



IBM Software Group

# Channel Framework Part 1: Concepts and Configuration in WAS

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WebSphere® Support Technical Exchange



# Agenda

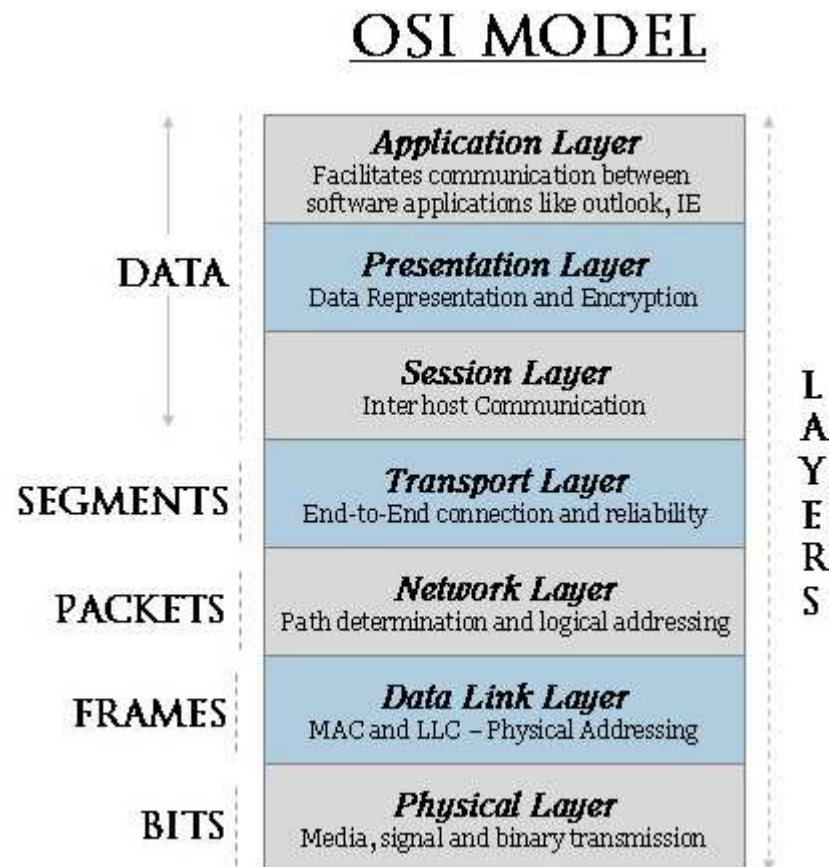
- OSI model concepts
- OSI stack layers
- Socket and Port
- Overview of channels and chains in WebSphere
- Inbound connection vs. Outbound connection
- WebContainer transport chain
- TCP inbound Channel
- HTTP inbound channel
  - NCSA access logging
  - HTTP error logging
- Web Container inbound channel
- SSL inbound channel

# OSI Model

- Open Systems Interconnection (OSI) model defines networking layers
- Similar communication functions are grouped into 7 logical layers
- A layer serves the layer above it and is served by the layer below it
- Control is passed from one layer to the next, starting at the application layer in one station, and proceeding to the bottom layer, over the channel to the next station and back up the hierarchy



## OSI Model (continued)



## OSI Model – Transport

- Along with Application Layer, it is the most important layer from a WAS perspective
- Most often used for connection-oriented communication, such as TCP or UDP, over Sockets described by Network-layer addresses
- Controls flow between applications running on host/remote machines
- Protocols: TCP, UDP, µTP, NBF

16-bit						32-bit					
Source Port						Destination Port					
Sequence Number											
Acknowledgement Number (ACK)											
Offset Reserved		U	A	P	R	S	F	Window			
Checksum						Urgent Pointer					
Options and Padding											

## OSI Model – Presentation/Application

- Handles conversion (deserialization) of network data to and from user- or application-readable data
- Best illustrated by examples of associated protocols: HTTP, Telnet, FTP, DNS, SIP, SSH, LDAP, RDP, NFS, BitTorrent, IRCP
- Utilize transport protocols and connection sessions in order to facilitate application-specific communication
- A list of HTTP header fields can be found here:  
<http://www.w3.org/Protocols/rfc2616/rfc2616-sec14.html>

## Socket and Port

- A **socket** is endpoint of a two-way communication link between two programs running on the network bound to **port** number.
- Server bound to specific port and listening on that socket for incoming requests.
- client knows the hostname of the machine on which the server is running and the port number on which the server is listening



