Cisco Expo 2008

Cisco Data Center: WAN acceleration

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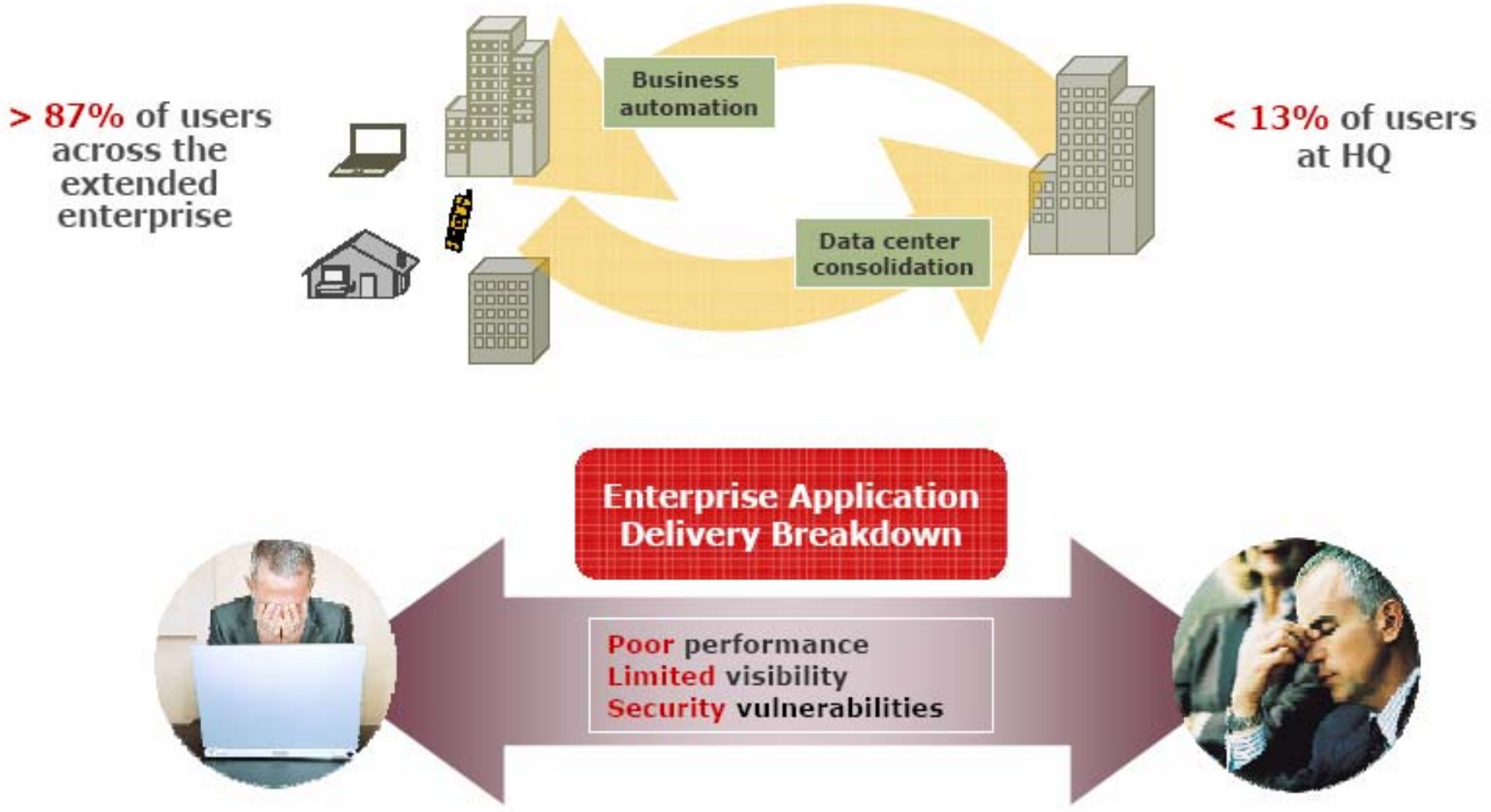
Agenda

