Cisco WAAS Express

General

Q. What is Cisco® Wide Area Application Services (WAAS) Express?

A. Cisco WAAS Express extends the Cisco WAAS product portfolio with a small-footprint, cost-effective solution that offers bandwidth optimization and application acceleration capabilities. It is based on Cisco IOS® Software and integrated into the Cisco Integrated Services Router Generation 2 (ISR G2) platform.

Cisco WAAS Express is an innovative Cisco IOS Software feature that optimizes TCP traffic flows across the WAN to provide a better application experience to branch-office users. Cisco WAAS Express builds on the success of the Cisco WAAS Appliance and Software; however, unlike Cisco WAAS on a Cisco Wide Area Virtualization Engine (WAVE) appliance, virtual appliance, or Cisco Services-Ready Engine (SRE) Module, Cisco WAAS Express requires no additional hardware.

Note that there are several differences between Cisco WAAS Express and the Cisco WAVE deployment model. Cisco WAAS Express requires no additional hardware because it uses the router's CPU and memory for optimization. Also, Cisco WAAS Express provides selected acceleration for file services and HTTP/S web applications, whereas the Cisco WAVE method has comprehensive application optimizers for several named applications.

Q. What technologies does Cisco WAAS Express use to optimize traffic?

A. Cisco WAAS Express optimizes WAN bandwidth using these technologies:

- Transport flow optimization (TFO): TFO typically represents three activities: TCP optimization, TFO negotiation, and data framing. TCP optimization is performed using binary increase congestion control (BIC) TCP and selective acknowledgements (SACKs).

- Data redundancy elimination (DRE): DRE inspects TCP traffic and identifies patterns within the message. After patterns have been identified, redundant patterns can be safely replaced by small signatures, thus reducing bandwidth consumption significantly. In Cisco WAAS Express, DRE is performed completely in router memory; thus, maximum DRAM is required in every platform.

- Lempel-Ziv (LZ) compression: LZ compression is a standards-based compression mechanism that can be used to further decrease the amount of bandwidth consumed by a TCP flow. LZ compression can be used in conjunction with DRE or independently.

- Optimization for SSL applications: The SSL Express Accelerator feature integrates transparently with existing data center key management and trust models that both WAN optimization and application acceleration components can use. Encryption key pairs are stored securely in a secure vault on the Cisco WAAS Central Manager and distributed securely to the Cisco WAAS devices in the data center to be stored in a secure vault. This feature allows Cisco WAAS Express to securely apply optimization to connections previously encrypted by SSL/TLS.

- Enhanced bandwidth optimization for file services and web applications: The Common Internet File System (CIFS) Accelerator feature provides selected acceleration for file-based CIFS (with Server Message Block Version 1 [SMBv1]) applications and HTTP/S web applications. The CIFS Express Accelerator feature includes write optimizations, read-ahead optimizations, and negative caching. The HTTP/S Express Accelerator feature caches metadata information, which allows Cisco WAAS Express to respond locally to certain HTTP requests. These local responses are based on cached metadata from previously seen server responses and are continuously updated. The accelerator also includes hints to help DRE perform better optimization and offload compression from the web servers.

Q. Does Cisco WAAS Express have application optimizers for specific applications?

A. Cisco WAAS Express has selected optimization only for file services and web applications, called express accelerators, whereas Cisco WAAS deployed on Cisco WAVE appliances, virtual appliances, or Cisco SRE Modules provides comprehensive application optimization support.

Q. What applications can take advantage of Cisco WAAS Express?

A. Technically, any application that uses TCP as its underlying transport can benefit from Cisco WAAS Express. However, much will depend on the redundant elements in the application's transactions and the WAN bandwidth conditions. The more redundancy, the greater the benefit that the application will receive from Cisco WAAS Express. Typical applications that benefit include HTTP, FTP, and mail applications.

Q. What compression ratios can I get on my traffic?

A. Compression ratios vary by the compressibility of the traffic. However, in lab tests, compression ratios of greater than 2:1 have been achieved.