## Socket and Port (continued)

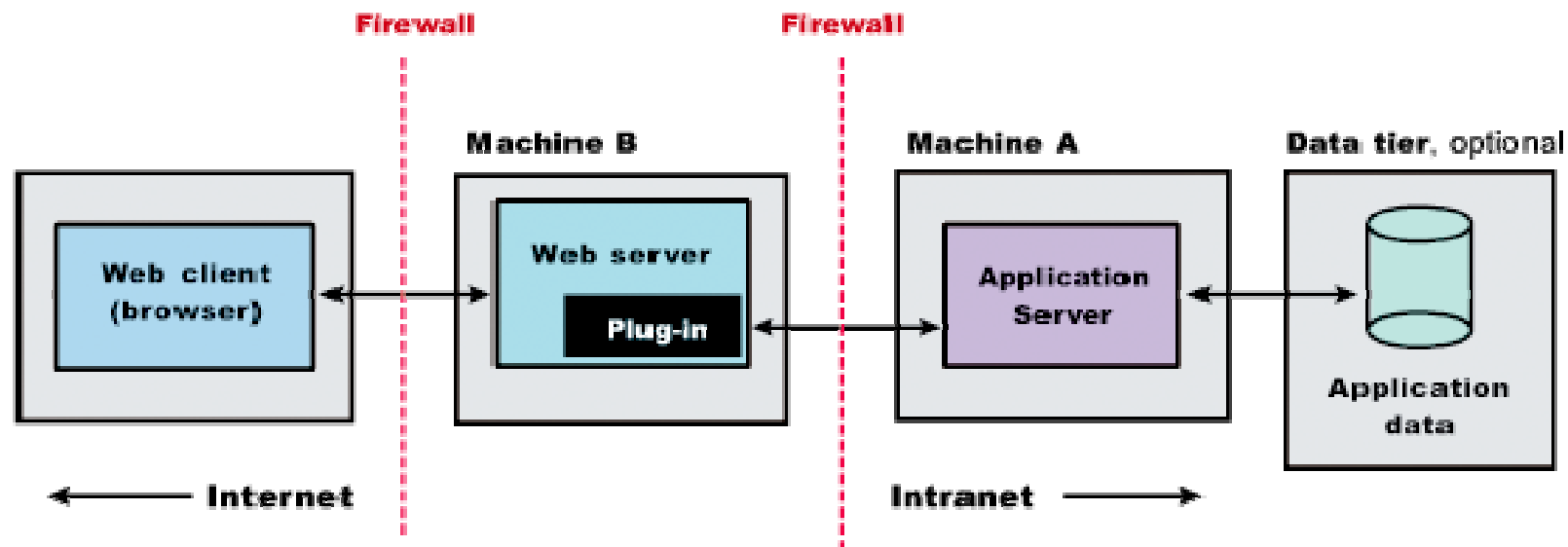
- Server accepts the connection, a socket is successfully created and the client can use the socket to communicate with the server
- The client and server can now communicate by writing to or reading from their sockets



- An endpoint is a combination of an **IP address** and a **port number**. Every TCP connection can be uniquely identified by its two endpoints



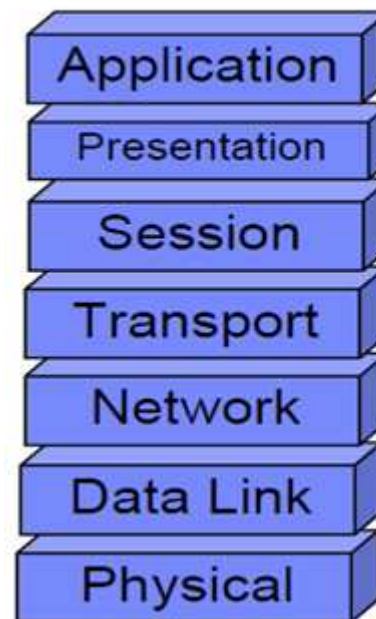
## Common communication pattern in WAS



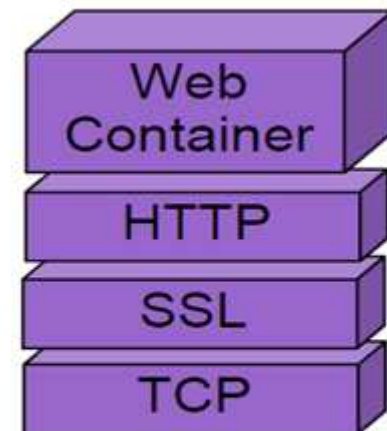
# Channel Framework

- Method for creating and facilitating transports.
- Simplified OSI network stack approach.
- Each layer is a **Channel**.
- Stack of channels is a **Chain**.

