Video-on-Demand Prepositioning with Cisco Wide Area Application Services

What You Will Learn

Providing high-quality streaming video on demand (VoD) to personnel in remote offices over a WAN can consume considerable bandwidth and degrade total office productivity when the transfer occurs during prime work hours. The problem is compounded when multiple people attempt to stream VoD files at the same time. Cisco® Wide Area Application Services (WAAS) can mitigate high bandwidth use with generic acceleration provided by Cisco WAAS Transport Flow Optimization (TFO) and Data Redundancy Elimination (DRE). Further acceleration can be achieved by prepositioning the high-quality VoD files on the remote Cisco WAAS devices. This document describes the use case and savings achieved.

Video-on-Demand Delivery

VoD can provide precise information at just the right time, when the viewer is ready and willing to receive the material and able to use it immediately. However, VoD files, especially high-quality multimedia presentations, typically consume large amounts of bandwidth as they are streamed from the source to the consumer. File sizes in the gigabyte range are not uncommon for robust VoD files. Moving these data streams from the source streaming server to the consumer over a WAN can consume significant resources, typically during prime working hours when that bandwidth could be more productively employed. Further, high-quality and high-bandwidth streaming VoD can require more physical bandwidth than is available in some small offices, making VoD playback quality poor as packets are dropped or delayed and bandwidth-starved streams attempt to keep the playback buffer full.

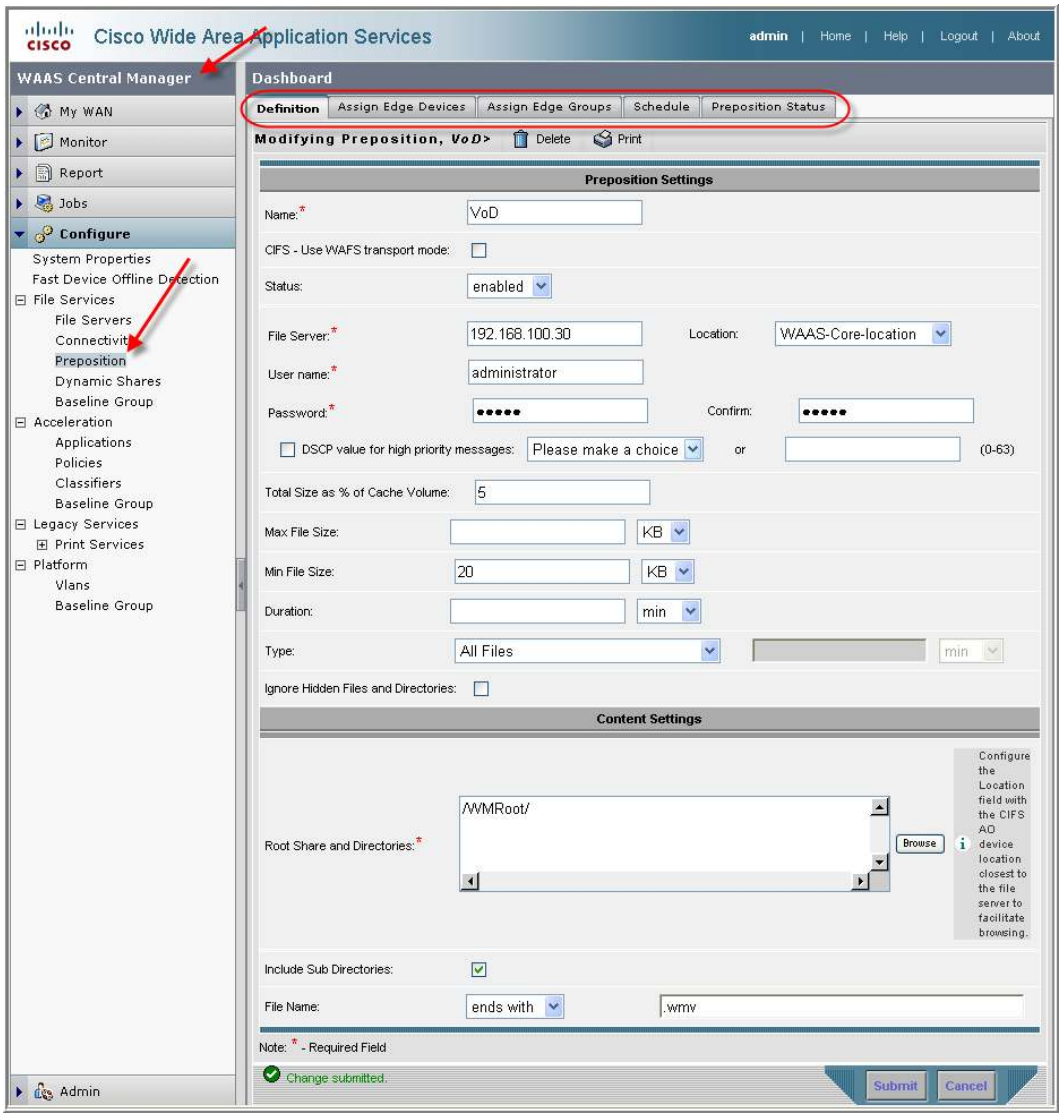
Cisco Wide Area Application Services (WAAS) can mitigate the high bandwidth usage with generic acceleration provided by Transport Flow Optimization (TFO) and Data Redundancy Elimination (DRE). TFO manages and optimizes the WAN network connection on both sides of the WAN ensuring that the available bandwidth is fully and optimally utilized. DRE removes redundant byte patterns typically found in a VoD stream, minimizing the amount of data that traverses the WAN. Replay of the VoD by the same or different end user takes advantage of the warm DRE cache so that a minimal amount of data is required to cross the WAN. Additional acceleration can be achieved by “pre-warming” the DRE cache ahead of anticipated requests for the VoD stream.

