Max Content Size:	81920	Bytes
Replacement Policy: *	Least Frequently Used	
Accept Reload Request:	□	
Verify Host:	□	
Default Policy No-Cache:	☑	
Insert Age:	□	
Insert Via:	□	

Figure 12: RAM Caching template

4. In the Policy section, enter or select the following values:

    - **URI**: portion of the URI string on which to match
    - **Action**: Select the cache option
    - **Duration**: Cache content age field

5. Click **Add**.



Policy

URI: Action: Cache Duration: 3600 Seconds

□	URI	Action	Duration/Pattern
□	/images/*	Cache	3600
□	/javascript/*	Cache	3600
□	/ui/*	Cache	3600
□	/branding/*	Cache	3600

Figure 13: RAM Caching policy

6. Click **OK**, then click **Save** to save the configuration.

6.4 CONNECTION REUSE

This section describes the AX Connection Reuse feature and how to configure it. Connection Reuse reduces the overhead associated with TCP connection setup, by establishing TCP connections with Blackboard Application Servers and then reusing those connections for multiple client requests. Connection Reuse significantly increases the responsiveness of the Blackboard Application Servers. This results in better Blackboard server performance and in improved scalability for production infrastructures.

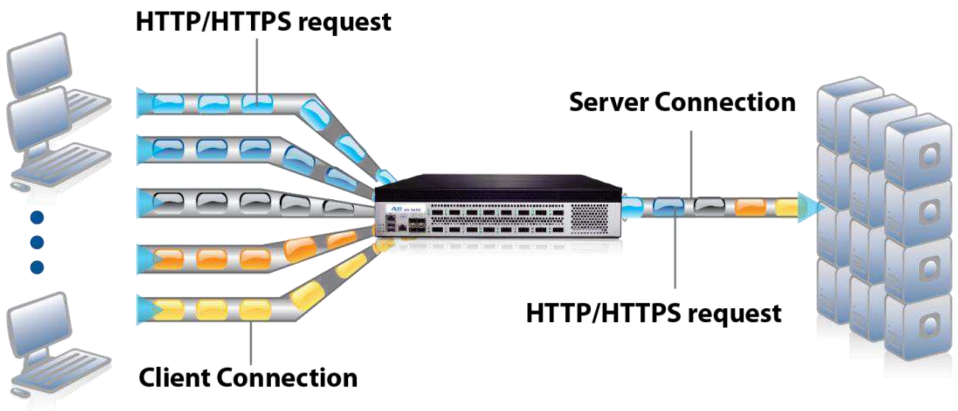
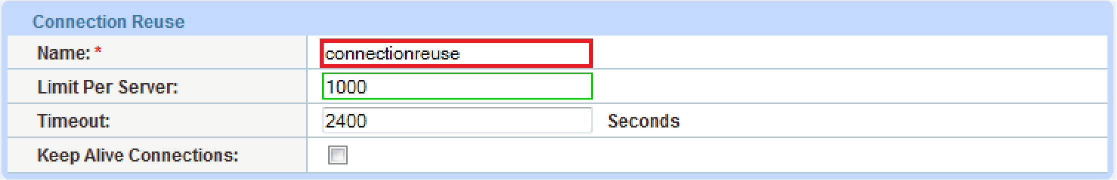


Figure 14: Connection Reuse feature

To configure a Connection Reuse Template:

1. Navigate to **Config Mode** > **Service** > **Template** > **Application** > **Connection Reuse**.
2. Click **Add**.
3. Enter the **Name** "connectionreuse".



Connection Reuse

Name: *	connectionreuse	
Limit Per Server:	1000	
Timeout:	2400	Seconds
Keep Alive Connections:	□	

Figure 15: Connection Reuse template

4. Click **OK**, then click **Save** to save the configuration.

6.5 HTTP COMPRESSION

HTTP Compression provides bandwidth optimization by compressing HTTP/HTTPS objects served by Blackboard Application Servers before forwarding those objects to clients. The advantage of this feature is that clients need less bandwidth, and thus experience faster download of the HTTP/HTTPS objects. The AX Series offers various levels of compression, ranging from 1 to 9. Level 1 compression offers the lowest compression ratio whereas level 9 offers the highest compression ratio. For optimum compression performance, level 1 is recommended.