OSI Reference Model

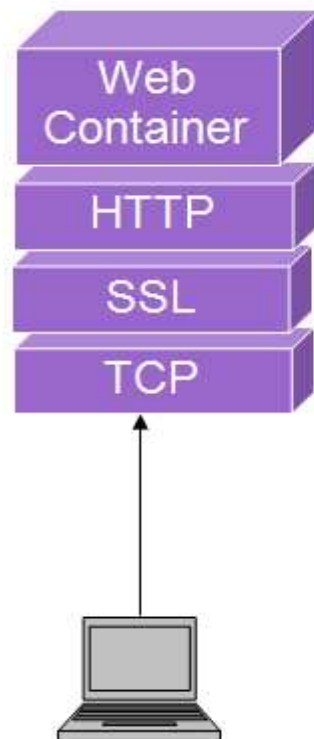


Channel Framework

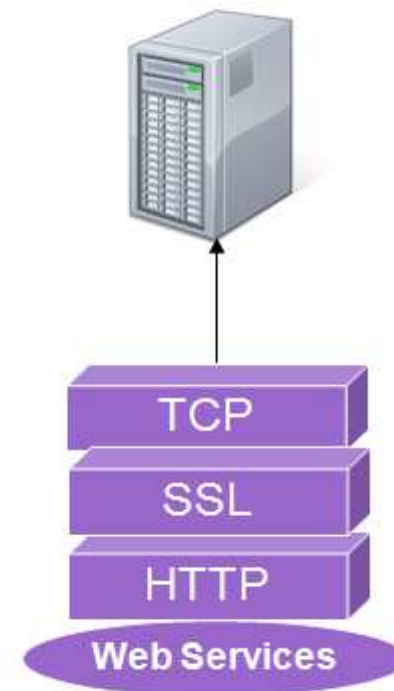


# Inbound vs. Outbound connection

**In bound connection**



**OutBound Connection**



# WebContainer Transport Chain – no SSL

[Application servers](#) > [server1](#) > [Web container transport chains](#) > [WCInboundDefault](#)

Use this page to view and manage a transport chain. Transport chains represent network within a client or server.

Configuration

## General Properties

\* Name

WCInboundDefault

☒ Enabled

## Transport Channels

### • [TCP inbound channel \(TCP\\_2\)](#)

Host	*
Port	9087
Thread pool	WebContainer
Maximum open connections	20000
Inactivity timeout	60 seconds

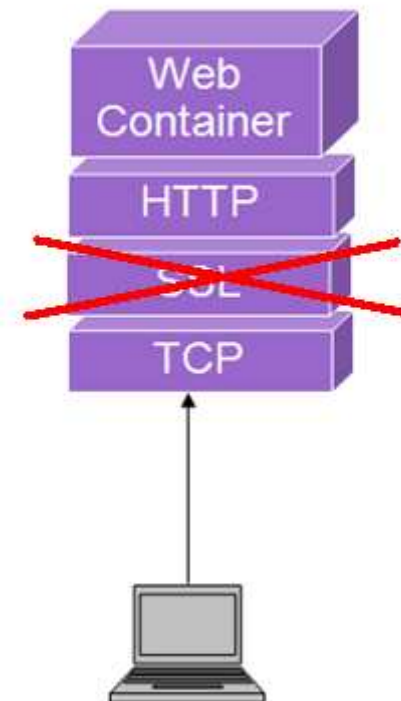
### • [HTTP inbound channel \(HTTP\\_2\)](#)

Use persistent keep alive connections	Enabled
Maximum persistent requests per connection	100
Read timeout	60 seconds
Write timeout	60 seconds
Persistent timeout	30 seconds

### • [Web container inbound channel \(WCC\\_2\)](#)

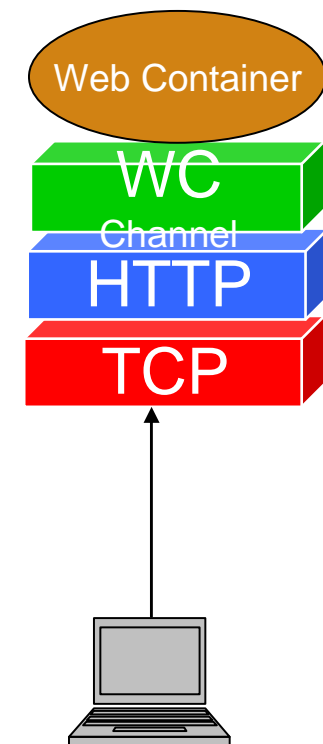
[Apply](#) [OK](#) [Reset](#) [Cancel](#)

