Agenda

• Enterprise Application Delivery Challenges
• Introducing Cisco Wide Area Application Services
• Network Integration and Deployment
• In-Depth Examination of Optimizations
• Management and WAE Platforms
• Summary
• Q&A
Reality of the Extended Enterprise

Where are the users?

> 87% of users across the extended enterprise

< 13% of users at HQ

Enterprise Application Delivery Breakdown

Poor performance
Limited visibility
Security vulnerabilities

Source: Cisco IAR Speaker Series
Typical Application Environment Today

Majority of Users are Remote

- Multiple applications
- Distributed users – partner, supplier
- Complex application environments
- Security and data management concerns

Enterprise Applications

E-mail Servers

Legacy Application Servers

DATA CENTER

WAN, VPN, Internet

HTTP, HTTPS

Enterprise Applications

E-mail Servers

Legacy Application Servers

DATA CENTER

Majority of Users are Remote

- Branch Office User
- Home/Road User

- Multiple applications
- Distributed users – partner, supplier
- Complex application environments
- Security and data management concerns
I/T’s Application Delivery Problem

- Increasingly distributed workforce drives need for distribution of I/T resources to remote locations
  - Enable productivity
  - Drive revenue and profits

- Data protection, availability, compliance, and management drives need for consolidation
  - Fewer devices to manage
  - Fewer points to protect
The WAN Is A Barrier To Consolidation

• Applications are designed for LAN environments
  - High bandwidth
  - Low latency
  - Reliability

• WAN characteristics hinder consolidation
  - Already congested
  - Low bandwidth
  - Latency
  - Packet Loss
Bandwidth

• Bandwidth constraints keep applications from performing well
• Too much data and too small of a pipe causes congestion, packet loss, and backpressure
Packet Loss, Congestion, and Retransmission

- Packet loss and congestion cause retransmission which hinders application performance and throughput
- Commonly caused by saturated device transmit queues in the network path
Latency

- Latency impairs application performance in three ways:
  - **Network latency** – the amount of time necessary for a message to traverse the network
  - **Transport latency** – the amount of time necessary for the transport mechanism (TCP) to acknowledge and retransmit data
  - **Application latency** – “chattiness” of an application protocol causing messages to be exchanged across the network

Round Trip Time (RTT) ~ many many milliseconds
Need for Application-Specific Acceleration

- Many application protocols can not be adequately optimized through simple compression and transport optimizations alone.
- Application protocols are commonly developed in “utopian” environments, i.e. the client and the server are on the same LAN or very close to one another.
- Application-induced or protocol-induced latency and unnecessary data transfers hinder overall end-user performance.
Need for Application-Specific Acceleration

• The result is that hundreds upon thousands of messages must traverse the network before any usable data is served or function is completed!
Need for Application-Specific Acceleration

- In this simple example of a 1MB Word document open, over 1000 messages are exchanged.

- With a 40mS RTT WAN, this equates to over 52 seconds of “wait” time before the document is usable!
Branch Office IT Issues

- **Application performance**
  - Bandwidth & throughput limitations
  - Latency and packet loss
  - End user experience

- **Infrastructure cost / complexity**
  - File, print and email servers
  - Storage and backup
  - WAN bandwidth

- **Data protection**
  - Failing backups / lost data
  - Costly off-site vaulting
  - Compliance

Companies spend 6 Billion dollars per year on branch servers, storage, backup and management
Source: IDC, Gartner, Cisco Analysis

The average branch has 4-6 servers
Source: Nemertes Research
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Cisco Vision: the Consolidated Branch

Current Branch

Consolidated Branch

Design Goals:

• Fewer local servers / no storage + backup
• Continued LAN-level application performance
• Ability to leverage centralized applications
• Preserve services of existing network
Cisco WAAS Overcomes the WAN

• Cisco WAAS is a solution that leverages a hardware footprint (WAE) in the remote office and in the data center to overcome application performance problems in WAN environments
Cisco WAAS Enables Consolidation

• Cisco Wide Area Application Services (WAAS)
  - Transparent integration
  - Robust optimizations
  - Auto discovery

• Infrastructure Consolidation
  - Remove costly servers
  - Centralize data protection
  - Save WAN resources

• Application Acceleration
  - Application adapters
  - Advanced compression
  - Throughput optimizations
  - Policy-based configuration
### WAAS Accelerates Broad Range of Applications