Prepositioning Video-on-Demand

Without employing a fully deployed and managed content distribution network (CDN), Cisco WAAS can provide a significant reduction in cross-WAN traffic by using the Common Internet File System (CIFS) file prepositioning capability and off-peak bandwidth to pre-warm the DRE cache in anticipation of a subsequent TCP request for the streaming data. Since the DRE cache is protocol agnostic, prepositioning with CIFS prepares the DRE cache for subsequent requests regardless of the requesting protocol used to stream the VoD file from the origin streaming server.

Cisco WAAS Software Release 4.1 introduced the new CIFS Application Optimizer, which simplifies configuration and enables transparent network integration. Configuring a prepositioning job is a simple task of defining the source file server on which the files are located, the edge Cisco WAAS devices to receive the files, and the schedule for running the preposition job. This configuration can be accomplished on the Cisco WAAS Central Manager, as shown in Figure 1.

Figure 1. Cisco WAAS CIFS Preposition Task Definition



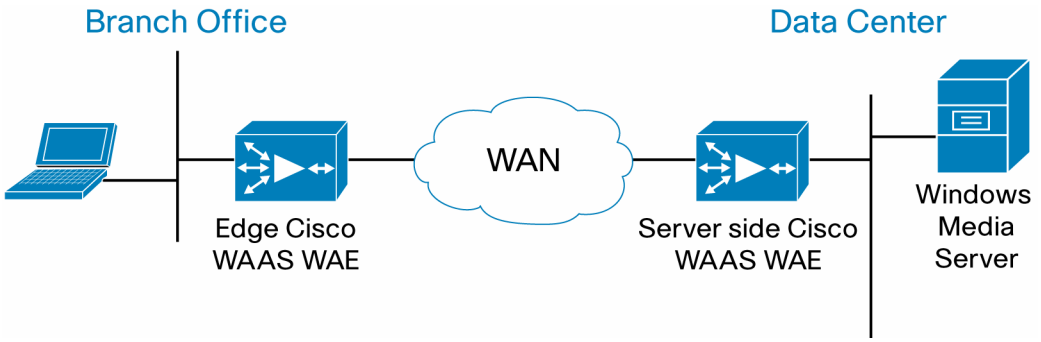
This preposition task prepositions all files on the Windows Media Server at 192.168.100.30 in the default Windows Media publishing root directory (/WMRoot/) ending with .wmv that are greater than 20 KB in size. After you define the preposition task, using either the Assign Edge Devices or Assign Edge Groups tab at the top, you must then assign Cisco WAAS devices to the task to receive the prepositioned files. You then use the Schedule tab to specify the frequency with which the origin server is scanned for changes in VoD files.