In bound connection



# WebContainer Transport Chain – no SSL

```
"WebContainer : 0" J9VMThread:0x4AD73200, j9thread_t:0x4C79F854, java/lang/Thread:0x2364FEF8, state:R, prio=5
at SnoopServlet.doGet(SnoopServlet.java:44)
at javax/servlet/http/HttpServlet.service(HttpServlet.java:718)
at javax/servlet/http/HttpServlet.service(HttpServlet.java:831)
at com/ibm/ws/cache/servlet/ServletWrapper.serviceProxied(ServletWrapper.java:307)
at com/ibm/ws/cache/servlet/CacheHook.handleFragment(CacheHook.java:571)
at com/ibm/ws/cache/servlet/CacheHook.handleServlet(CacheHook.java:247)
at com/ibm/ws/cache/servlet/ServletWrapper.service(ServletWrapper.java:259)
at com/ibm/ws/webcontainer/servlet/ServletWrapper.service(ServletWrapper.java:1583)
at com/ibm/ws/webcontainer/servlet/ServletWrapper.handleRequest(ServletWrapper.java:870)
at com/ibm/ws/webcontainer/servlet/ServletWrapper.handleRequest(ServletWrapper.java:475)
at com/ibm/ws/webcontainer/servlet/ServletWrapperImpl.handleRequest(ServletWrapperImpl.java:175)
at com/ibm/ws/webcontainer/webapp/WebApp.handleRequest(WebApp.java:3799)
at com/ibm/ws/webcontainer/webapp/WebGroup.handleRequest(WebGroup.java:276)
at com/ibm/ws/webcontainer/WebContainer.handleRequest(WebContainer.java:930)
at com/ibm/ws/webcontainer/WSWebContainer.handleRequest(WSWebContainer.java:1583)
at com/ibm/ws/webcontainer/channel/WCChannelLink.ready(WCChannelLink.java:182)
at com/ibm/ws/http/channel/inbound/impl/HttpInboundLink.handleDiscrimination(HttpInboundLink.java:455)
at com/ibm/ws/http/channel/inbound/impl/HttpInboundLink.handleNewInformation(HttpInboundLink.java:384)
at com/ibm/ws/http/channel/inbound/impl/HttpInboundLink.ready(HttpInboundLink.java:272)
at com/ibm/ws/tcp/channel/impl/NewConnectionInitialReadCallback.sendToDiscriminators(NewConnectionInitialReadCallback.java:165)
at com/ibm/ws/tcp/channel/impl/NewConnectionInitialReadCallback.complete(NewConnectionInitialReadCallback.java:165)
at com/ibm/ws/tcp/channel/impl/AioReadCompletionListener.futureCompleted(AioReadCompletionListener.java:165)
at com/ibm/io/async/AbstractAsyncFuture.invokeCallback(AbstractAsyncFuture.java:217)
at com/ibm/io/async/AsyncChannelFuture.fireCompletionActions(AsyncChannelFuture.java:161)
at com/ibm/io/async/AsyncFuture.completed(AsyncFuture.java:138)
at com/ibm/io/async/ResultHandler.complete(ResultHandler.java:204)
at com/ibm/io/async/ResultHandler.runEventProcessingLoop(ResultHandler.java:775)
at com/ibm/io/async/ResultHandler$2.run(ResultHandler.java:905)
at com/ibm/ws/util/ThreadPool$Worker.run(ThreadPool.java:1564)
```



# WebContainer Transport Chain – with SSL

[Application servers](#) > [server1](#) > [Web container transport chains](#) > [WCInboundDefaultSecure](#)

Use this page to view and manage a transport chain. Transport chains represent network protocols within a client or server.