<table>
<thead>
<tr>
<th>Application</th>
<th>Protocol</th>
<th>Typical Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>File Sharing</td>
<td>Windows (CIFS)</td>
<td>2X-100X</td>
</tr>
<tr>
<td>Email</td>
<td>Exchange (MAPI)</td>
<td>2X-50X</td>
</tr>
<tr>
<td></td>
<td>SMTP/POP3, IMAP</td>
<td></td>
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<tr>
<td></td>
<td>Notes</td>
<td></td>
</tr>
<tr>
<td>Internet and Intranet</td>
<td>HTTP</td>
<td>2X-50X</td>
</tr>
<tr>
<td>Data Transfer</td>
<td>FTP</td>
<td>2X-50X</td>
</tr>
<tr>
<td>Software Distribution</td>
<td>SMS</td>
<td>2X-100X</td>
</tr>
<tr>
<td></td>
<td>Altiris</td>
<td></td>
</tr>
<tr>
<td>Database Applications</td>
<td>SQL</td>
<td>2X-10X</td>
</tr>
<tr>
<td></td>
<td>Oracle</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Notes</td>
<td></td>
</tr>
<tr>
<td>Data Protection</td>
<td>Backup Applications</td>
<td>2X-10X</td>
</tr>
<tr>
<td></td>
<td>Replication Applications</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>Any TCP-based Application</td>
<td>2X-10X</td>
</tr>
</tbody>
</table>

* Performance improvement varies based on user workload, compressibility of data, and WAN characteristics and utilization. Actual numbers are case-specific and results may vary.
[Remote] User Experience: LAN-Like Access to Various Applications

### File Services
- **Save 5-MB PowerPoint**
  - Operation Over Native WAN: 20 Sec
  - Operation with WAAS: 20 Sec
- **Download of 8MB MS SMS Package**
  - Operation Over Native WAN: 40 Sec
  - Operation with WAAS: 40 Sec

### SharePoint
- **Open 500KB Word Doc**
  - Operation Over Native WAN: 15 Sec
  - Operation with WAAS: 15 Sec
- **Save 1MB Word Doc**
  - Operation Over Native WAN: 30 Sec
  - Operation with WAAS: 30 Sec

### Mail - Exchange
- **Native**
  - Bandwidth Consumed: 25%
- **WAAS - Exchange 2003**
  - Bandwidth Consumed: 25%
- **WAAS - Exchange 2000**
  - Bandwidth Consumed: 25%

### Data Protection
- **SnapMirror Op of 1GB; T3/80**
  - Operation Over Native WAN: 51 Min
  - Operation with WAAS: 51 Min
- **Backup Op of 83MB; T1/80**
  - Operation Over Native WAN: 22 Min
  - Operation with WAAS: 22 Min
- **Restore Op of 83MB; T1/80**
  - Operation Over Native WAN: 23 Min
  - Operation with WAAS: 23 Min

**[Network Link—T1, 80ms Latency]**

Red bars represent Operation Over Native WAN, and blue bars represent Operation with WAAS.
Cisco WAAS Optimization Architecture

- L7: Application Optimization
  - Video
  - Web
  - Enterprise Apps
  - Email
  - File Services
  - Local Services
  - Other Apps

- L4: Transport Optimization
  - Content Distribution
  - TCP Flow Optimizations (TFO)
  - Persistent Session-Based Compression
  - Data Redundancy Elimination (DRE)

- Network Infrastructure
  - Application Classification and Policy Engine
  - Logical and Physical Integration
  - Security
  - Monitoring
  - Quality of Service
  - Core Routing & Switching Services
Cisco Wide Area Application Services provides the industry’s most innovative and robust file services optimizations:

- Application protocol proxy (CIFS) to handle protocol message workload at the edge to mitigate the impact of latency
- Application data and meta data cache to serve usable content at the edge to mitigate unnecessary data transfers when safe
- Network compression (DRE, LZ) to minimize bandwidth usage during data transfer scenarios (read or write)
- TCP optimizations (TFO) to improve utilization of the available network capacity
WAAS File Services Introduction

- Intelligent local handling and optimization of protocol mitigates latency
- File caching to remove the need to unnecessarily transfer files, validation ensures stale data is never served
- Transparent integration ensures no client or server changes to apply optimization