Q. What platforms support Cisco WAAS Express?

A. Cisco WAAS Express is supported only on the Cisco ISR G2 routers (Cisco 880 and 890 platforms, Cisco 1921 and 1941, and Cisco 2900 and 3900 Series). Additionally, Cisco WAAS Express requires these platforms to have the maximum DRAM per platform installed.

Q. Is Cisco WAAS Express supported on the Cisco 1800, 2800, and 3800 Series ISRs?

A. No. The first-generation Cisco ISRs do not have the CPU and DRAM needed to support Cisco WAAS Express.

Q. Does Cisco WAAS Express introduce any new hardware?

A. No. Cisco WAAS Express is purely a software feature; however, it requires the maximum DRAM to be installed in the platform.

Q. Why do I need to upgrade DRAM in my routers to support Cisco WAAS Express?

A. Cisco WAAS Express stores the DRE cache in DRAM. When you configure the feature, Cisco WAAS Express verifies that the maximum DRAM is present; if it is not, the configuration will fail.

Q. How do I purchase Cisco WAAS Express?

A. Cisco WAAS Express is provided through a Cisco IOS Software feature license. The license can be purchased individually as a PAK or preinstalled on the router by ordering a Cisco WAAS Express bundle.

Q. What are the part numbers for Cisco WAAS Express?

A. Following are the Cisco WAAS Express part numbers:

FL-C880-WAASX

FL-C890-WAASX

FL-C1941-WAASX

FL-C2901-WAASX

FL-C2911-WAASX

FL-C2921-WAASX

FL-C2951-WAASX

FL-C3900-WAASX

Q. What bundles are available for Cisco WAAS Express?

A. Cisco WAAS Express offers two types of bundles: Cisco WAAS and Secure Cisco WAAS bundles. The Cisco WAAS bundles offer hardware and the Cisco WAAS Express Feature license, and maximum memory is built into the bundle. The Secure Cisco WAAS bundles offer hardware and the Cisco WAAS Express Feature license and Security Feature license, and maximum memory is built into the bundle. Table 1 lists the part numbers.

Table 1. Cisco WAAS Express Bundle Ordering Information

Cisco Router Platform	Cisco WAAS Only Bundles	Secure Cisco WAAS Bundles
Cisco 1941	C1941-WAASX/K9	C1941-WAASX-SEC/K9
Cisco 2901	C2901-WAASX/K9	C2901-WAASX-SEC/K9
Cisco 2911	C2911-WAASX/K9	C2911-WAASX-SEC/K9
Cisco 2921	C2921-WAASX/K9	C2921-WAASX-SEC/K9
Cisco 2951	C2951-WAASX/K9	C2951-WAASX-SEC/K9
Cisco 3925	C3925-WAASX/K9	C3925-WAASX-SEC/K9
Cisco 3945	C3945-WAASX/K9	C3945-WAASX-SEC/K9

Q. Is there an evaluation license for Cisco WAAS Express so I can see if it helps me?

A. Yes. Maximum memory is required to turn on the evaluation license for 60 days.

Solution Integration

Q. Is Cisco WAAS Express part of the Cisco WAAS product line?

A. Cisco WAAS Express is part of the Cisco WAAS portfolio. Cisco WAAS Express offers WAN optimization capability requiring no additional hardware components. The Cisco WAAS Appliance provides bandwidth optimization and application acceleration.

Q. What are the differences in functions between Cisco WAAS and Cisco WAAS Express?

A. Cisco WAAS Express primarily offers Layer 4 transport optimization capability, which provides bandwidth optimization. Primary features include TFO, compression, DRE, and selected bandwidth optimization for file services and web applications. In addition to these features, Cisco WAAS offers comprehensive application acceleration, virtualization capabilities, and video delivery optimization.

Q. Does Cisco WAAS Express require a headend?

A. Yes. Cisco WAAS Express requires a Cisco Wide Area Application Engine (WAE) running Cisco WAAS 4.2.1 or later as the headend.