For a detailed description on how to set up a VoD preposition job, see the section “Configuring Cisco WAAS Prepositioning” in the document Deploying Cisco Wide Area Application Services and Digital Media Systems for Video Acceleration.

Baseline Testing

With a warm DRE cache, you can expect significant reduction in the amount of data traversing the WAN. To test the results, a lab environment was set up using a Windows Media Server, a server-side Cisco WAAS Wide Area Application Engine (WAE) Appliance, an edge Cisco WAAS WAE, and a Windows Media Player running on a laptop computer (Figure 2).

Figure 2. Test Lab



If realistic timings are desired, a WAN emulator should be configured with the appropriate throttles. The test described here did not use timings, instead focusing on bandwidth savings.

For the baseline test, we will clear the DRE cache and all statistics on the edge Cisco WAE and then play a video. When the video is complete, we will capture the DRE statistics.

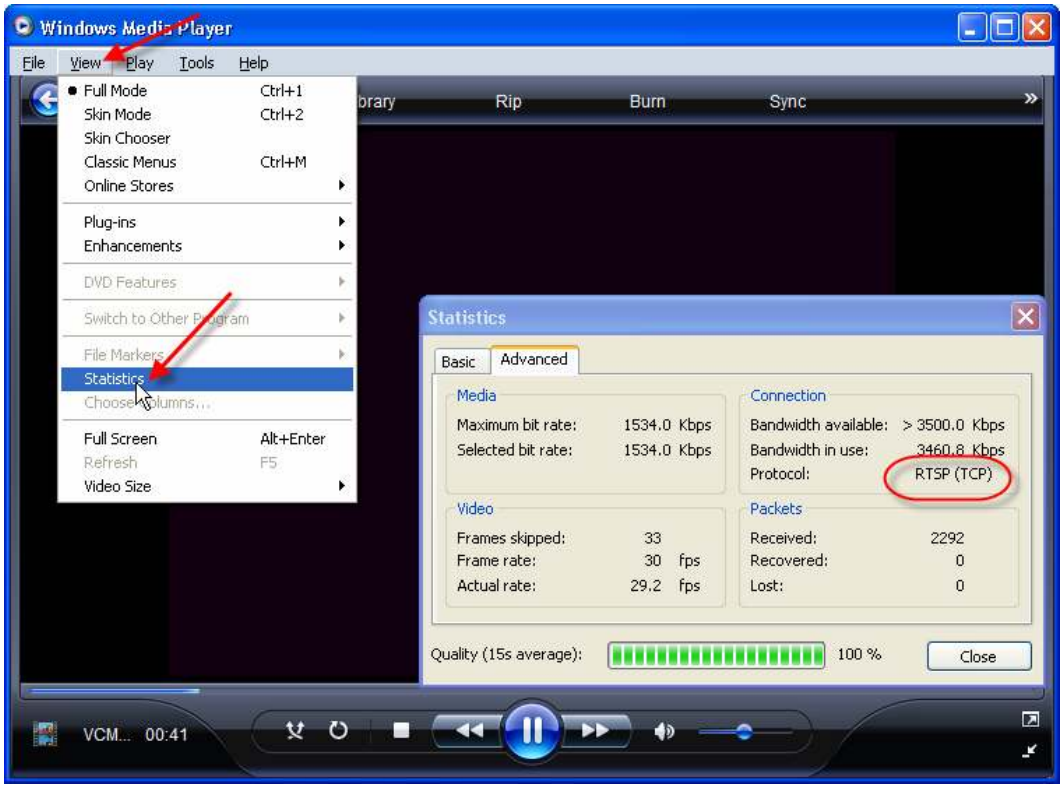
1. Log on to the edge WAAS WAE command-line interface (CLI) and clear the DRE cache and all statistics.

```
WAAS-Edge# clear cache dre
TFO application needs to be restarted (all existing
connections will be reset, alarms may be raised and system may reboot
if required).
Do you want to Continue? [yes/no]yes
Restarting processes
Clearing DRE cache
Done. No reboot was required.
WAAS-Edge# show statistics dre

Cache:
    Status: Usable, Oldest Data (age): 0s
    Total usable disk size:  25100 MB,  Used: 0.00%
      Hash table RAM  size:    100 MB,  Used: 0.00%
WAAS-Edge# clear statistics all
WAAS-Edge# show statistics connection all
WAAS-Edge#
```

2. Play the video and verify that the stream is a TCP stream. For this example, the URL we will play is rtsp://192.168.100.30/VCM2007b.wmv. This file is a 4-minute Windows Media VoD streaming at 1.5 Mbps. The file size is 52.7 MB.