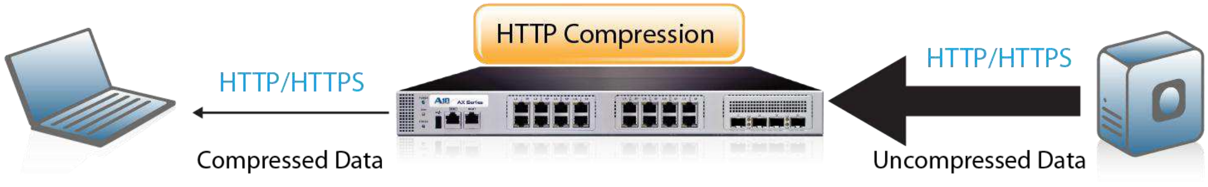
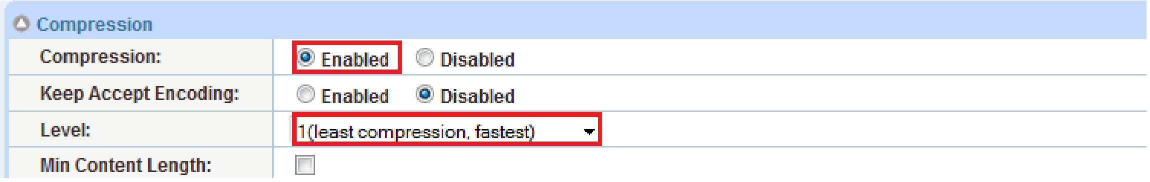


Figure 16: HTTP Compression feature

To enable HTTP compression:

> ***Note:*** *This procedure modifies the existing template called "redirectrewrite" as referred to in section 6.2.2 HTTP Redirect-Rewrite.*

1. Navigate to **Config Mode** > **Service** > **Template** > **Application** > **HTTP**.
2. Click "redirectrewrite"
3. Click the down arrow next to “Compression” to display the configuration section shown below.
4. Select **Enabled** next to **Compression**.
5. Make sure the Level is set to **1 (least compression, fastest)**.



Compression

Compression:	● Enabled ○ Disabled
Keep Accept Encoding:	○ Enabled ● Disabled
Level:	1(least compression, fastest)
Min Content Length:	□

Figure 17: HTTP template (compression options)

6. Click **OK**, then click **Save** to save the configuration.

7 LOAD BALANCING CONFIGURATION

This section of the deployment guide explains how to configure load balancing for the Blackboard Application Servers. Basic load balancing consists of the following configuration resources:

- **Servers** (also called "real servers") – The Blackboard Application Servers.
- **Service Group** – The pool of real servers. A service group contains a set of real servers from which the AX device can select to service client requests. A service group supports multiple real Blackboard Application Servers as one logical Application Server.
- **Virtual Server** (also called a virtual IP or "VIP") – The single virtual device to which clients will send Blackboard requests.
- **Virtual Service** (also called "virtual port") – The protocol port on the VIP to which clients send Blackboard requests. In this deployment guide, the virtual services are HTTP (port 80) and HTTPS (port 443). The features configured in the previous sections can be applied to these virtual services.

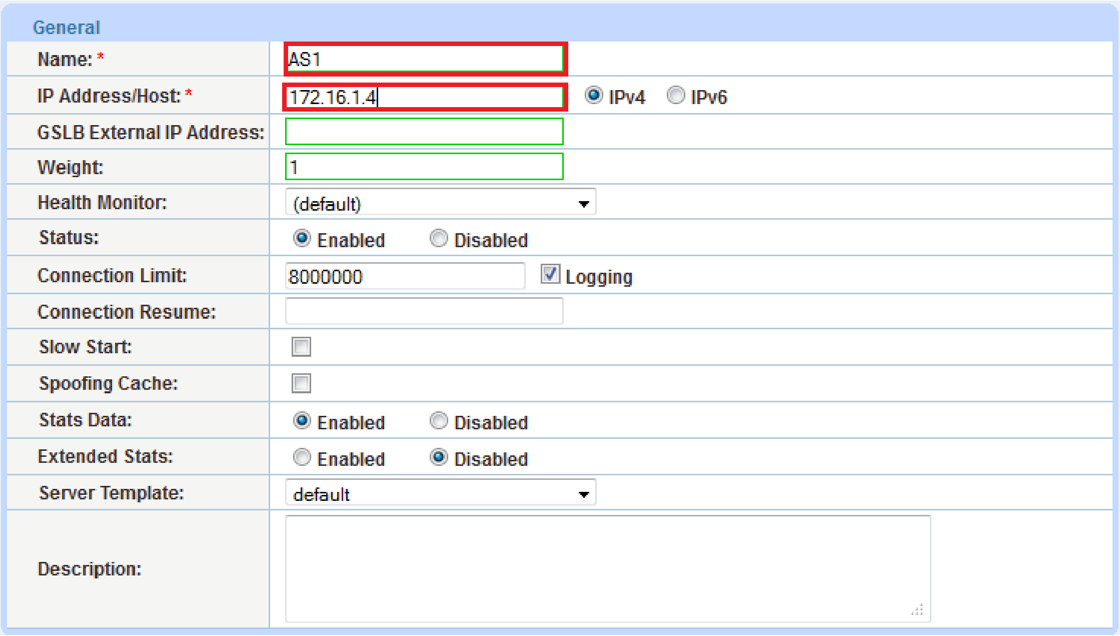
Load-balancing configuration overview:

1. Configure the servers.
2. Add the servers to a service group.
3. Bind the service group to a virtual server. Add the virtual services to the virtual server and apply features to the virtual services.