Configuration

## General Properties

\* Name

WCInboundDefaultSecure

☒ Enabled

## Transport Channels

### • [TCP inbound channel \(TCP\\_4\)](#)

Host	*
Port	9450
Thread pool	WebContainer
Maximum open connections	20000
Inactivity timeout	60 seconds

### • [SSL inbound channel \(SSL\\_2\)](#)

SSL configuration (Centrally managed)

### • [HTTP inbound channel \(HTTP\\_4\)](#)

Use persistent keep alive connections	Enabled
Maximum persistent requests per connection	100
Read timeout	60 seconds
Write timeout	60 seconds
Persistent timeout	30 seconds

### • [Web container inbound channel \(WCC\\_4\)](#)

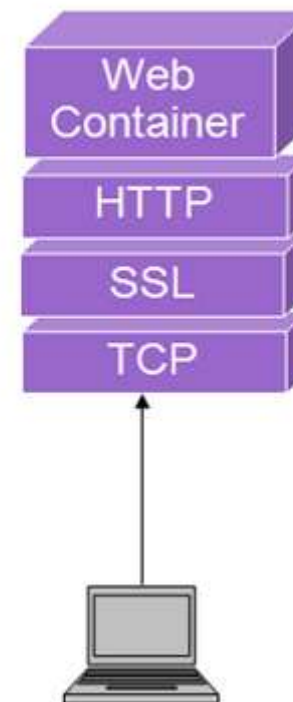
Apply

OK

Reset

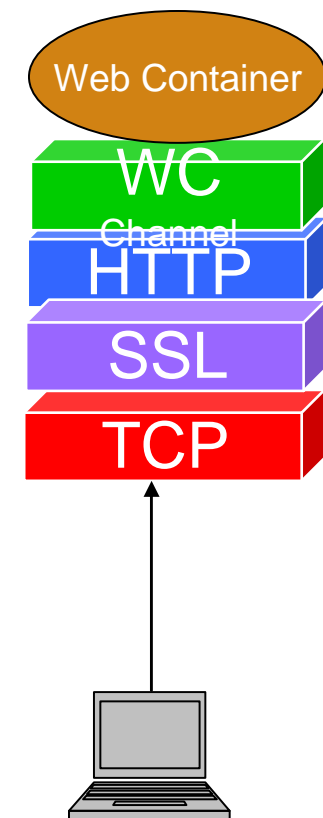
Cancel

## In bound connection



# WebContainer Transport Chain – with SSL

```
"WebContainer : 2" J9VMThread:0x45408D00, j9thread_t:0x457064EC, java/lang/Thread:0x
at SnoopServlet.doGet(SnoopServlet.java:44)
at javax/servlet/http/HttpServlet.service(HttpServlet.java:718)
at javax/servlet/http/HttpServlet.service(HttpServlet.java:831)
at com/ibm/ws/cache/servlet/ServletWrapper.serviceProxied(ServletWrapper.java:307)
at com/ibm/ws/cache/servlet/CacheHook.handleFragment(CacheHook.java:571)
at com/ibm/ws/cache/servlet/CacheHook.handleServlet(CacheHook.java:247)
at com/ibm/ws/cache/servlet/ServletWrapper.service(ServletWrapper.java:259)
at com/ibm/ws/webcontainer/servlet/ServletWrapper.service(ServletWrapper.java:1583)
at com/ibm/ws/webcontainer/servlet/ServletWrapper.handleRequest(ServletWrapper.java:
at com/ibm/ws/webcontainer/servlet/ServletWrapper.handleRequest(ServletWrapper.java:
at com/ibm/ws/webcontainer/servlet/ServletWrapperImpl.handleRequest(ServletWrapperIm
at com/ibm/ws/webcontainer/webapp/WebApp.handleRequest(WebApp.java:3799)
at com/ibm/ws/webcontainer/webapp/WebGroup.handleRequest(WebGroup.java:276)
at com/ibm/ws/webcontainer/WebContainer.handleRequest(WebContainer.java:930)
at com/ibm/ws/webcontainer/WSWebContainer.handleRequest(WSWebContainer.java:1583)
at com/ibm/ws/webcontainer/channel/WCChannelLink.ready(WCChannelLink.java:182)
at com/ibm/ws/http/channel/inbound/impl/HttpInboundLink.handleDiscrimination(HttpInb
at com/ibm/ws/http/channel/inbound/impl/HttpInboundLink.handleNewInformation(HttpInb
at com/ibm/ws/http/channel/inbound/impl/HttpInboundLink.ready(HttpInboundLink.java:2
at com/ibm/ws/ssl/channel/impl/SSLConnectionLink.determineNextChannel(SSLConnectionL
at com/ibm/ws/ssl/channel/impl/SSLConnectionLink.readyInboundPostHandshake(SSLConnec
at com/ibm/ws/ssl/channel/impl/SSLConnectionLink.readyInbound(SSLConnectionLink.java
at com/ibm/ws/ssl/channel/impl/SSLConnectionLink.ready(SSLConnectionLink.java:291)
at com/ibm/ws/tcp/channel/impl/NewConnectionInitialReadCallback.sendToDiscriminators
at com/ibm/ws/tcp/channel/impl/NewConnectionInitialReadCallback.complete(NewConnecti
at com/ibm/ws/tcp/channel/impl/AioReadCompletionListener.futureCompleted(AioReadComp
at com/ibm/io/async/AbstractAsyncFuture.invokeCallback(AbstractAsyncFuture.java:217)
at com/ibm/io/async/AsyncChannelFuture$1.run(AsyncChannelFuture.java:205)
at com/ibm/ws/util/ThreadPool$Worker.run(ThreadPool.java:1564)
```