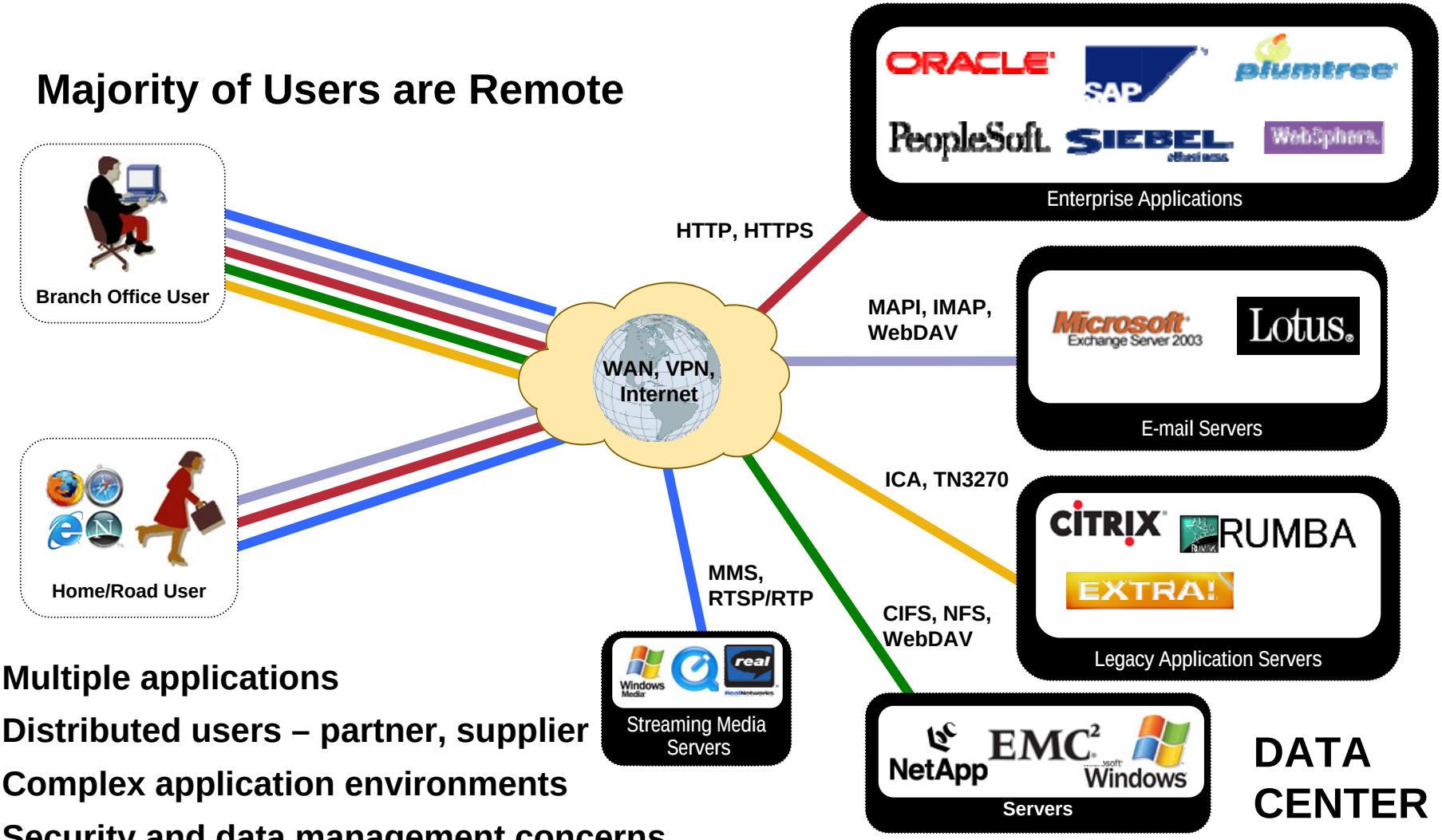
- Enterprise Application Delivery Challenges
- Introducing Cisco Wide Area Application Services
- Network Integration and Deployment
- In-Depth Examination of Optimizations
- Management and WAE Platforms
- Summary
- Q&A

Reality of the Extended Enterprise
Where are the users?