7.1 SERVER CONFIGURATION

To configure the real servers (Blackboard Application Servers):

1. Navigate to **Config Mode** > **Service** > **SLB** > **Server**.
2. Click **Add**.
3. In the General section, enter the following information:
   - ♦ **Name**: "AS1"
   - ♦ **IP Address/Host**: "172.16.1.4"



General

Name: *	AS1
IP Address/Host: *	172.16.1.4 ● IPv4 ○ IPv6
GSLB External IP Address:	
Weight:	1
Health Monitor:	(default)
Status:	● Enabled ○ Disabled
Connection Limit:	8000000 ☑ Logging
Connection Resume:	
Slow Start:	□
Spoofing Cache:	□
Stats Data:	● Enabled ○ Disabled
Extended Stats:	○ Enabled ● Disabled
Server Template:	default
Description:	

Figure 18: Server configuration

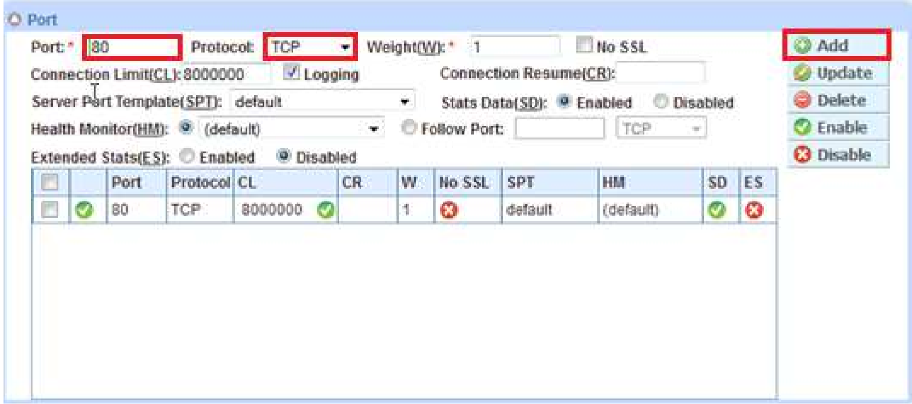
4. In the Port section, enter or select the following values:

   - **Port**: “80”

   - **Protocol**: “TCP”

5. Click **Add**.

Note: *Enter additional servers if necessary.*



Port

Port: * 80 Protocol: TCP Weight(W): * 1 □ No SSL

Connection Limit(CL): 8000000 ☑ Logging Connection Resume(CR):

Server Port Template(SPT): default Stats Data(SD): ● Enabled ○ Disabled

Health Monitor(HM): ● (default) ○ Follow Port: TCP

Extended Stats(ES): ○ Enabled ● Disabled

□		Port	Protocol	CL	CR	W	No SSL	SPT	HM	SD	ES
□	✓	80	TCP	8000000 ✓		1	☒	default	(default)	✓	☒

Figure 19: Server port configuration

6. Click **OK**, then click **Save** to save the configuration.

7.2 SERVICE GROUP CONFIGURATION

To configure the service group:

1. Navigate to **Config Mode** > **Service** > **SLB** > **Service Group**.

2. Click **Add**.

3. In the General section, enter or select the following information:

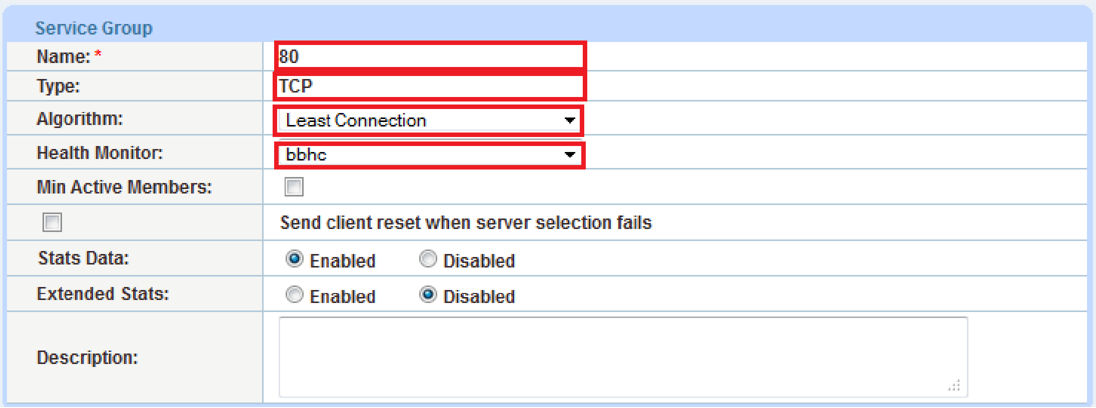
    - **Name**: “80”

    - **Type**: “TCP”

    - **Algorithm**: “Least Connection”

    - **Health Monitor**: "bbhc"

Note: By default, the AX device uses the ICMP (ping) method to test server availability. An additional health monitor is used to test the availability of the TCP or UDP port. Instead of the default TCP health monitor, this deployment uses the HTTP health monitor ("bbhc") configured in *HTTP Health Monitor*. For more information on AX health monitoring options, refer to the *AX Series Application Delivery and Server Load Balancing Guide*.