- Sessions maintained end-to-end ensures no security reconfiguration
- Auditing, access-control, and quotas are fully preserved
- Scheduled preposition to prepopulate DRE and edge data cache

- Advanced WAN optimization layer improves throughput and efficiency
- Data Redundancy Elimination (DRE) eliminates redundant network data
- TCP optimizations to improve protocol ability to fully utilize network

- Disconnected mode of operation allows R/O access to fully-cached content when the server is unreachable
WAAS File Services Introduction

Centralized and Optimized

Decentralized and Spaggreed
Intelligent Message Suppression

- **IMS provides latency reduction**
  - Eliminate unnecessary message transfer and minimize WAN RTTs
  - Batch composite commands
  - Message prediction and pre-fetch

- **File performance optimizations**
  - Read-ahead caching during file access to increase read cache hits
  - Asynchronous write-behind caching when safe, synchronous write-behind to ensure file integrity
Data Caching and Integrity

• Edge file segment caching and meta data caching
  Data cached on-demand as files or directories are opened
  Prepopulation of edge cache via CDN-like preposition

• Coherency, concurrency, and ACL
  Cache validation guarantees no stale data served
  File locking and AAA handled synchronously with server
CIFS Integration with WAN Optimization

• File services adapter leverage WAN optimization capabilities provided by DRE, TFO, and LZ
  
  DRE and LZ improves open and save operation performance through compression and data suppression
  
  TFO enables the protocol to more effectively, efficiently utilize available WAN resources
Intelligent File Preposition

- Intelligent preposition capabilities with flexible configuration to prepopulate cache with files before the first user request
- Leverage Data Redundancy Elimination (DRE) and LZ compression to improve transfer performance and user save performance
Cisco WAAS can be configured to prevent specific types of files from being stored on the data center file server or NAS device.

- Prevent non-desirable file types from consuming precious WAN resources, improve productivity.
Cisco WAAS Print Services

• Centrally Managed Print Services
  Print driver distribution
  Client driver download repository
  Status and health reporting

• Supports Any Printer
  Full feature compatibility
  Job control and status monitoring
  Guest and disconnected printing

• Print Server Configuration
  Network parameters (IP, name, etc)
  Queue definition and ACLs
Cisco WAAS Print Services

• Many organizations have difficulty consolidating file services because of the WAN burden that would be created due to print services traffic

• Cisco WAAS provides Windows-compatible print services to eliminate the need for print jobs to traverse the WAN
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Seamless, Transparent Integration

- **Integration into the network fabric with high availability, load-balancing, and failover regardless of interception mechanism**
  - Physical inline
  - WCCPv2
  - Policy-Based Routing
  - CSM/ACE Modules
- **Compliance with network value-added features**
  - Preservation of packet headers
  - Classification - QoS, NBAR, Queuing, Policing, Shaping
  - Security - Firewall policies, Access Control Lists
  - Reporting - NetFlow, monitoring
Cisco WAE Physical Inline Deployment

• Physical inline interception
  - Physical in-path deployment between switch and router or firewall
  - Mechanical fail-to-wire upon hardware, software, or power failure
  - Requires no router configuration

• Scalability and high availability
  - Two two-port groups
  - Serial clustering with load-sharing and fail-over
  - Redundant network paths and asymmetric routing

• Seamless integration
  - Transparency and automatic discovery
  - 802.1q support, configurable VLANs
  - Supported on all WAE appliances
Cisco WAE WCCPv2 Deployment

- **WCCPv2 interception**
  
  Out-of-path with redirection of flows to be optimized (all flows or selective via redirect-list)

  Automatic load-balancing, load redistribution, fail-over, and fail-through operation

- **Scalability and high availability**

  Up to 32 WAEs within a service group and up to 32 routers

  Linear performance and scalability increase as devices are added

- **Seamless integration**

  Transparency and automatic discovery

  Supported on all WAE platforms
Cisco WAE PBR Deployment

- **Policy-Based Routing (PBR)**
  - Out-of-path with redirection of flows to be optimized (all flows or selective via access-list)
  - WAE treated as a next-hop router
- **High availability**
  - Failover capability allows a secondary WAE to be used should the primary WAE fail
  - IP SLAs ensure availability by tracking WAE liveliness
- **Seamless integration**
  - Transparency and automatic discovery
  - Supported on all WAE platforms
Cisco WAE ACE Deployment