3. From the Windows Media Player menu, choose **View > Statistics** and then select the Advanced tab.



Note: The protocol is Real Time Streaming Protocol (RTSP) and TCP: RTSP(TCP). TCP is the default protocol selected in modern versions of Windows Media Player when Fast Cache is enabled on the Windows Media Server. If the protocol is not TCP, Cisco WAAS will not be able to intercept the stream request. When the protocol changes from RTSP(TCP) to Cache, the file download is complete, and the stream will continue playing from the local cache.

4. On to the edge Cisco WAAS WAE CLI, display the connection statistics and the DRE statistics.

```
WAAS-Edge#show statistics connection optimized

D:DRE,L:LZ,T:TCP Optimization,
C:CIFS,E:EPM,G:GENERIC,H:HTTP,M:MAPI,N:NFS,V:VIDEO

ConnID  Source IP:Port        Dest IP:Port          PeerID
Accel
328     192.168.200.101:2345  192.168.100.30:554    0:14:5e:95:23:c7
TDLG
WAAS-Edge#show statistics dre

Cache:
    Status: Usable, Oldest Data (age): 3m40s
    Total usable disk size:  25100 MB,  Used: 0.22%
      Hash table RAM  size:    100 MB,  Used: 0.00%

Connections:   Total (cumulative): 53   Active: 1
```

```
Encode:
   Overall: msg: 12, in: 6471 B, out: 2073 B, ratio: 67.96%
       DRE: msg: 11, in: 6171 B, out: 6282 B, ratio: 0.00%
DRE Bypass: msg: 1, in: 300 B
        LZ: msg: 12, in: 6727 B, out: 2073 B, ratio: 69.18%
 LZ Bypass: msg: 0, in: 0 B
    Avg latency: 0.206 ms    Delayed msg: 0
  Encode th-put: 2556 KB/s
  Message size distribution:
   0-1K=0%  1K-5K=0%  5K-15K=0%  15K-25K=0%  25K-40K=0%  >40K=0%
Decode:
   Overall: msg: 4218, in: 53325 KB, out: 52774 KB, ratio: 0.00%
       DRE: msg: 4218, in: 53329 KB, out: 52774 KB, ratio: 0.00%
DRE Bypass: msg: 0, in: 0 B
        LZ: msg: 944, in: 2864 KB, out: 2868 KB, ratio: 0.13%
 LZ Bypass: msg: 3274, in: 50460 KB
    Avg latency: 0.267 ms
  Decode th-put: 46775 KB/s
  Message size distribution:
   0-1K=2%  1K-5K=20%  5K-15K=42%  15K-25K=22%  25K-40K=12%  >40K=0%
   WAAS-Edge#
```

Note: The optimized connection with destination port 554 and the DRE decoding statistics showing 0 percent, indicating that there were no repeating byte patterns.

5. Clear the browser cache to remove the cached video from the local machine. For Internet Explorer, choose **Tools > Internet Options** from the menu. In the Temporary Internet Files section on the General tab, click Delete Files, select “Delete all offline content,” and then click OK.
6. On to the edge Cisco WAAS WAE CLI, clear the statistics.

```
WAAS-Edge# clear statistics all
WAAS-Edge# show statistics dre

Cache:
    Status: Usable, Oldest Data (age): 17m48s
    Total usable disk size:  25100 MB,  Used: 0.23%
      Hash table RAM  size:    100 MB,  Used: 0.00%
WAAS-Edge#
```