Service Group

Name: *	80
Type:	TCP
Algorithm:	Least Connection
Health Monitor:	bbhc
Min Active Members:	□
□	Send client reset when server selection fails
Stats Data:	● Enabled ○ Disabled
Extended Stats:	○ Enabled ● Disabled
Description:	

Figure 20: Service group configuration

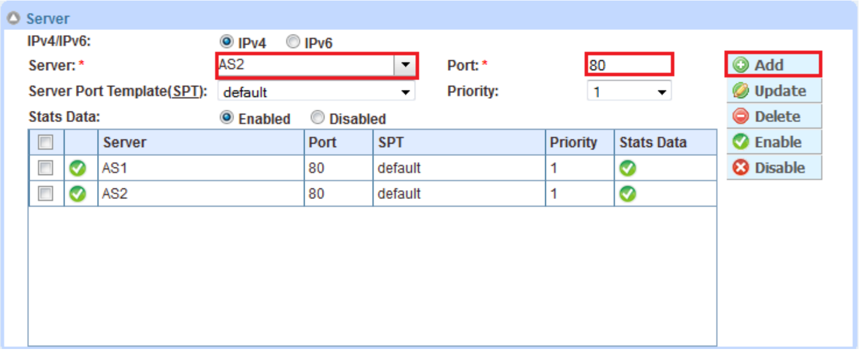
4. In the Server section, add the servers:

    a. Select “AS1” from the **Server** drop-down list.

    b. Enter “80” in the **Port** field.

    c. Click **Add**.

d. Repeat for each server. In the example shown below, two servers, "AS1" and "AS2", are added to the service group.



Server

IPv4/IPv6: ● IPv4 ○ IPv6

Server: * AS2   Port: * 80

Server Port Template(SPT): default   Priority: 1

Stats Data: ● Enabled ○ Disabled

□		Server	Port	SPT	Priority	Stats Data
□	✓	AS1	80	default	1	✓
□	✓	AS2	80	default	1	✓

Figure 21: Service group configuration (2)

5. Click **OK**, then click **Save** to save the configuration.

7.3 VIRTUAL SERVER CONFIGURATION

To configure the virtual server (VIP):

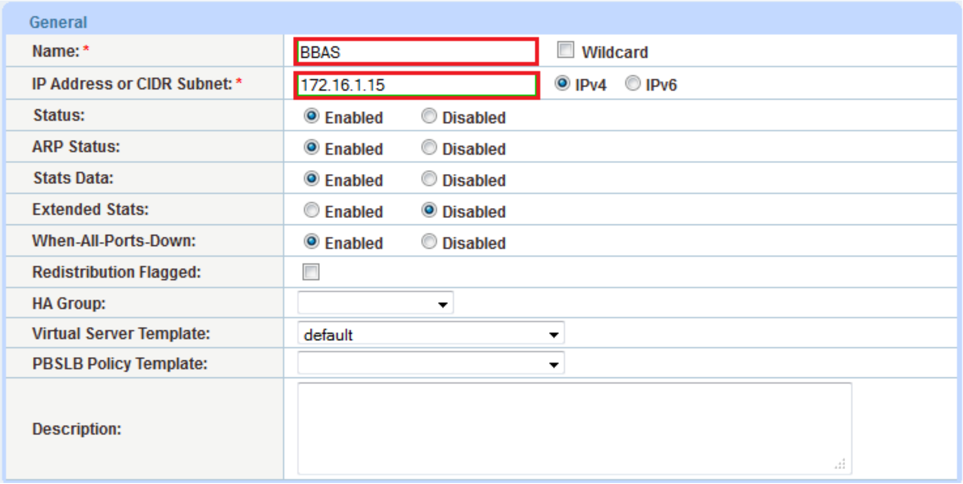
1. Navigate to **Config Mode** > **Service** > **SLB** > **Virtual Server**.