Source: Cisco IAR Speaker Series

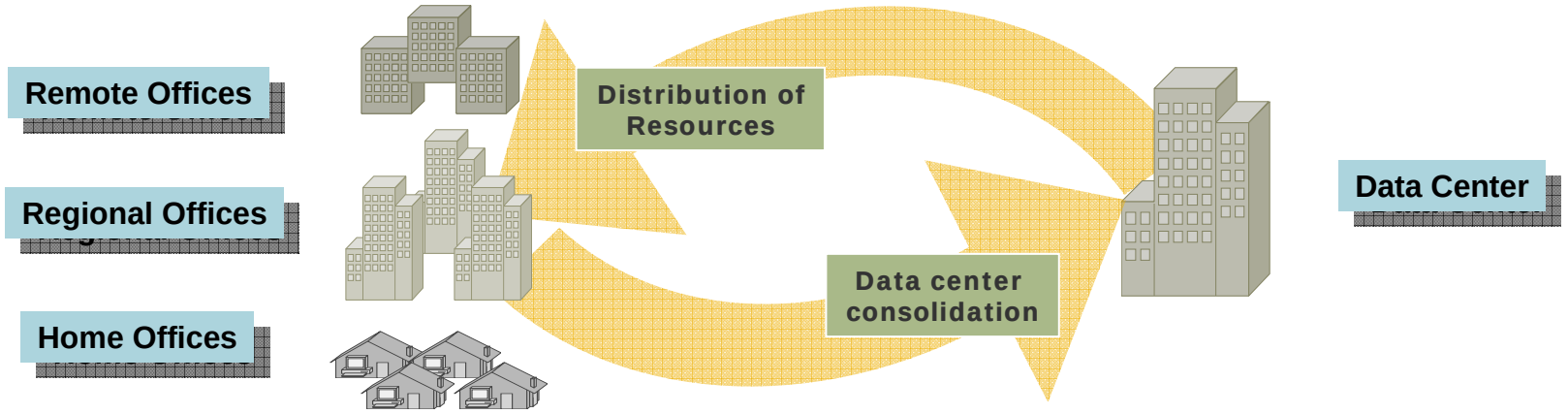
Typical Application Environment Today



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

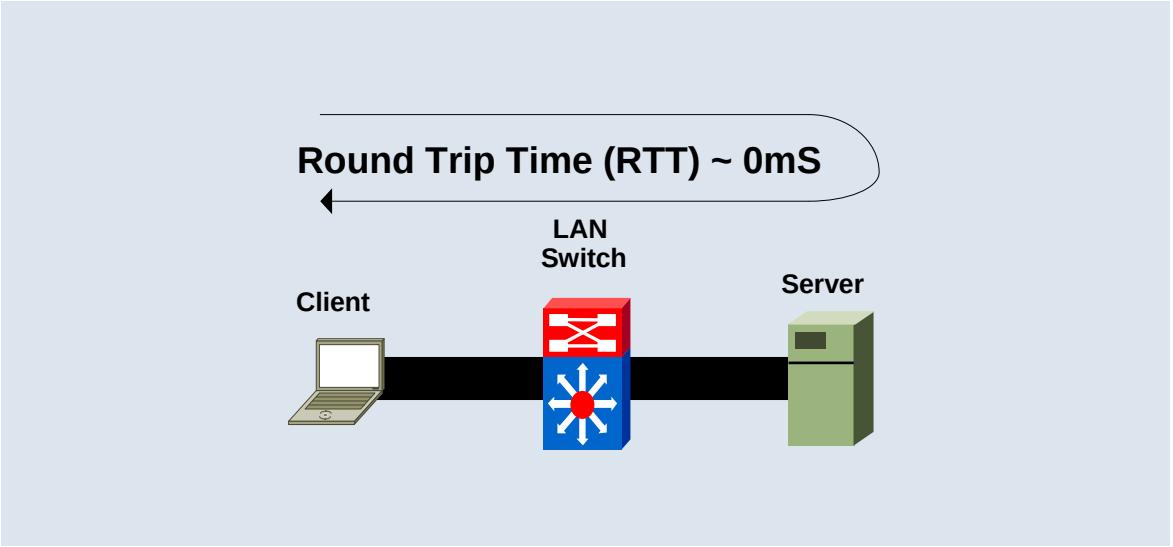
I/T's Application Delivery Problem

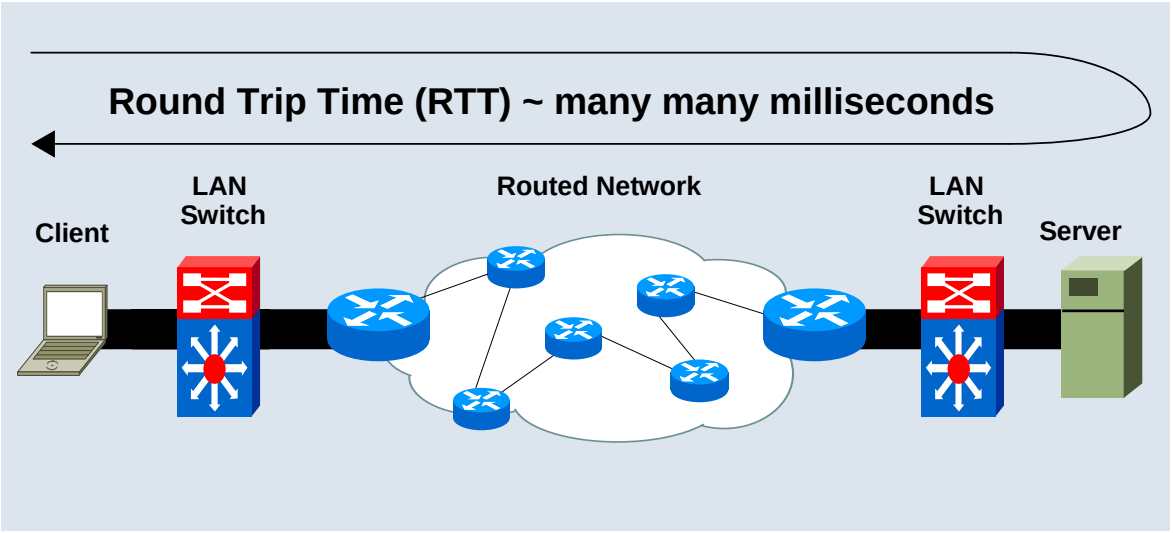
- **Increasingly distributed workforce drives need for distribution of I/T resources to remote locations**
  - **Enable productivity**
  - **Drive revenue and profits**
- **Data protection, availability, compliance, and management drives need for consolidation**
  - **Fewer devices to manage**
  - **Fewer points to protect**



The WAN Is A Barrier To Consolidation

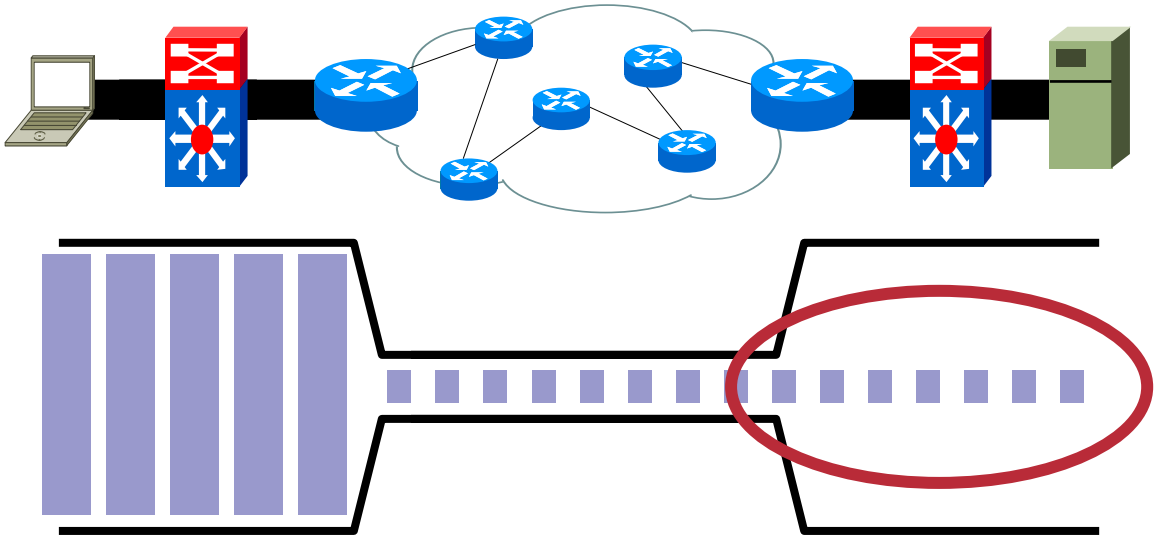
- **Applications are designed for LAN environments**
  - **High bandwidth**
  - **Low latency**
  - **Reliability**
- **WAN characteristics hinder consolidation**
  - **Already congested**
  - **Low bandwidth**
  - **Latency**
  - **Packet Loss**