• Application Control Engine (ACE)
  Industry-leading scalability and performance for the most demanding data center networks
  Supports up to 16Gbps throughput, 4M concurrent TCP connections, and 350K connections/sec setup

• Seamless integration
  Fully integrated with the Catalyst 6500 series of intelligent switches
  Transparency and automatic discovery
  Supported on all WAE appliances

• Industry Leading Functionality
  Solution for scaling servers, appliances, and network devices
  Virtual partitions, flexible resource assignment, security, and control
Cisco WAE devices automatically discover one another and negotiate optimization capabilities

- Performed per TCP connection
- Flexible optimization configuration using ATP
- Exchange of peer capabilities and limitations
Firewalled Environments

• Cisco WAEs use TCP option 0x21 (option 33) to automatically discover one another and negotiate policy to apply to a flow

Many firewalls scrub options from TCP segments as a means of ‘normalization’

Firewalls may need to be configured to permit this option as documented in the Cisco WAAS cookbook

Cisco Firewalls automatically detect and permit WAAS traffic

```
PIX-1# show capture waastfo
3 packets captured
  1: 14:52:02.994302 10.88.81.25.2628 > 10.87.102.235.8080: S 2428359878:2428359878(0) win 64512 <mss 1260,nop,nop,sackOK,opt-33:09001125ab4328070101>
  2: 14:52:05.993234 10.88.81.25.2638 > 10.87.102.235.8080: S 2428359878:2428359878(0) win 64512 <mss 1260,nop,nop,sackOK,opt-33:09001125ab4328070101>
  3: 14:52:12.001480 10.88.81.25.2628 > 10.87.102.235.8080: S 2428359878:2428359878(0) win 64512 <mss 1260,nop,nop,sackOK,opt-33:09001125ab4328070101>
3 packets shown
```
Firewalled Environments

- Once autodiscovery is complete and policy has been negotiated, WAAS begins proxying TCP for optimized flows
  - Separate SEQ/ACK management for each of the three distinct TCP connections
  - Firewalls may not permit the connection to continue, seeing it as “SEQ past window”
  - Requires configuration to permit this behavior, i.e. PIX/ASA ‘nailed’ option as per the WAAS Cookbook
  - Cisco products are aware of WAAS and do not need reconfiguration
Traditional WAN Optimization: Not Seamless, but Disruptive to Existing Network

Preservation of IP and TCP Header Information

Traditional WAN Optim.

Traditional WAN Optimization changes TCP/IP header information

Result:
• Services may not work
• Extra integration required
• Risk of downtime due to dedicated links
Cisco WAAS
Seamless Network Integration, Service Preservation

Full Preservation of IP and TCP Header Information

Cisco WAAS

Robust Application Adapters to Offload WAN and Data Center Local Services
Transport and Flow Optimizations Data Redundancy Elimination Accelerates ALL TCP Traffic
Data Center Scalability
Non-Transparent Optimization Challenges

- Complex configuration and possibility of human error
  - Doubles network management effort
  - Requires management of two routing topologies
  - Requires management of duplicate feature configuration
- Compromises network features of upstream routers, switches, and firewalls
  - Loss of visibility at L3/L4
  - Firewall policies, ACLs
  - QoS, NBAR
  - NetFlow
Network Integration Overview

• With the exception of inline, Cisco WAEs attach to the LAN as an appliance

• Relies on packet interception/redirection to enable application acceleration and WAN optimization
  
  Interception in each site where deployed
  
  Interception in both directions of packet flow

• Transparent optimizations maintain compatibility with most IOS features and other platforms
Use of Tertiary IFs or Sub-IFs

• With non-inline modes, the WAE must not be attached to the same segment as the interface performing redirection
• This is required to avoid routing loops, as we have no way to notify the router to bypass the interception and redirection (shown below)
Use of Tertiary IFs or Sub-IFs (Cont.)