2. Click **Add**.

3. In the General section, enter or select the following information:

   - **Name**: "BBAS"

   - **IP Address or CIDR Subnet**: "172.16.1.15"



General

Name: *	BBAS □ Wildcard
IP Address or CIDR Subnet: *	172.16.1.15 ● IPv4 ○ IPv6
Status:	● Enabled ○ Disabled
ARP Status:	● Enabled ○ Disabled
Stats Data:	● Enabled ○ Disabled
Extended Stats:	○ Enabled ● Disabled
When-All-Ports-Down:	● Enabled ○ Disabled
Redistribution Flagged:	□
HA Group:	
Virtual Server Template:	default
PBSLB Policy Template:	
Description:	

Figure 22: Virtual server configuration

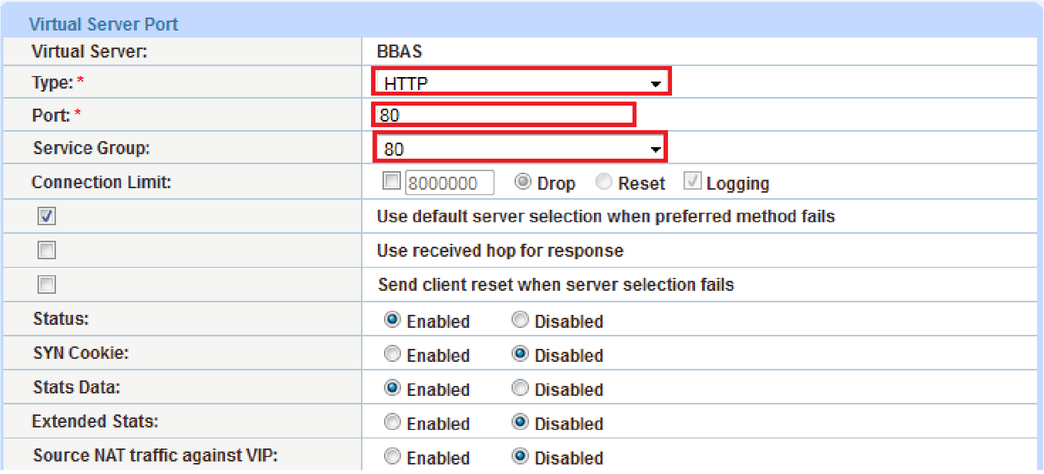
4. In the Port section, click **Add** to display Virtual Server Port configuration page.

5. For HTTP-to-HTTP traffic:

    a. Enter or select the following values:

    - **Type**: “HTTP”
    - **Port**: “80”
    - **Service Group**: “80”

    b. Click **Add**.



Virtual Server Port

Virtual Server:	BBAS
Type: *	HTTP
Port: *	80
Service Group:	80
Connection Limit:	□ 8000000 ● Drop ○ Reset ☑ Logging
☑	Use default server selection when preferred method fails
□	Use received hop for response
□	Send client reset when server selection fails
Status:	● Enabled ○ Disabled
SYN Cookie:	○ Enabled ● Disabled
Stats Data:	● Enabled ○ Disabled
Extended Stats:	○ Enabled ● Disabled
Source NAT traffic against VIP:	○ Enabled ● Disabled

Figure 23: Virtual server configuration (HTTP port)

6. For HTTPS-to-HTTP traffic (optional; see note below):

   a. In the Port section of the Virtual Server configuration page, click **Add**.

   b. Enter or select the following values instead:

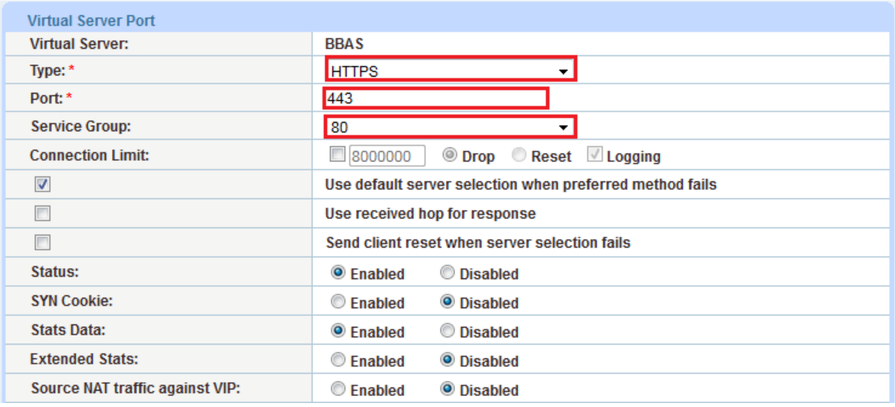
   ○ **Type**: “HTTPS”

   ○ **Port**: “443”

   ○ **Service Group**: “80”

   c. Click **Add**.

Note: Configuring an HTTPS port on the virtual server is optional, but is needed if a redirect from HTTP-to- HTTPS is configured, as described in the earlier section. This is also needed if direct HTTPS access is required. Adding a front-end HTTPS virtual server will minimize the need for users to guess whether the site is accessed through either HTTP or HTTPS. This optional HTTPS port provides HTTPS with no redirect.