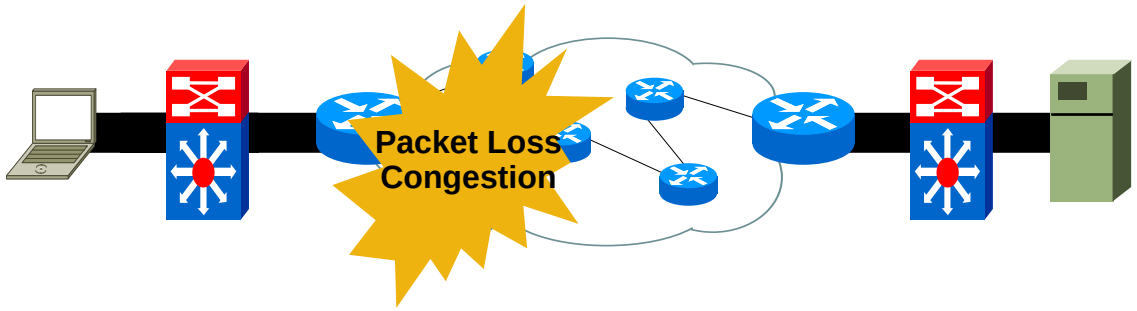
Bandwidth

- **Bandwidth constraints keep applications from performing well**
- **Too much data and too small of a pipe causes congestion, packet loss, and backpressure**