Tertiary Interface

Sub-Interface
Inline and NM interception

- Inline interception
- No need for PBR or WCCPv2
- Management connectivity
- ISR Network Module installation
- WCCPv2
- Internal GigEth interface
WCCPv2 Interception Considerations

- WAAS uses service groups 61 and 62 for traffic interception and redirection
  - Service group 61 – hash bucket assignment based on source IP address of the packet
  - Service group 62 – hash bucket assignment based on destination IP address of the packet
- One service group needs to be in the path of traffic for each direction of traffic flow
  - Ingress interception (preferred) – analyze, intercept, and redirect as packets enter an interface – less CPU utilization
  - Egress interception – analyze, intercept, and redirect as packets prepare to exit an interface – higher CPU utilization
- Placement of the services should not be overlooked
WCCPv2 Configuration – Routers

Recommended

62/in LAN and 61/in WAN keeps flows to a particular server pinned to the same WAE in both directions of traffic flow yielding better likelihood of compression per server

Load-balancing based on nodes outside of the location

61/in LAN and 62/in WAN keeps flows from a particular client pinned to the same WAE in both directions of traffic flow yielding better likelihood of compression per client

Load-balancing based on nodes within the location

• Note: most routers only support GRE-redirect, GRE-return, and hash assignment, which are default WCCP service configuration parameters
WCCPv2 Configuration – Router Isolation

Branch: 62/in LAN and 61/in WAN keeps flows to a particular server pinned to the same WAE in both directions of traffic flow yielding better likelihood of compression per server.

Load-balancing based on nodes outside of the location.

DC: 62/in WAN1 and 61/out WAN1 keeps flows to a particular server pinned to the same WAE in both directions of traffic flow yielding better likelihood of compression per server.

No ACLs required to not redirect flows to/from unoptimized branch.

Load-balancing based on nodes outside of the location.
WCCPv2 Configuration – Switches

Recommended

<table>
<thead>
<tr>
<th>61/in LAN and 62/in WAN keeps flows from a particular server pinned to the same WAE in both directions of traffic flow yielding better likelihood of compression</th>
</tr>
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<td>Load-balancing based on nodes within the location</td>
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</table>

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Load-balancing based on nodes outside of the location</td>
</tr>
</tbody>
</table>

• Note: configuration on switches is configured on L3 interfaces or SVIs only. Configure with appropriate parameters (L2-redirect, L2-return, mask assignment)
## Which Interception Method to Use?

<table>
<thead>
<tr>
<th></th>
<th>WCCPv2</th>
<th>Inline</th>
<th>CSM/ACE</th>
<th>PBR</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of Active WAEs</strong></td>
<td>32</td>
<td>2 (serial cluster, tested limit)</td>
<td>16000 (not practical but possible)</td>
<td>1</td>
</tr>
<tr>
<td><strong>Maximum Number of WAEs</strong></td>
<td>32</td>
<td>2 (serial cluster, tested limit)</td>
<td>16000 (not practical but possible)</td>
<td>8 (IOS dependent)</td>
</tr>
<tr>
<td><strong>Maximum Number of TCP Connections (with WAE-7326)</strong></td>
<td>240K</td>
<td>15K</td>
<td>4M</td>
<td>7.5K</td>
</tr>
<tr>
<td><strong>Maximum Throughput</strong></td>
<td>Up to 32Gbps (platform dependent)</td>
<td>Up to 2Gbps (two inline pairs)</td>
<td>Up to 16Gbps (platform dependent)</td>
<td>Up to 1Gbps</td>
</tr>
<tr>
<td><strong>Recommended Use</strong></td>
<td>Generally Recommended</td>
<td>Only if WCCPv2 can not be used (SP managed or low-end router)</td>
<td>Very large scale data center deployments</td>
<td>Last resort</td>
</tr>
</tbody>
</table>
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Data Transfer Without Compression
Networks With Compression

No Congestion or Less Congestion
Data Transfer With Compression
Cisco WAAS Advanced Compression

- Data Redundancy Elimination (DRE): application-agnostic compression eliminates redundant data from TCP streams providing up to 100:1 compression
- Persistent LZ Compression: session-based compression provides up to an additional 10:1 compression even for messages that have been optimized by DRE
DRE Chunk Identification

- Analyze incoming data streams using a sliding window to identify “chunks”
- Each chunk assigned a 5-byte signature
- Single-pass used to identify chunks at multiple levels
  - Basic chunks
  - Chunk aggregation (nesting)
- After chunks are identified, DRE will begin pattern matching
  - First look for largest chunks
  - Look for smaller chunks if necessary
Each chunk is assigned a 5-byte signature
DRE Pattern Matching

DRE Database

Original Message

Encoded Message

NO MATCH
NO MATCH
NO MATCH
Without TCP Proxy
TCP Proxy and TFO

Window Scaling
Large Initial Windows
Congestion Mgmt
Improved Retransmit
TCP Sawtooth

Return to maximum throughput could take a very long time!
Comparing TCP and TFO

Cisco TFO provides significant throughput improvements over standard TCP implementations.