Q. Can I use another Cisco WAAS Express router as a headend?

A. No. A router enabled for Cisco WAAS Express cannot be used as a headend. However, two routers using Cisco WAAS Express can forward optimized traffic to each other. Traffic between two routers will be optimized using only TFO and Lempel-Ziv-Stac (LZS) compression.

Q. What version of Cisco WAAS is supported with Cisco WAAS Express?

A. Cisco WAAS Express requires Cisco WAAS 4.2 or later. Previous versions are not supported. Cisco WAAS Express 2.0 in Cisco IOS Software Release 15.2(3)T requires Cisco WAAS 4.4.3c or later.

Q. Can I manage Cisco WAAS Express with my Cisco WAAS Central Manager?

A. Yes. Management is available through the Cisco WAAS Central Manager as well as the command-line interface (CLI).

Q. How does Cisco WAAS Express identify the headend?

A. Cisco WAAS Express has a feature called autodiscovery that allows it to automatically discover other Cisco WAAS devices on the network and accept connections from them.

Configuration

Q. How do I configure Cisco WAAS Express on my router?

A. Cisco WAAS Express is designed to be configured with a single command. In interface configuration mode, simply enter the command waas enable and save your configuration.

Q. What interfaces are supported by Cisco WAAS Express?

A. Cisco WAAS Express supports all interfaces supported by Cisco IOS Software. Cisco WAAS Express can be enabled directly on the main interface, subinterfaces, and logical interfaces such as dialer, virtual-template, and tunnel interfaces. However, Cisco WAAS Express should be enabled only on interfaces designated as WAN interfaces.

Q. Can I tune the default policy?

A. The default policy has been created to meet the needs of most common environments. It can be modified using the Cisco Common Classification Policy Language (C3PL). The Cisco WAAS Express default policy is generated when Cisco WAAS Express is enabled for the first time and is named **waas_default**. Use the **show policy-map type waas** command to view the default policy and the **show class-map type waas** command to view default classifiers (class map).

Q. Why do I get an error message "% no waas enable failed: There are active flows being optimized by Cisco WAAS. Please use forced option to disable Cisco WAAS" when I try to remove Cisco WAAS Express from an interface using the no waas enable configuration command?

A. This error occurs because active flows are being tracked by Cisco WAAS Express. Use the n**o waas enable force** configuration command to remove Cisco WAAS Express from an interface. If the **no waas enable force** command is run on the last interface that has Cisco WAAS Express enabled, all active flows will be reset.

Q. How do I remove the default Cisco WAAS Express policy and class map after I disable Cisco WAAS Express from all interfaces?

A. By default, after you disable Cisco WAAS Express on all interfaces, the default class maps and policy generated by Cisco WAAS Express are not automatically removed. Use the **waasconfig remove-all** command to remove all the default class maps and policy.

Q. What are the similarities between the Cisco WAAS default policy and Cisco WAAS Express default policy?

A. The Cisco WAAS Express default policy deployed on the router is exactly the same as the Cisco WAAS default policy, with the exception of application optimization-specific policies that are not part of Cisco WAAS Express.

Q. Does Cisco WAAS Express require me to configure Web Cache Communication Protocol (WCCP) or Policy-Based Routing (PBR)?

A. No. Cisco WAAS Express is an inline implementation using TCP redirect. It does not require WCCP or PBR to forward the packets.

Interoperability

Q. Does Cisco WAAS Express affect other Cisco IOS Software features?

A. Cisco WAAS Express should interoperate with most Cisco IOS Software features, except as described here. However, because Cisco WAAS Express uses the router CPU to optimize the traffic, it will probably affect the performance of other CPU-heavy applications. Cisco WAAS Express interoperability testing was specifically focused on quality of service (QoS), zone-based firewall, Network Address Translation (NAT), IP Security (IPsec), and Flexible NetFlow.