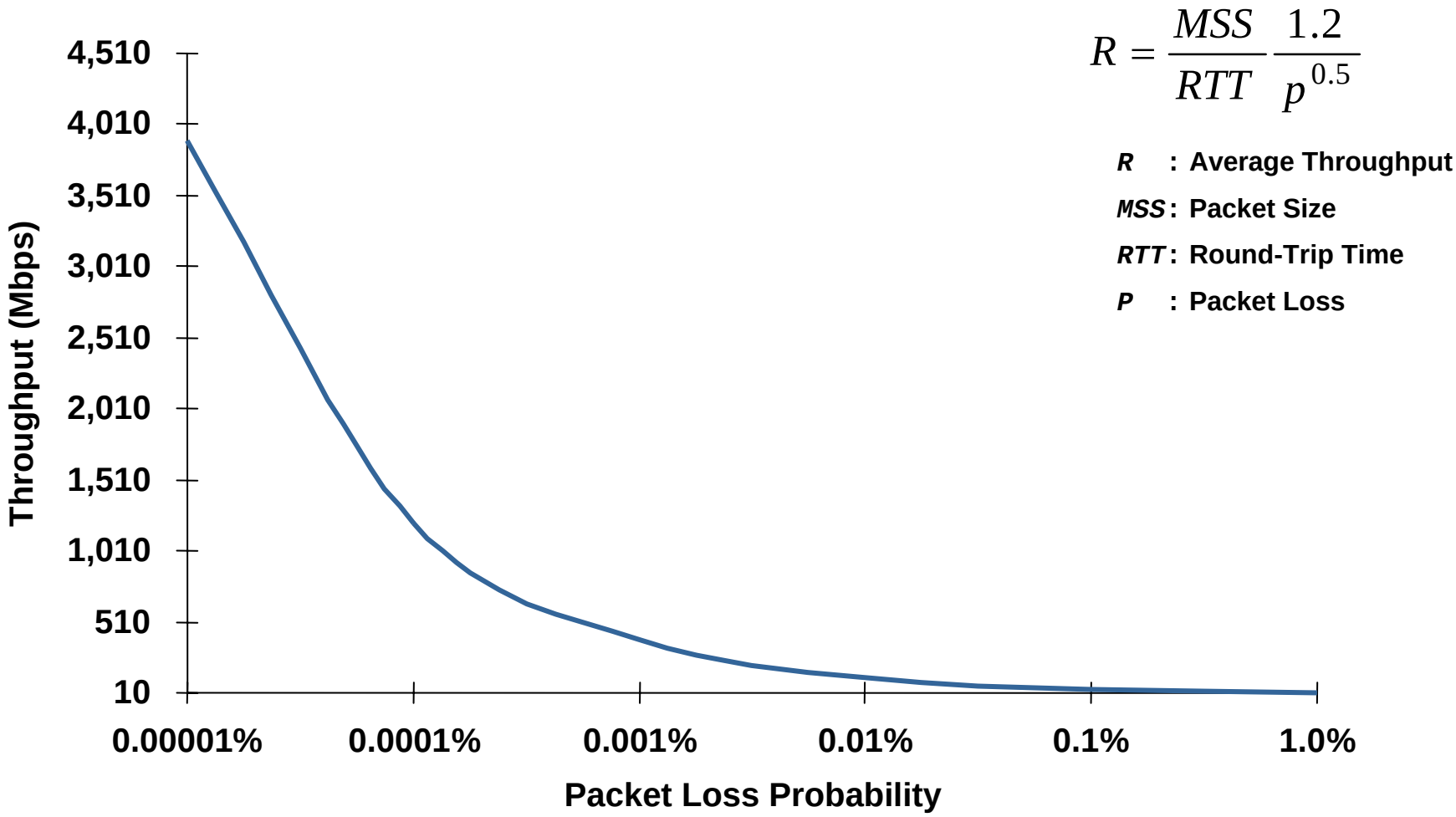


Packet Loss, Congestion, and Retransmission

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



The Impact of Packet Loss



$$R = \frac{MSS}{RTT}\frac{1.2}{p^{0.5}}$$

R : **Average Throughput**

MSS: **Packet Size**

RTT: **Round-Trip Time**

P : **Packet Loss**

Assuming 1250-Byte packet size, and 100ms RTT

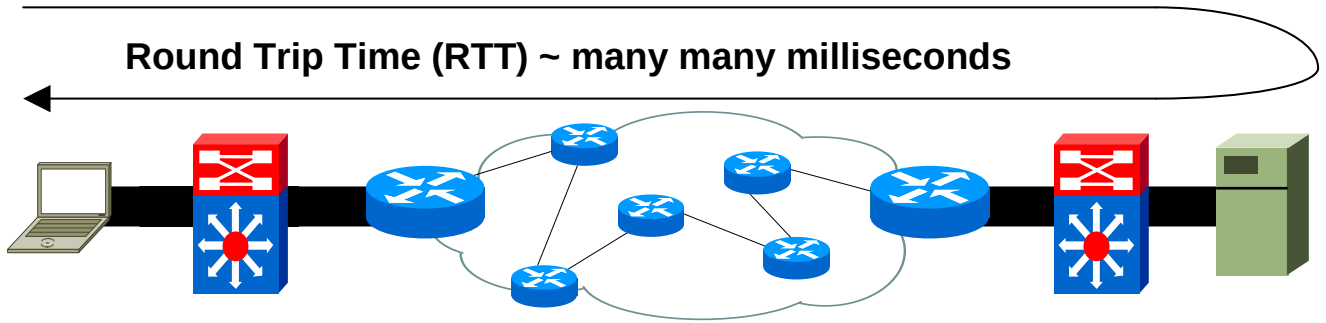
Latency

- **Latency impairs application performance in three ways:**

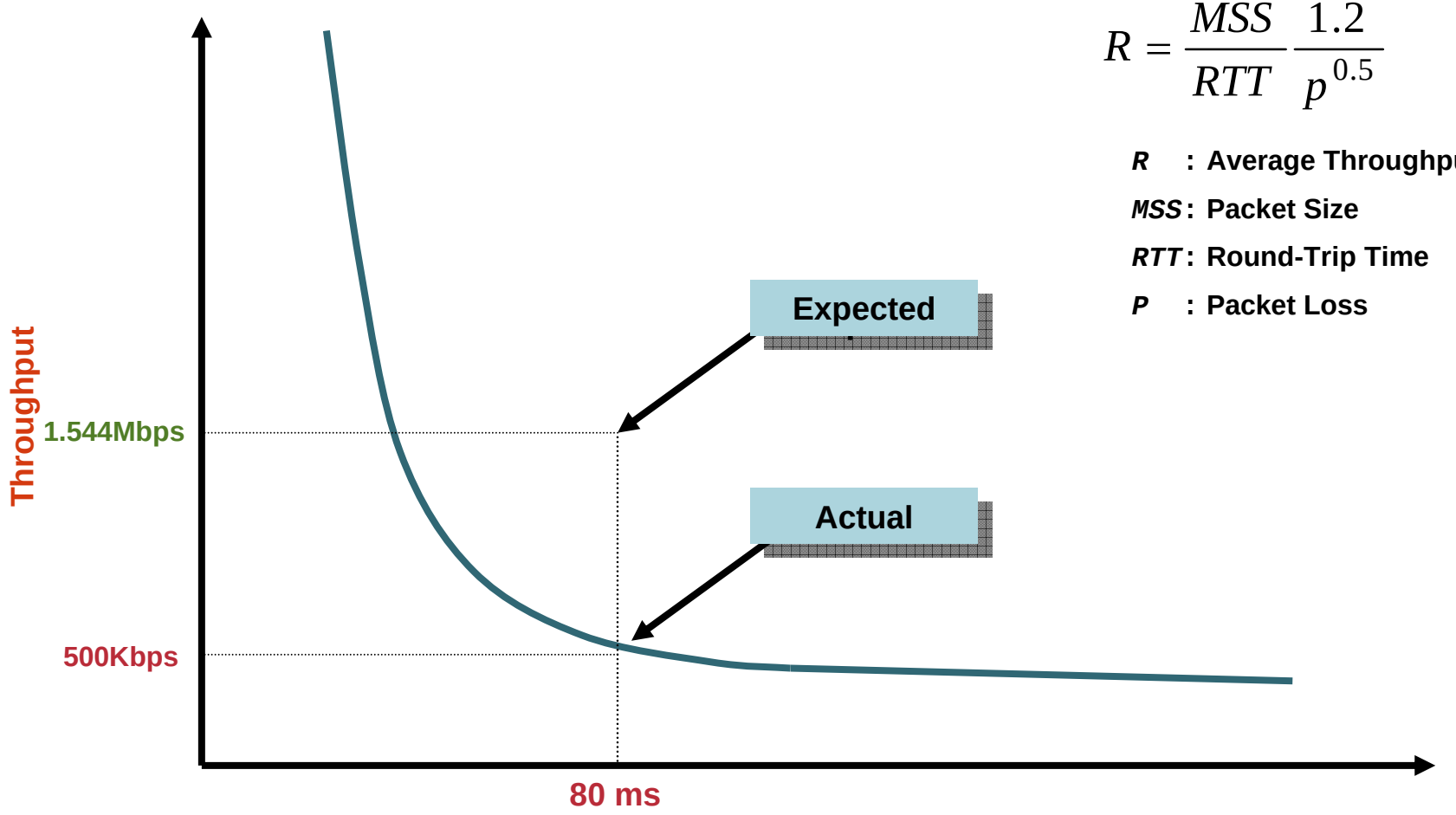
  Network latency – the amount of time necessary for a message to traverse the network