Virtual Server Port

Virtual Server:	BBAS
Type: *	HTTPS
Port: *	443
Service Group:	80
Connection Limit:	□ 8000000 ● Drop ○ Reset ☑ Logging
☑	Use default server selection when preferred method fails
□	Use received hop for response
□	Send client reset when server selection fails
Status:	● Enabled ○ Disabled
SYN Cookie:	○ Enabled ● Disabled
Stats Data:	● Enabled ○ Disabled
Extended Stats:	○ Enabled ● Disabled
Source NAT traffic against VIP:	○ Enabled ● Disabled

Figure 24: Virtual server configuration (HTTPS port)

7. Click **OK**, then click **Save** to save the configuration.

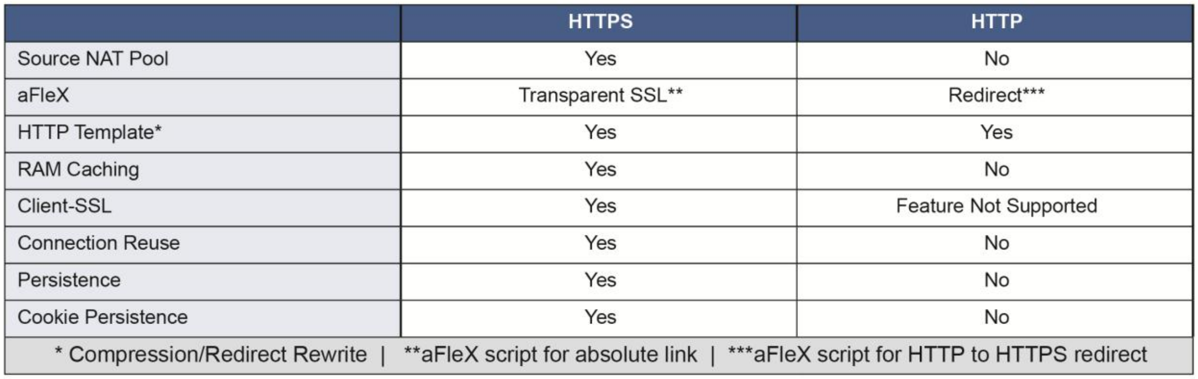
8 BINDING FEATURES TO THE VIP

In previous sections of this deployment guide, the following types of resources were configured for the HTTPS and HTTP virtual services:

- NAT pool
- aFleX scripts

- Feature templates

The following matrix lists these resources and the virtual service type to which they apply (for installations not using the SSL option please refer to section 8.3).



	HTTPS	HTTP
Source NAT Pool	Yes	No
aFleX	Transparent SSL**	Redirect***
HTTP Template*	Yes	Yes
RAM Caching	Yes	No
Client-SSL	Yes	Feature Not Supported
Connection Reuse	Yes	No
Persistence	Yes	No
Cookie Persistence	Yes	No

* Compression/Redirect Rewrite | **aFleX script for absolute link | ***aFleX script for HTTP to HTTPS redirect

Figure 25: Virtual service matrix

You can apply these resources as applicable to the HTTP and HTTPS virtual services created in *Virtual Server Configuration*.

To apply a configuration resource to a virtual service:

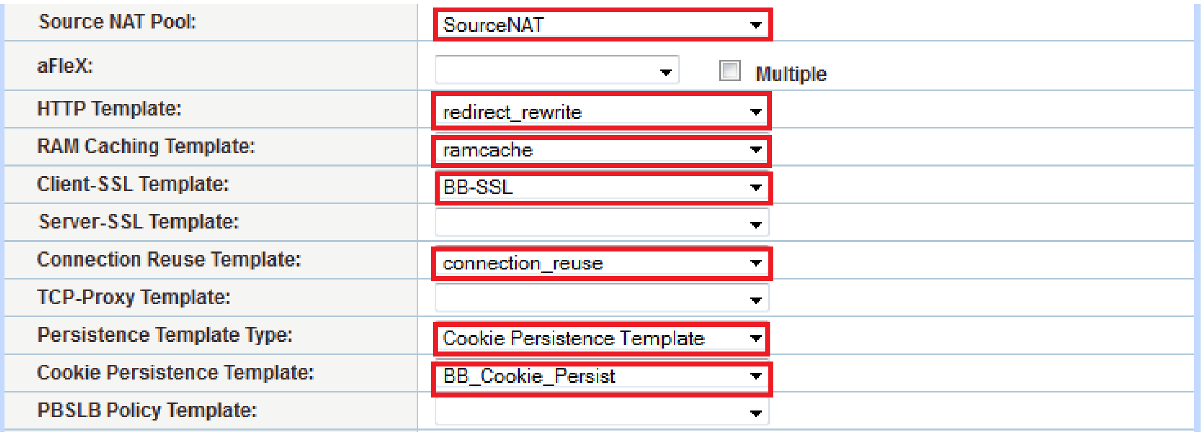
1. Navigate to **Config Mode** > **Service** > **SLB** > **Virtual Service**.
2. Click on the virtual service. The service names include the virtual server IP address (VIP), the service type, and the port number.
3. Select the resource from the applicable drop-down list.
4. Click **OK**, then click **Save** to save the configuration.