- **TCP**
- **TFO**

Diagram showing the comparison of TCP and TFO in terms of cwnd (congestion window) over time (RTT). The TFO curve shows earlier and faster increases in cwnd compared to TCP, indicating faster throughput.

**Key Points**
- **Slow start**
- **Congestion avoidance**
- Time (RTT)
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WAAS Intuitive Central Management

- Comprehensive Management
  - Central configuration
  - Device grouping
  - Monitoring, statistics
  - Alerts, reporting

- Easy-to-use Interface
  - Graphical U/I, Wizards
  - IOS CLI
  - Roles-based administration

- Proven Scalability
  - 1000’s of nodes
  - Redundancy and recovery
WAAS Intuitive Central Management (cont.)
Cisco WAE Family Positioning

Performance

Enterprise Data Center

WAE-612

WAE-7326
WAE-7341
WAE-7371

ACE
(for WAAS load balancing)

Regional Office or Small Data Center

WAE-512

Branch or Remote Office

NME-WAE-502
NME-WAE-522
NME-WAE-302

Scalability

Enterprise Data Center

WAE-612

WAE-7326
WAE-7341
WAE-7371

ACE
(for WAAS load balancing)

Regional Office or Small Data Center

WAE-512

Branch or Remote Office

NME-WAE-502
NME-WAE-522
NME-WAE-302

Scalability
Cisco WAAS Mobile Overview

1. Where It Sits

[Diagram showing the placement of WAAS Mobile Client and Server]

2. What It Does

- Installs on Windows Desktop
- Accelerates Mobile VPN connections over the Internet

3. Why It’s Better

<table>
<thead>
<tr>
<th>Purpose Built for the Windows PC/Laptop</th>
<th>Not an appliance software ported to Windows OS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Similar to Cisco’s approach with VPN client</td>
</tr>
<tr>
<td></td>
<td>Results in reliability &amp; stability on the Windows PC</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Industry-leading Performance</th>
<th>Significantly higher throughput</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Better application performance</td>
</tr>
<tr>
<td></td>
<td>Tested under a wide range of links</td>
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</table>

<table>
<thead>
<tr>
<th>Lowest TCO</th>
<th>Best reliability, stability and troubleshooting tools reduce cost of support</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Centralized policy based management reduces deployment and support cost</td>
</tr>
<tr>
<td></td>
<td>Integration with software distribution tools reduces deployment costs</td>
</tr>
</tbody>
</table>

Available Now!
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Summary

- Not all application protocols can be optimized through generic WAN optimization – some require application-specific acceleration to function properly over a WAN.
- Cisco WAAS provides robust application-specific and network-layer optimizations to enable application delivery and file server consolidation.
- Cisco WAAS file services provides integration flexibility and can help enable consolidation of additional CIFS-based platforms such as software distribution servers.
- Cisco WAAS also provides Windows-compatible and centrally-managed print services with driver distribution and disconnected printing capabilities.
Why Choose Cisco WAAS?

• Application-specific optimization for file and print services helps to enable file server and data protection consolidation while enabling offline access to fully cached files

• High performance WAN optimization to reduce bandwidth consumption and maximize throughput, efficiency to significantly improve application delivery over the WAN

• Network transparency preserves investment in existing network feature configurations and physical integration provides industry’s best total cost of ownership model

• Robust and proven secure central management platform scales to meet the needs of the largest organizations

• Integration with industry-leading application networking technologies such as the ACE module for data center integration, scalability, and performance

• Cisco’s world-class 24hx7d technical assistance center
Sample ROI

Problems

- Low bandwidth
- High latency
- Packet Loss
- Expensive backup solution
- Distributed file servers
- High OPEX

Benefits

- Centralization of resources
- Better throughput
- Lower application latency
- Reliability
- Central backup
- Lower OPEX
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Questions?