  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



The Impact of Latency



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R : **Average Throughput**

MSS : **Packet Size**

RTT : **Round-Trip Time**

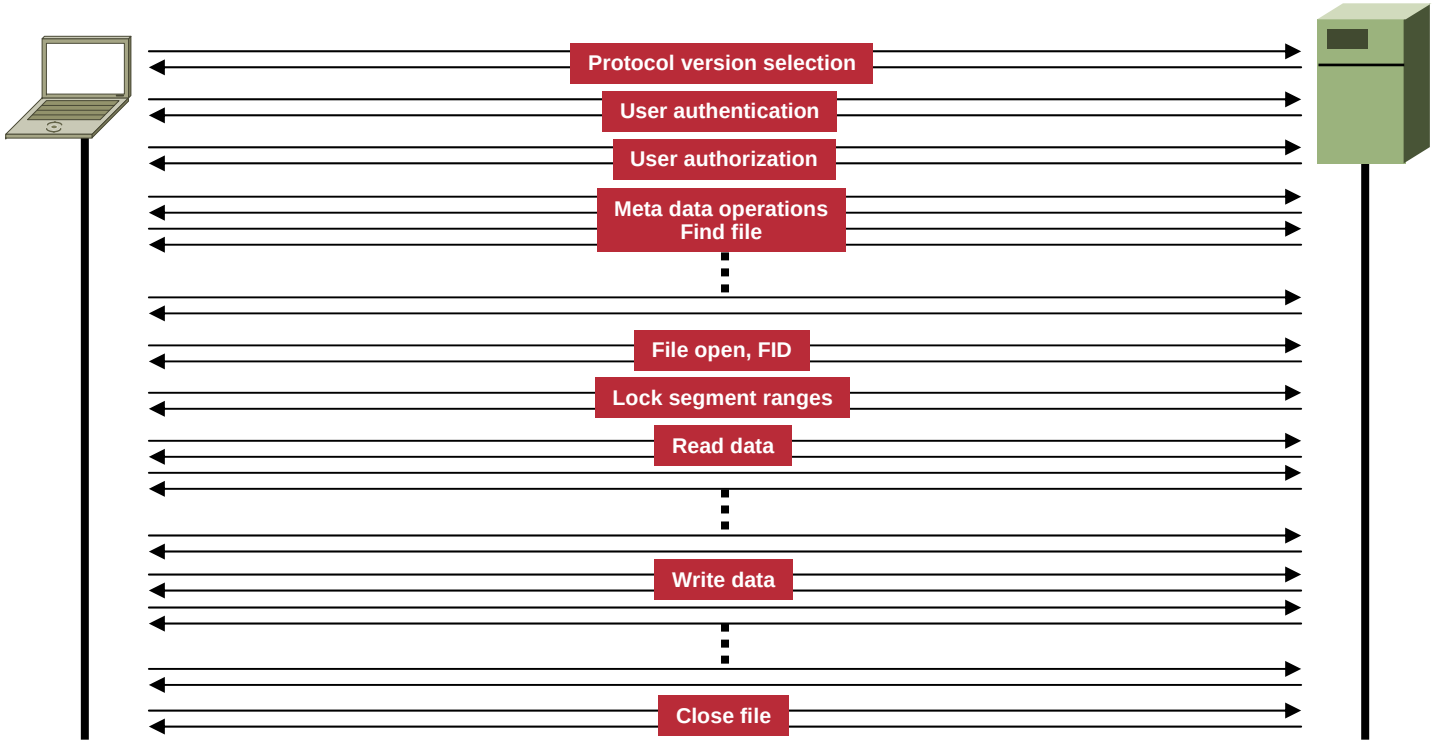
P : **Packet Loss**

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

- **Applying compression to communications between the client and server certainly minimizes the amount of bandwidth consumed by each protocol message**

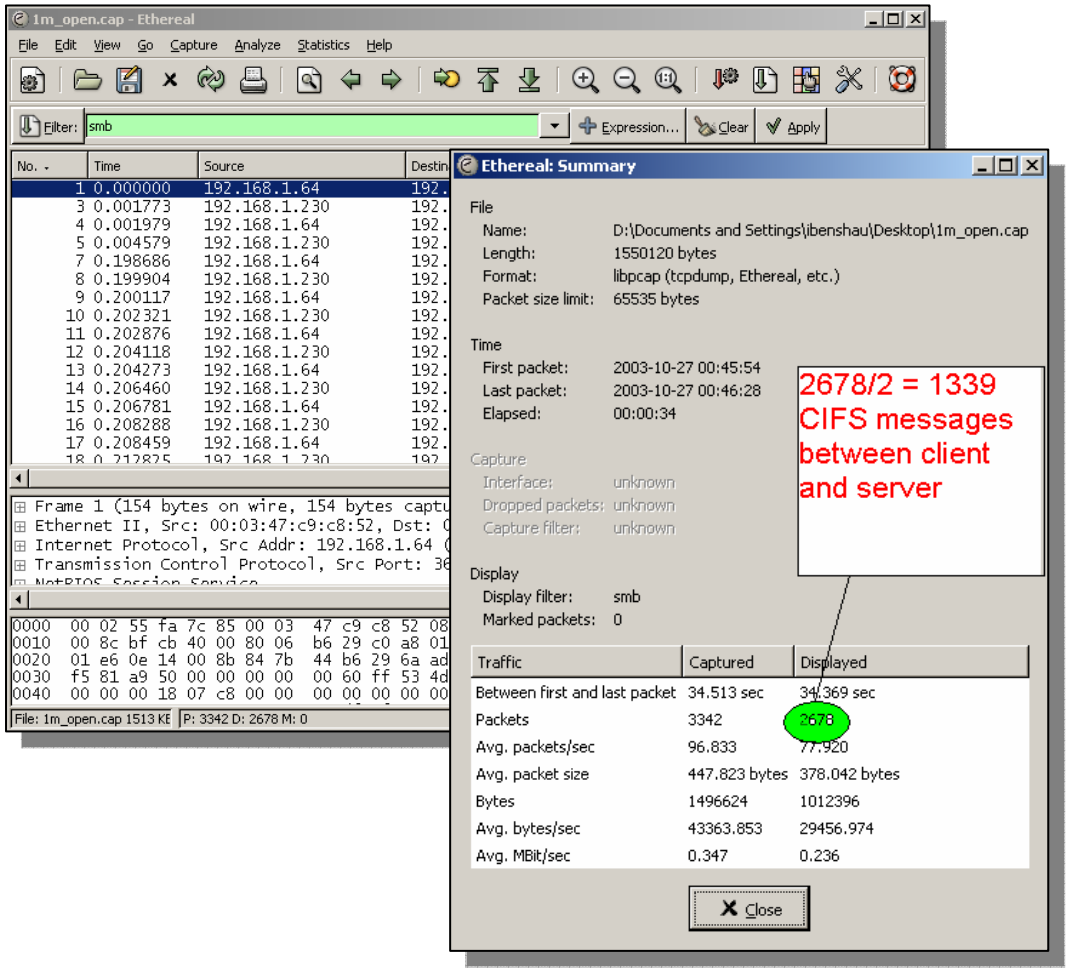
  But many hundreds or thousands messages must still go back and forth across the WAN in sequence!