7. Play the video again.
8. On to the edge Cisco WAAS WAE CLI, again display the DRE statistics.

```
WAAS-Edge# show statistics dre

Cache:
    Status: Usable, Oldest Data (age): 23m7s
    Total usable disk size:  25100 MB,  Used: 0.24%
      Hash table RAM  size:    100 MB,  Used: 0.00%

Connections:   Total (cumulative): 49   Active: 1
```

```
Encode:
   Overall: msg: 11, in: 6168 B, out: 1580 B, ratio: 74.38%
       DRE: msg: 11, in: 6168 B, out: 4771 B, ratio: 22.65%
DRE Bypass: msg: 0, in: 0 B
        LZ: msg: 11, in: 4771 B, out: 1580 B, ratio: 66.88%
 LZ Bypass: msg: 0, in: 0 B
    Avg latency: 0.190 ms Delayed msg: 0
  Encode th-put: 2879 KB/s
  Message size distribution:
   0-1K=0%  1K-5K=0%  5K-15K=0%  15K-25K=0%  25K-40K=0%  >40K=0%
Decode:
   Overall: msg: 4259, in: 3244 KB, out: 52774 KB, ratio: 93.85%
       DRE: msg: 4259, in: 3277 KB, out: 52774 KB, ratio: 93.79%
DRE Bypass: msg: 0, in: 0 B
        LZ: msg: 3177, in: 2976 KB, out: 3009 KB, ratio: 1.09%
 LZ Bypass: msg: 1082, in: 268 KB
    Avg latency: 0.218 ms
  Decode th-put: 56807 KB/s
  Message size distribution:
   0-1K=2%  1K-5K=20%  5K-15K=42%  15K-25K=22%  25K-40K=11%  >40K=0%
   WAAS-Edge#
```

Note: The decode compression ratio of 93.85 percent. The 52,774-KB VoD stream was delivered to the media player, but only 3244 KB traversed the WAN.

CIFS AO Prepositioning

The baseline testing described in the preceding section demonstrates the power of a warm DRE cache when delivering VoD. However, for the initial test, little or no acceleration occurred, and if the transfer had occurred during peak business hours, that bandwidth requirement could infringe on the bandwidth needs of more business-critical applications. To address this concern, the VoD files can be prepositioned during off -peak hours using the CIFS Application Optimizer and a preposition job. Even though the VoD files will not be accessed as CIFS files, transferring the VoD files using CIFS will populate the DRE cache in the same manner as the initial baseline test.

This document does not detail the steps required to set up a CIFS Application Optimizer preposition job. For a detailed description of how to set up a VoD preposition job, see the section "Configuring Cisco WAAS Prepositioning" in the document Deploying Cisco Wide Area Application Services and Digital Media Systems for Video Acceleration.

For this test, we will preposition the video file on the edge Cisco WAAS device. When creating the Cisco WAAS CIFS preposition job, you should limit the number of files transferred by entering a specific filename in the preposition job definition.

1. Log on to the edge Cisco WAAS WAE CLI and clear the DRE cache and all statistics.

```
WAAS-Edge# clear cache dre
TFO application needs to be restarted (all existing
connections will be reset, alarms may be raised and system may reboot
if required).
Do you want to Continue? [yes/no]yes
Restarting processes
```

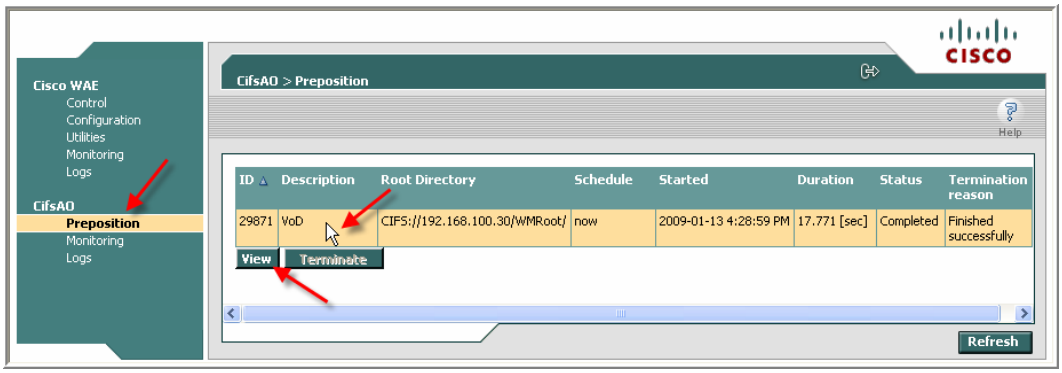
```
Clearing DRE cache
Done. No reboot was required.
WAAS-Edge# show statistics dre

Cache:
    Status: Usable, Oldest Data (age): 0s
    Total usable disk size:  25100 MB,  Used: 0.00%
      Hash table RAM  size:    100 MB,  Used: 0.00%
WAAS-Edge# clear statistics all
WAAS-Edge# show statistics connection all
WAAS-Edge#
```