Q. How do access control lists (ACLs) affect Cisco WAAS Express?

A. The effect of ACLs depends greatly on the placement of the WAN interface on which Cisco WAAS Express is enabled and the placement of the ACLS, as well as on the direction of the ACLs. ACLs applied on the same interface as Cisco WAAS Express in an outbound manner process the traffic before Cisco WAAS Express, and therefore process preoptimized traffic. ACLs applied inbound on the same interface process traffic before Cisco WAAS Express, and therefore process optimized traffic. An ACL placed on a LAN interface, or any other nonoptimized interface, processes the traffic normally.

Q. Will Cisco WAAS Express function with my voice features enabled?

A. Yes. Cisco WAAS Express will function with voice features enabled. Please refer to sizing guidelines for more information about Cisco WAAS Express capabilities with voice.

Q. Are any Cisco IOS Software features not recommended for use with Cisco WAAS Express?

A. Because Cisco WAAS Express changes TCP values in the traffic streams, Cisco IOS Software features that rely on those values are not supported with Cisco WAAS Express. These features include Flexible Packet Matching (FPM) and Cisco Performance Routing (Pfr). Cisco Network-Based Application Recognition (NBAR) can be used if it is enabled on a LAN interface.

Performance

Q. What is the performance of Cisco WAAS Express?

A. Cisco WAAS Express primarily provides bandwidth optimization. Cisco WAAS Express performance is measured in terms of the number of users and maximum number of optimized TCP connections. The recommended number of users is based on 10 TCP connections per user. Table 2 shows the maximum number of optimized TCP connections with multiple features turned on simultaneously, such as VPN, firewall, and NAT. The table also shows the maximum WAN bandwidth sizing recommendations when choosing a Cisco ISR G2 router for Cisco WAAS Express.

Table 2.   Recommendations for Best Performance

Cisco Router Platform	Recommended Number of Users	TCP Connections	Maximum WAN Bandwidth Supported
Cisco 880 platform	7-10	75	1.5 Mbps
Cisco 890 platform	7-10	75	2 Mbps
Cisco 1921[*]	5	50	0.512 Mbps
Cisco 1941	15	150	4 Mbps
Cisco 2901	15	150	6 Mbps
Cisco 2911	20	200	6 Mbps
Cisco 2921	20	200	6 Mbps
Cisco 2951	20	200	6 Mbps
Cisco 3925	40	400	10 Mbps
Cisco 3945	40	400	10 Mbps

[*] Cisco 1921 routers have fixed, nonexpandable memory. DRE is disabled on these platforms.

Q. What if I exceed the recommended bandwidth?

A. Since Cisco WAAS Express uses the router's CPU, overdriving the bandwidth could overdrive the router CPU. Thus, Cisco WAAS Express has a back-off algorithm to release CPU cycles after the router CPU exceeds 80 percent utilization. At this point, Cisco WAAS Express will begin to slow down the rate at which traffic is sent, which will result in lower CPU consumption. A high CPU alarm will be raised, which can be viewed by entering the **show waas alarm** command. An informational log message will also be generated:

```
Aug 12 11:43:02.705 MDT: %WAAS-6-WAAS_INFRA_THROTTLE_ON: IOS-WAAS has started
throttling connections due to high CPU utilization
```

When Cisco WAAS Express determines that the CPU has fallen below the threshold, it stops throttling and generates another information log message:

```
Aug 12 11:44:29.847 MDT: %WAAS-6-WAAS_INFRA_THROTTLE_OFF: IOS-WAAS has stopped
throttling connections
```

Q. Can I adjust the CPU threshold?

A. Yes. The CPU threshold is an adjustable parameter. The default setting is 80 percent. To adjust this value, configure **cpu-threshold** under **parameter-map type waaswaas_global**:

```
Router(config)#parameter-map type waaswaas_global
Router(config-profile)#cpu-threshold?
<0-100>Set the Maximum CPU threshold
```