- **Applying transport optimizations to communications between the client and server improves the ability of each message to efficiently and fully utilize available network capacity**

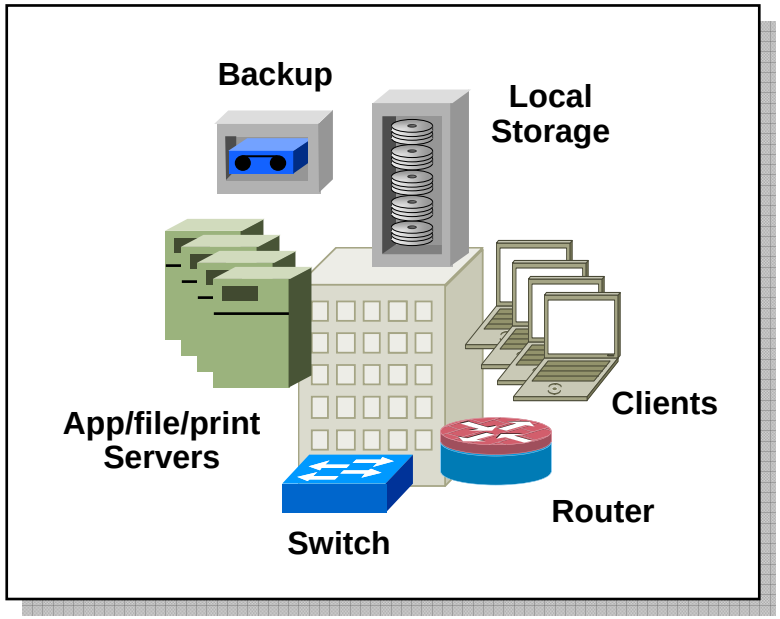
  But many hundreds or thousands of messages must still go back and forth across the WAN in sequence!

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



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

- **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**

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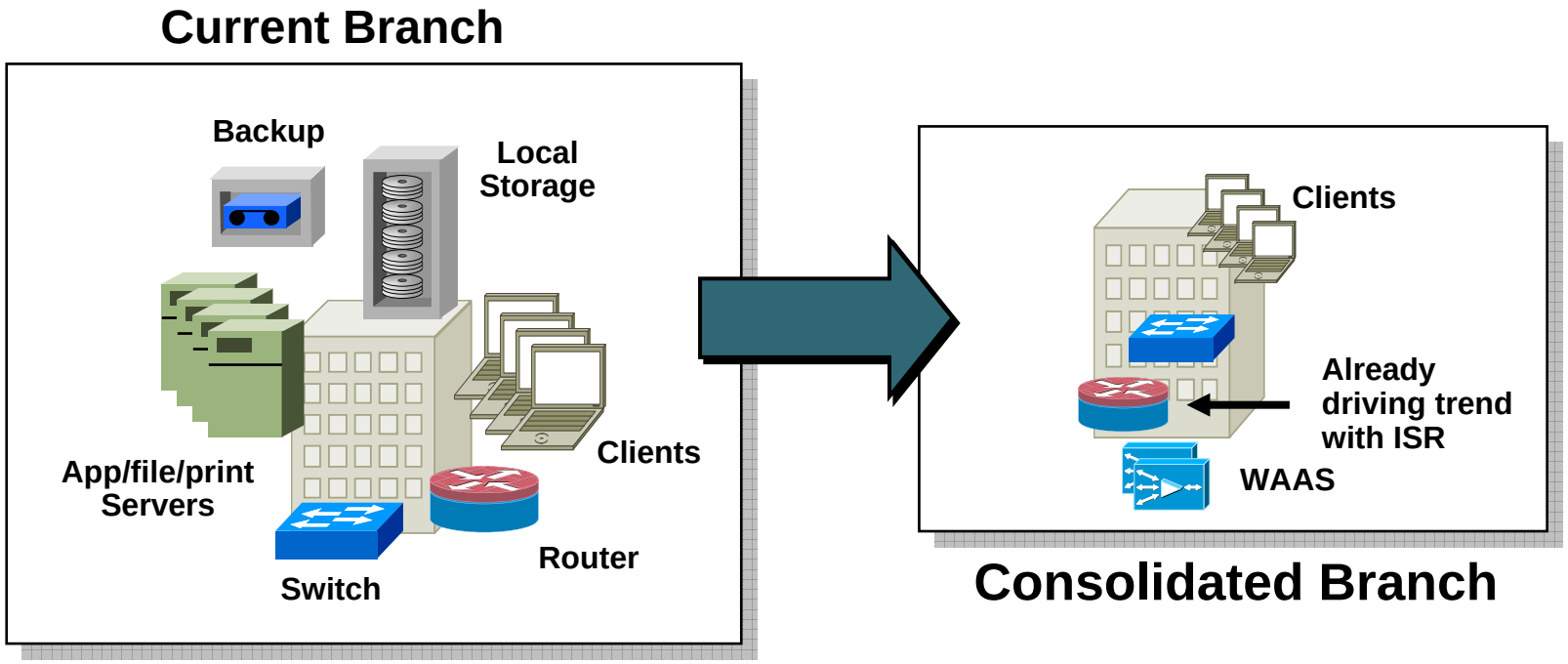
Cisco Vision: the Consolidated Branch