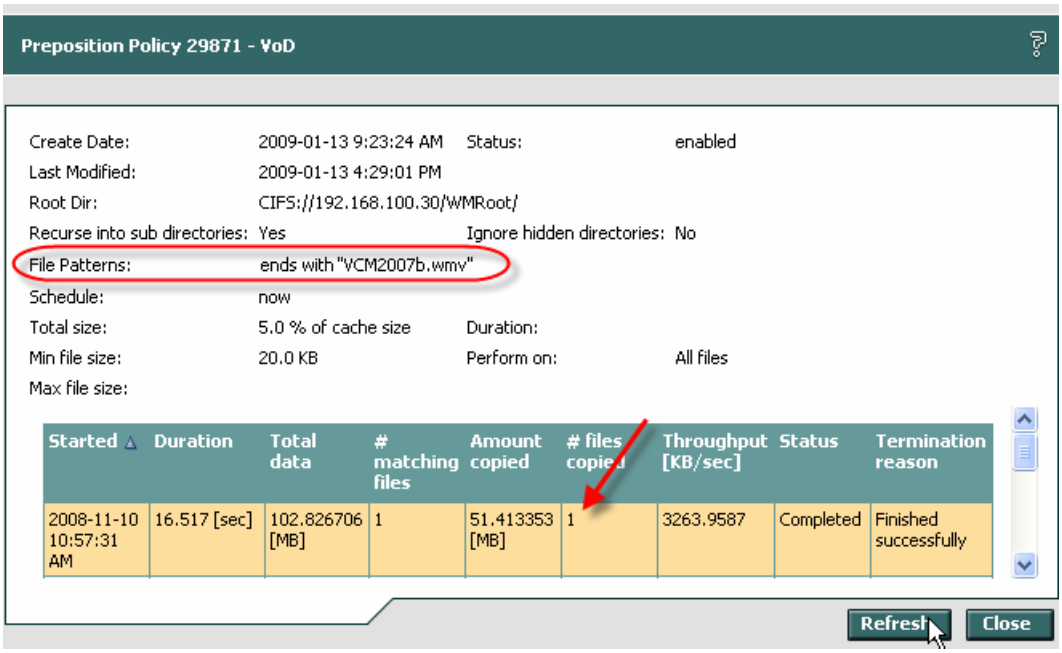
2. Set up and run the preposition job to preposition the selected VoD on the edge Cisco WAE device.

   The Cisco WAAS device CLI does not provide any way to query the preposition job status and verify that the preposition job has completed or that the VoD is indeed located in the CIFS cache on the Cisco WAE. The Cisco WAAS WAE GUI (as opposed to the Cisco WAAS Central Manager GUI) can be used to infer that the file is present on the edge Cisco WAAS WAE.

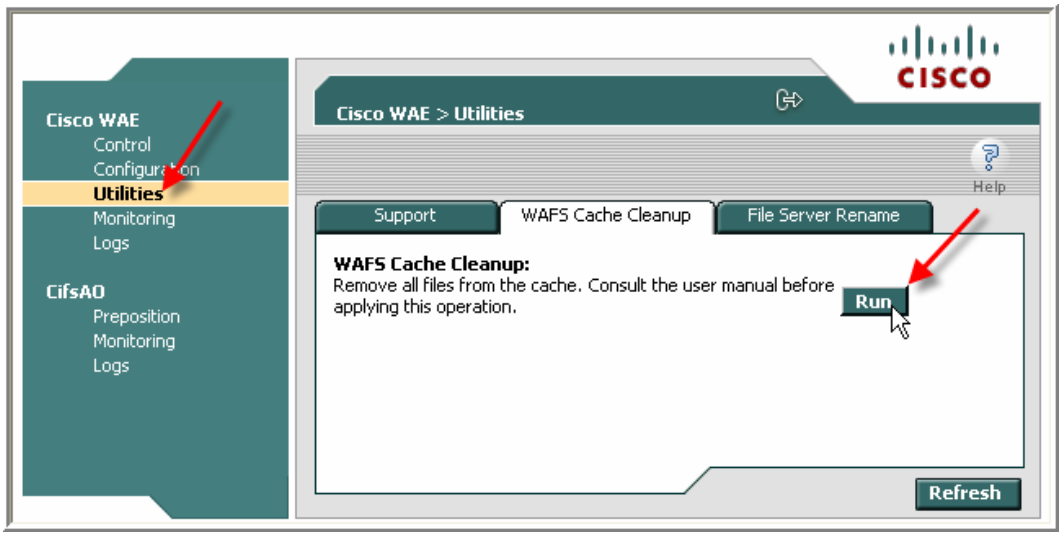
3. Open a browser window and enter the edge Cisco WAAS WAE device GUI URL (https://<your_wae_IP_or_fqdn>:8443).
4. Log in to the device GUI. In the menu at the left, under CifsAO, select Preposition.
5. Click the Refresh button until the job status is Completed.
6. Click the row containing the completed job and then click View.