# TCP inbound Channel

## Messages

Transport Channel TCP\_2 is shared between two or more transport chains. Changes to TCP\_2 will affect multiple network protocol stacks.

[Application servers](#) > [server1](#) > [Web container transport chains](#) > [WCInboundDefault](#) > [TCP inbound channel \(TCP\\_2\)](#)

Use this page to configure a TCP inbound channel for inbound network traffic.

## Configuration

### General Properties

\* Transport channel name

TCP\_2

Port

WC\_defaulthost (\*:9087)

Thread pool

WebContainer

\* Maximum open connections

20000

\* Inactivity timeout

60 seconds

Address exclude list

Address include list

Hostname exclude list

Hostname include list

### Additional Properties

Custom properties

### Related Items

Ports

Thread pools

### General Properties

\* Name

WebContainer

Description

\* Minimum Size

50 threads

\* Maximum Size

50 threads

\* Thread inactivity timeout

60000 milliseconds

☐ Allow thread allocation beyond maximum thread size

## Port Name

☐ Well-known Port

Select Port name

DRS\_CLIENT\_ADDRESS

☒ User-defined Port

Specify Port name

\* Host

\* Port

1

Apply

OK

Reset

Cancel

Apply

OK

Reset

Cancel



# HTTP inbound channel

[Application servers](#) > [server1](#) > [Web container transport chains](#) > [WCInboundDefault](#) > HTTP inbound channel (HTTP\_2)

Use this page to configure a channel for handling inbound HTTP requests from a remote client.

## Configuration

### General Properties

- \* Transport channel name
- Discrimination weight
- \* Read timeout  
 seconds
- \* Write timeout  
 seconds
- \* Persistent timeout  
 seconds

### Additional Properties

- [Custom properties](#)

### Related Items

- [NCSA access and HTTP error logging](#)

# HTTP inbound channel (continue)

[Application servers](#) > [server1](#) > [Web container transport chains](#) > [WCInboundDefault](#) > HTTP inbound channel (HTTP\_2)

Use this page to configure a channel for handling inbound HTTP requests from a remote client.

## Persistent connections

- ☒ Use persistent keep alive connections
- ☐ Unlimited persistent requests per connection
- ☒ Maximum persistent requests per connection
- Maximum persistent requests per connection
- 100

## Denial of service protection

Maximum header field size

32768 bytes

Maximum headers

50

☐ Limit request body buffer size

Maximum request body buffer size

bytes

# HTTP inbound channel (continue)

[Application servers](#) > [server1](#) > [Web container transport chains](#) > [WCInboundDefault](#) > HTTP inbound channel (HTTP\_2)

Use this page to configure a channel for handling inbound HTTP requests from a remote client.

## Logging

☐ Enable logging

### ☒ NCSA Access logging

☒ Use global logging service

Enable access logging: true

Access log file path: \${SERVER\_LOG\_ROOT}/http\_access.log

Access log maximum size: 500

Maximum number of historical files: 1

NCSA access log format : Common

☐ Use chain-specific logging

☒ Enable access logging

\* Access log file path

Access log maximum size

MB

Maximum number of historical files

\* NCSA access log format

Common

### ☒ Error logging

## Logging

☐ Enable logging

### ☒ NCSA Access logging

☐ Use global logging service

Enable access logging: true

Access log file path: \${SERVER\_LOG\_ROOT}/http\_access.log

Access log maximum size: 500

Maximum number of historical files: 1

NCSA access log format : Common

☒ Use chain-specific logging

☒ Enable access logging

\* Access log file path

Access log maximum size

MB

Maximum number of historical files

\* NCSA access log format

Common

### ☒ Error logging

# NCSA access logging

- Example of NCSA access logging: NCSA access log format “combined”