Monitoring and Troubleshooting

Q. How do I know whether Cisco WAAS Express is active and processing traffic?

A. Enter the command **show waas status** to display the interface on which Cisco WAAS Express inspects traffic, the status of the license, the number of active connections, and the maximum number of connections supported by the platform:

```
Router#show waas status
WAAS Enabled Interface Policy Map
Serial0/2/0 waas_global
WAAS Feature License
License Type: Permanent
Maximum Flows : 200
Total Active connections : 10
Total optimized connections : 10
```

Q. How do I know when my evaluation license will expire?

A. Enter the command **show license detail Cisco WAAS_Express** to see the status of the Cisco WAAS Express license and the duration for which the license is valid. In the output shown here, **Evaluation period left** shows the duration that Cisco WAAS Express can operate before the license expires. Note that only the time when Cisco WAAS Express is active on the interface is counted against the evaluation license duration:

```
Router#show license detail WAAS_Express
Feature: WAAS_Express Period left: 15 hours 54 minutes
Index: 1 Feature: WAAS_Express Version: 1.0
License Type: Evaluation
License State: Active, In Use, EULA accepted
Evaluation total period: 60 days 0 hour
Evaluation period left: 15 hours 54 minutes
License Count: Non-Counted
License Priority: Low
Store Index: 2
Store Name: Primary License Storage
```

Q. What will happen to my optimized TCP connections when the Cisco WAAS Express license expires?

A. After the license expires, Cisco WAAS Express will be disabled on all interfaces, and all optimized TCP connections will be reset.

Q. How do I monitor optimized and pass-through connections on a Cisco WAAS Express router?

A. For optimized TCP connections, use the **show waas connection** command. Unlike Cisco WAAS, Cisco WAAS Express currently does not keep track of pass-through TCP connections, to save memory on the router. Cisco WAAS Express provides a counter for all the pass-through conditions, which can be displayed by entering **show waas statistics pass-through**:

```
Router#show waas connection
ConnID Source IP:PortDestIP:PortPeerIDAccel
98 192.168.11.99 :45882 192.168.31.99 :80 0016.9d38.ca1d TLD
Router#show waas statistics pass-through
Pass Through Statistics:
Overall: 1
```

```
No Peer: 0
Rejected due to Capabilities: 0
Rejected due to Resources: 0
Interface Application config: 0
Interface Global config: 1
Asymmetric setup: 0
Peer sync was in progress: 0
IOS WAAS is intermediate router: 0
Internal error: 0
Other end is in black list: 0
AD version mismatch: 0
Incompatable AO: 0
Connection limit exceeded: 0
AOIM peertable full: 0
Others: 0
```

Note that existing connections before Cisco WAAS Express is enabled are not tracked by Cisco WAAS Express.

Q. I have QoS on my WAN interface. After enabling Cisco WAAS Express, my QoS counter seems incorrect. What do I do?

A. For optimized flows, the class-map counter in the QoS policy map may differ from the action counter. This difference occurs because the class-map counter counts preoptimized traffic. Please rely on the action counter to see the true traffic placed on the WAN link:

```
Service-policy output: police_egress
Class-map: police (match-any)
13642 packets, 12885261 bytes <- Class-map counter shows pre-optimized traffic
which does not reflect the true traffic sent on the WAN.
30 second offered rate 2117000 bps, drop rate 0 bps
Match: access-group 100
13642 packets, 12885261 bytes
30 second rate 2117000 bps
Match: access-group 101
0 packets, 0 bytes
30 second rate 0 bps
police: <- Action counter shows optimized traffic sent on the WAN.
rate 1500000 bps, burst 46875 bytes
conformed 6093 packets, 1681509 bytes; actions:
set-dscp-transmit 11
exceeded 40 packets, 59075 bytes; actions:
set-dscp-transmit af12
conformed 287000 bps, exceed 7000 bps
Class-map: class-default (match-any)
45 packets, 2006 bytes
30 second offered rate 0 bps, drop rate 0 bps
Match: any
```

For More Information

For more information on WAAS, please go to http://www.cisco.com/go/waas.

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