For example, to apply HTTP template “redirectrewrite” to the HTTP virtual service:

1. Navigate to **Config Mode** > **Service** > **SLB** > **Virtual Service**.
2. Click on “_172.16.1.15_HTTP_80” in the **Name** column.
3. Select “redirectrewrite” from the **HTTP Template** drop-down list.
4. Click **OK**, then click **Save** to save the configuration.

8.1 HTTPS VIRTUAL SERVICE FEATURE TEMPLATES

This example shows selection of all the resources configured for the HTTPS virtual service.

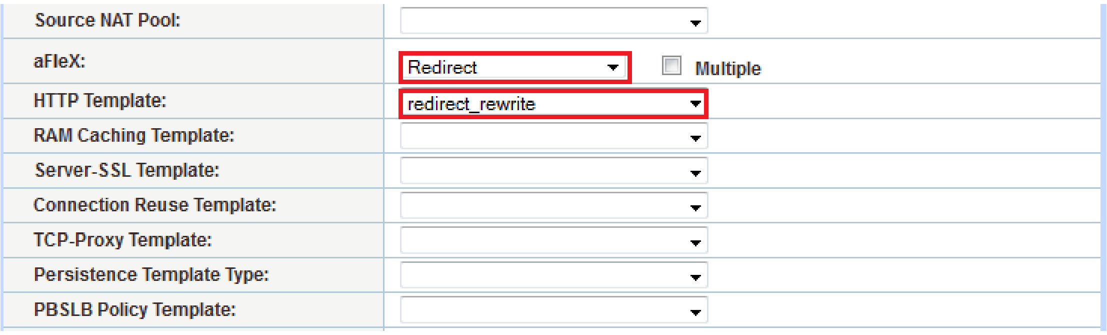


Source NAT Pool:	SourceNAT
aFleX:	□ Multiple
HTTP Template:	redirect_rewrite
RAM Caching Template:	ramcache
Client-SSL Template:	BB-SSL
Server-SSL Template:	
Connection Reuse Template:	connection_reuse
TCP-Proxy Template:	
Persistence Template Type:	Cookie Persistence Template
Cookie Persistence Template:	BB_Cookie_Persist
PBSLB Policy Template:	

Figure 26: HTTPS virtual service features

8.2 HTTP VIRTUAL SERVICE FEATURE TEMPLATES

This example shows selection of all the resources configured for the HTTP virtual service.

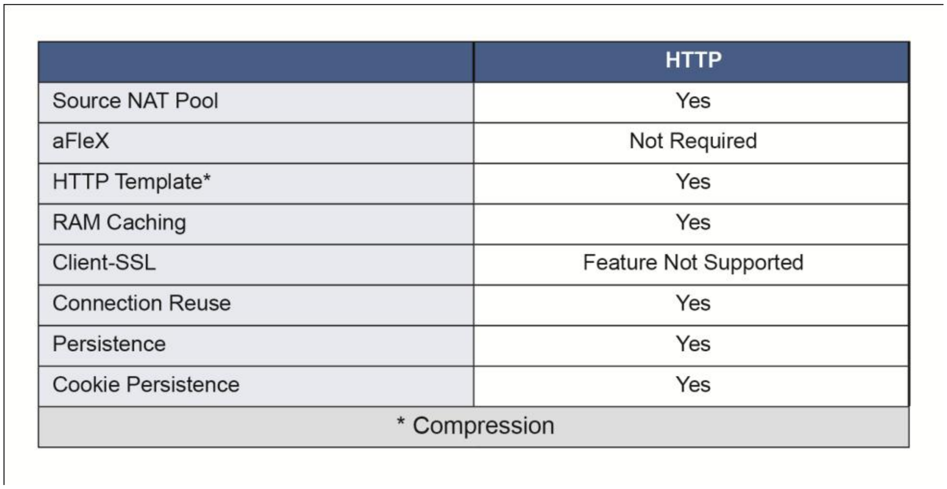


Source NAT Pool:	
aFleX:	Redirect □ Multiple
HTTP Template:	redirect_rewrite
RAM Caching Template:	
Server-SSL Template:	
Connection Reuse Template:	
TCP-Proxy Template:	
Persistence Template Type:	
PBSLB Policy Template:	

Figure 27: HTTP virtual service features

8.3 ALTERNATIVE CONFIGURATION USING HTTP ACCESS

If a Blackboard administrator decides to deploy the Blackboard Learn+ solution in a simple HTTP configuration, Figure 28 describes the virtual service features required for a non-secured HTTP VIP configuration (no SSL). Feature templates must be created as needed using the "create…" option on the drop-down menu or create feature templates first, then bind the features to the VIP. All feature configurations are described in the above chapters on this deployment guide.