host rfc931 username date:time request statuscode bytes referrer user\_agent cookie

```
9.27.162.163 - - [13/Aug/2012:09:48:03 -0400] "GET /snoop HTTP/1.1" 200 9568 - "Mozilla/5.0 (Windows NT 5.1)
AppleWebKit/537.1 (KHTML, like Gecko) Chrome/21.0.1180.75 Safari/537.1" -
9.27.162.163 - - [13/Aug/2012:09:48:04 -0400] "GET /favicon.ico HTTP/1.1" 404 130 - "Mozilla/5.0 (Windows NT 5.1)
AppleWebKit/537.1 (KHTML, like Gecko) Chrome/21.0.1180.75 Safari/537.1" -
127.0.0.1 - - [13/Aug/2012:10:03:47 -0400] "GET /hitcount?selection=SS2 HTTP/1.1" 200 2226
"http://localhost:9087/hitcount?selection=SS2" "Mozilla/4.0 (compatible; MSIE 8.0; Windows NT 5.1; Trident/4.0; .NET CLR
2.0.50727; .NET CLR 3.0.4506.2152; InfoPath.2; .NET CLR 3.5.30729; MS-RTC LM 8)"
"JSESSIONID=00006jRYkgqyMV064n3oBIY5e7X:-1"
```

9.27.162.163 : Client IP address

Username : As request is not authenticated .. Username is is “-”

13/Aug/2012:09:48:03 -0400 : Time stamp of request

GET /snoop HTTP/1.1 : Request URL

200 : Response code

bytes : Response bytes ..

Mozilla/5.0 (Windows NT 5.1) AppleWebKit/537.1 (KHTML, like Gecko) Chrome/21.0.1180.75 Safari/537.1 : Client browser

JSESSIONID=00006jRYkgqyMV064n3oBIY5e7X:-1 : JsessionID info came with request

## NCSA access logging-NEW 7.0.0.25 – 8.0.0.2

- New feature introduced starting 7.0.0.25 and 8.0.0.2 to enhance access logging.
- New customer property “accessLogFormat” has been added which allows more customization with access logging. Now same features as access logging at web server side.
- The value for this property is a space separated list of options e.g. %h %i %u %t "%r" %s %b
- Available options are:
  - %a : Remote IP address
  - %A : Local IP address
  - %b : Response size in bytes excluding headers
  - %B : Response size in bytes excluding headers
  - %{CookieName}C or %C: The request cookie specified within the brackets, or all if not specified
  - %D : The elapsed time of the request - millisecond accuracy, microsecond precision
  - %h : Remote host
  - %i or %{HeaderName}i : HeaderName header value from the request
  - %m : Request method
  - %o or %{HeaderName}o : HeaderName header value from the response
  - %q : Output the query string with any password escaped
  - %r : First line of the request
  - %s : Status code of the response
  - %t : NCSA format of the start time of the request
  - %u : Remote user according to the WebSphere Application Server specific \$WSRU header
  - %U : URL Path, not including the query string
- [http://www14.software.ibm.com/webapp/wsbroker/redirect?version=matt&product=was-base-dist&topic=rrun\\_chain\\_httpcustom](http://www14.software.ibm.com/webapp/wsbroker/redirect?version=matt&product=was-base-dist&topic=rrun_chain_httpcustom)

# Http error logging

- Example of Http error logging: Error logging level "Debug"