For this particular preposition job, the file pattern was set to specify a single file, VCM2007b.wmv. This single file was successfully copied.



Note: To clear all prepositioned files from the edge Cisco WAE, on the Cisco WAE menu, click Utilities and then click the WAFS Cache Cleanup tab. Click Run. This will remove all prepositioned files from the Cisco WAE and allow the preposition job to be repeated with successful results. This procedure does not, however, clear the DRE cache. The command to do that must be entered from the device CLI.



7. When the VoD has been successfully prepositioned, delete all temporary internet file to remove the VoD from the local cache; clear the DRE statistics on the edge Cisco WAAS WAE CLI and then play the video again.
8. On to the edge Cisco WAAS WAE CLI, again display the DRE statistics.

```
WAAS-Edge# show statistics dre

Cache:
    Status: Usable, Oldest Data (age): 7h
    Total usable disk size:  25100 MB,  Used: 0.25%
```

```
      Hash table RAM  size:    100 MB,  Used: 0.00%
WAAS-Edge#sho stat dre

Cache:
    Status: Usable, Oldest Data (age): 7h
    Total usable disk size:  25100 MB,  Used: 0.25%
      Hash table RAM  size:    100 MB,  Used: 0.00%

Connections:   Total (cumulative): 3   Active: 1

Encode:
   Overall: msg: 11, in: 6159 B, out: 1527 B, ratio: 75.21%
       DRE: msg: 11, in: 6159 B, out: 4693 B, ratio: 23.80%
DRE Bypass: msg: 0, in: 0 B
        LZ: msg: 11, in: 4693 B, out: 1527 B, ratio: 67.46%
 LZ Bypass: msg: 0, in: 0 B
    Avg latency: 0.182 ms Delayed msg: 0
  Encode th-put: 3010 KB/s
  Message size distribution:
   0-1K=0%  1K-5K=0%  5K-15K=0%  15K-25K=0%  25K-40K=0%  >40K=0%
Decode:
   Overall: msg: 4252, in: 3233 KB, out: 52774 KB, ratio: 93.87%
       DRE: msg: 4252, in: 3266 KB, out: 52774 KB, ratio: 93.81%
DRE Bypass: msg: 0, in: 0 B
        LZ: msg: 3167, in: 2970 KB, out: 3003 KB, ratio: 1.10%
 LZ Bypass: msg: 1085, in: 263 KB
    Avg latency: 0.227 ms
  Decode th-put: 54574 KB/s
  Message size distribution:
   0-1K=2%  1K-5K=20%  5K-15K=42%  15K-25K=22%  25K-40K=11%  >40K=0%
   WAAS-Edge#
```

Note: Again the decode compression ratio of 93.87 percent. The 52,774-KB VoD stream was delivered to the media player, but only 3233 KB traversed the WAN.

Conclusion

Without incurring the cost and complexity of a fully deployed and managed CDN, Cisco WAAS can significantly reduce cross-WAN traffic by using the CIFS file prepositioning capability and off-peak bandwidth to pre-warm the DRE cache.

For More Information

For more information please visit http://www.cisco.com/go/waas.

Americas Headquarters
Cisco Systems, Inc.
San Jose, CA

Asia Pacific Headquarters
Cisco Systems (USA) Pte. Ltd.
Singapore

Europe Headquarters
Cisco Systems International BV
Amsterdam, The Netherlands

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