	HTTP
Source NAT Pool	Yes
aFleX	Not Required
HTTP Template*	Yes
RAM Caching	Yes
Client-SSL	Feature Not Supported
Connection Reuse	Yes
Persistence	Yes
Cookie Persistence	Yes
* Compression	

Figure 28: Blackboard HTTP AX configuration

Note: HTTP Template will be used for compression feature only.

9 CONCLUSION

The deployment guide shows how a Blackboard Learn$^+$ Solution can be optimized with the A10 Networks AX Series Advanced Traffic Manager. By using the AX device to load balance Blackboard Application Servers, the following key advantages are achieved:

- More secure Blackboard environment by encryption of client communication to the Blackboard Application Server using secured (HTTPS) connectivity
- Improved server availability using transparent application load sharing across multiple Blackboard Application Servers
- Dynamic addition of new Application Servers to the Blackboard server pool
- Continued availability even if a Blackboard Application Server fails, with no direct impact on users' access to the applications
- Improved Blackboard performance throughput, faster user response time, and reduced Blackboard Application Server CPU utilization, through implementation of the HTTP Compression, Connection Reuse, and RAM Caching features

By deploying the AX Series Advanced Traffic Manager, significant benefits are achieved for all Blackboard Learn$^+$ users. For more information about AX Series products, please refer to the following URLs:

http://a10networks.com/products/axseries.php http://a10networks.com/resources/solutionsheets.php

http://a10networks.com/resources/casestudies.php

10 APPENDIX

The appendix contains two sets of CLI configuration that have been shown in this deployment guide. Section 10.1 shows a "full" configuration with SSL, while section 10.2 shows the configuration with HTTP only (no SSL configured).

10.1 AX SYSTEM CONFIGURATION

Below is a CLI configuration based on the parameters entered in this deployment guide

Note: This config sample reflects the configuration parameters within Chapters 5 through

Chapter 8.

```
hostname BlackboardAX

clock timezone America/Los_Angeles

ip nat pool SourceNAT 172.16.1.22 172.16.1.22 netmask /24

health monitor bbhc

 method http expect response-code 200

extended-stats

slb enable-l7-req-acct

slb server AS1 172.16.1.4

   port 80  tcp

slb server AS2 172.16.1.5

   port 80  tcp

slb service-group 80 tcp

    method least-connection

    health-check bbhc

    member AS1:80
    member AS2:80
slb template connection-reuse connectionreuse
slb template cache ramcache
   disable-insert-age
   disable-insert-via
   default-policy-nocache
   policy uri /images/* cache
   policy uri /javascript/* cache
   policy uri /ui/* cache
   policy uri /branding/* cache
slb template http redirectrewrite
   insert-client-ip
   compression enable
   redirect-rewrite secure
slb template client-ssl BB-SSL
   cert BBCert
   key BBCert
slb template persist cookie bbcookie
   name bbcookie
   expire 31536000
   match-type server
slb virtual-server BBAS 172.16.1.15
   port 443  https
      name _172.16.1.15_HTTPS_443
      source-nat pool SourceNAT
      service-group 80
      template http redirectrewrite
      template cache ramcache
      template client-ssl BB-SSL

      template connection-reuse connectionreuse

      template persist cookie bbcookie

      aflex "transparent SSL"

   port 80  http

      name _172.16.1.15_HTTP_80

      service-group 80

      template http redirectrewrite

      aflex redirect

end
```

10.2 ALTERNATIVE CONFIGURATION USING HTTP ONLY (NO SSL OPTION)

Below is a CLI configuration based on the alternative configuration using HTTP Access as referred on Section 8.3 Alternative CONFIGURATION Using HTTP Access.

```
hostname BlackboardAX

clock timezone America/Los_Angeles

interface management

 ip address 172.16.1.126 255.255.255.0

 ip default-gateway 172.16.1.1

interface ethernet 1

 ip address 172.16.1.12 255.255.255.0

ip nat pool SourceNAT 172.16.1.22 172.16.1.22 netmask /24

health monitor bbhc

 method http expect response-code 200

extended-stats

slb enable-l7-req-acct

slb server AS1 172.16.1.4
```

```
  port 80  tcp
slb server AS2 172.16.1.5
  port 80  tcp
slb service-group 80 tcp
   method least-connection
   health-check bbhc
   member AS1:80
   member AS2:80
slb template connection-reuse connectionreuse
slb template cache ramcache
  disable-insert-age
  disable-insert-via
  default-policy-nocache
  policy uri /images/* cache
  policy uri /javascript/* cache
  policy uri /ui/* cache
  policy uri /branding/* cache
slb template http Compression
  compression enable
slb template persist cookie bbcookie
  name bbcookie
  expire 31536000
  match-type server
slb virtual-server BBAS 172.16.1.15
  port 80  http
    name _172.16.1.15_HTTP_80
    source-nat pool SourceNAT
    service-group 80
    template http Compression
    template cache ramcache
    template connection-reuse connectionreuse
    template persist cookie bbcookie
no terminal auto-size
terminal width 80
terminal length 0
end
```