[Mon, 13 Aug 2012 13:48:03 GMT] [INFO] [9.27.162.163:2265/9.27.162.35:9087] Received new connection  
[Mon, 13 Aug 2012 13:48:03 GMT] [DEBUG] [9.27.162.163:2265/9.27.162.35:9087] Starting to parse the message  
[Mon, 13 Aug 2012 13:48:03 GMT] [DEBUG] [9.27.162.163:2265/9.27.162.35:9087] Connection persistence updated to true  
[Mon, 13 Aug 2012 13:48:03 GMT] [DEBUG] [9.27.162.163:2265/9.27.162.35:9087] Finished parsing the message  
[Mon, 13 Aug 2012 13:48:03 GMT] [DEBUG] [9.27.162.163:2265/9.27.162.35:9087] Connection persistence updated to true  
[Mon, 13 Aug 2012 13:48:03 GMT] [DEBUG] [9.27.162.163:2265/9.27.162.35:9087] Sending headers to client  
[Mon, 13 Aug 2012 13:48:03 GMT] [DEBUG] [9.27.162.163:2265/9.27.162.35:9087] Reading for another request  
[Mon, 13 Aug 2012 13:48:04 GMT] [DEBUG] [9.27.162.163:2265/9.27.162.35:9087] Starting to parse the message  
[Mon, 13 Aug 2012 13:48:04 GMT] [DEBUG] [9.27.162.163:2265/9.27.162.35:9087] Connection persistence updated to true  
[Mon, 13 Aug 2012 13:48:04 GMT] [DEBUG] [9.27.162.163:2265/9.27.162.35:9087] Finished parsing the message  
[Mon, 13 Aug 2012 13:48:04 GMT] [DEBUG] [9.27.162.163:2265/9.27.162.35:9087] Sending headers to client  
[Mon, 13 Aug 2012 13:48:04 GMT] [INFO] [9.27.162.163:2265/9.27.162.35:9087] Closing connection to client  
[Mon, 13 Aug 2012 14:03:46 GMT] [INFO] [127.0.0.1:3082/127.0.0.1:9087] Received new connection  
[Mon, 13 Aug 2012 14:03:46 GMT] [DEBUG] [127.0.0.1:3082/127.0.0.1:9087] Starting to parse the message  
[Mon, 13 Aug 2012 14:03:47 GMT] [DEBUG] [127.0.0.1:3082/127.0.0.1:9087] Connection persistence updated to true  
[Mon, 13 Aug 2012 14:03:47 GMT] [DEBUG] [127.0.0.1:3082/127.0.0.1:9087] Finished parsing the message  
[Mon, 13 Aug 2012 14:03:47 GMT] [DEBUG] [127.0.0.1:3082/127.0.0.1:9087] Connection persistence updated to true  
[Mon, 13 Aug 2012 14:03:47 GMT] [DEBUG] [127.0.0.1:3082/127.0.0.1:9087] Sending headers to client  
[Mon, 13 Aug 2012 14:03:47 GMT] [DEBUG] [127.0.0.1:3082/127.0.0.1:9087] Reading for another request  
[Mon, 13 Aug 2012 14:04:19 GMT] [INFO] [127.0.0.1:3082/127.0.0.1:9087] Closing connection to client

9.27.162.163:2265 : Client IP and Port

9.27.162.35:9087 : Server IP and port

Received new connection : Starting new connection

Sending headers to client : Sending response

Reading for another request : Waiting for another request on persistent connection

Closing connection to client : Closing connection after persistent time out

# Web Container inbound channel

[Application servers](#) > [server1](#) > [Web container transport chains](#) > [WCInboundDefault](#) > **Web container inbound channel (WCC\_2)**

Use this page to view and configure an HTTP inbound channel. This type of transport channel handles inbound messages for servlets and JSP engines.

Configuration

## General Properties

\* Transport channel name

WCC\_2

Discrimination weight

10

\* Write buffer size

32768

bytes

Apply

OK

Reset

Cancel

## Additional Properties

■ [Custom properties](#)

# SSL inbound channel

[Application servers](#) > [server1](#) > [Web container transport chains](#) > [WCInboundDefaultSecure](#) > **SSL inbound channel (SSL\_2)**

Use this page to view and configure a channel for handling the encryption and decryption of data over inbound connections.

Configuration

### General Properties

\* Transport channel name  
SSL\_2

Discrimination weight  
1

### SSL Configuration

☒ Centrally managed  
☐ Specific to this endpoint

Select SSL Configuration  
CellDefaultSSLSettings


Apply OK Reset Cancel

### Additional Properties

[Custom properties](#)

### Related Items

[SSL configuration - cell level](#)  
[View centrally managed SSL tree](#)



### SSL Configuration

☐ Centrally managed  
☒ Specific to this endpoint

Select SSL Configuration

- CellDefaultSSLSettings
- CellDefaultSSLSettings
- NodeDefaultSSLSettings



## Summary

- OSI model used to divide network communication into functional “layers”
- From a WAS perspective, the Network (TCP/IP) and Application (HTTP) layers are by far the most important
- The Network layer communicates through sockets on specific ports
- Stack of channels are called chains
- Inbound chains are used by webcontainer to receive request and send response back.
- Channels in inbound chains are fully configurable as all levels

# Additional WebSphere Product Resources

- Learn about upcoming WebSphere Support Technical Exchange webcasts, and access previously recorded presentations at:  
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<http://www.websphereusergroup.org>
- Access key product show-me demos and tutorials by visiting IBM® Education Assistant:  
<http://www.ibm.com/software/info/education/assistant>
- View a webcast replay with step-by-step instructions for using the Service Request (SR) tool for submitting problems electronically:  
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- Sign up to receive weekly technical My Notifications emails:  
<http://www.ibm.com/software/support/einfo.html>



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