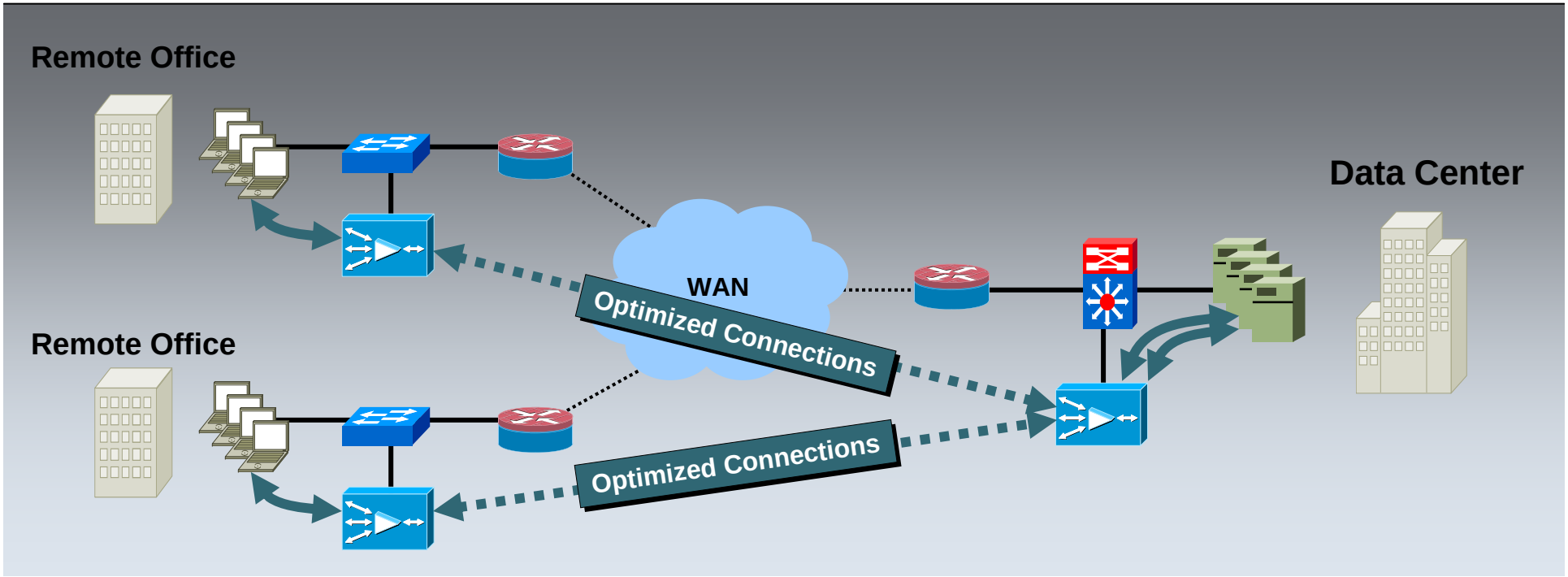


Design Goals:

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

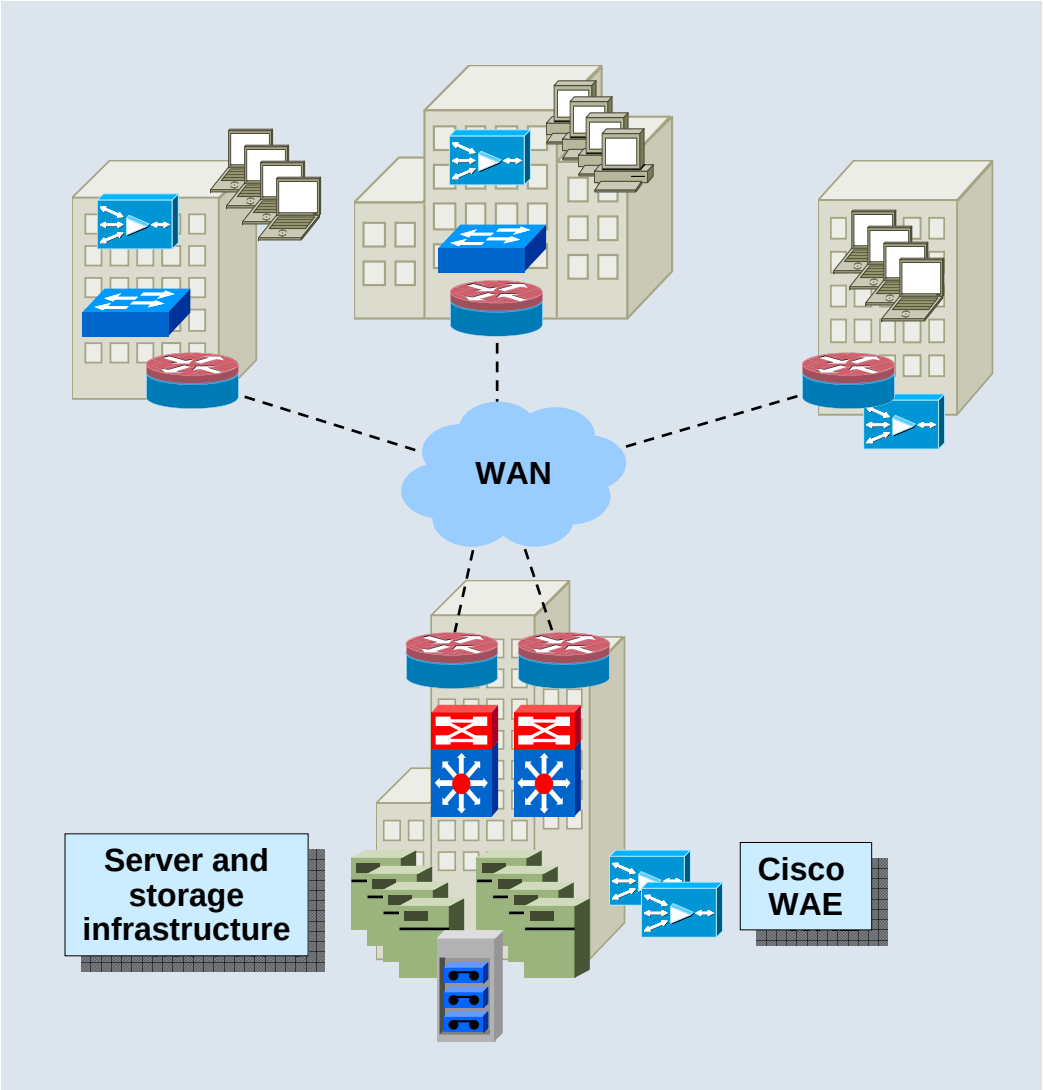
Cisco WAAS Overcomes the WAN

- **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**

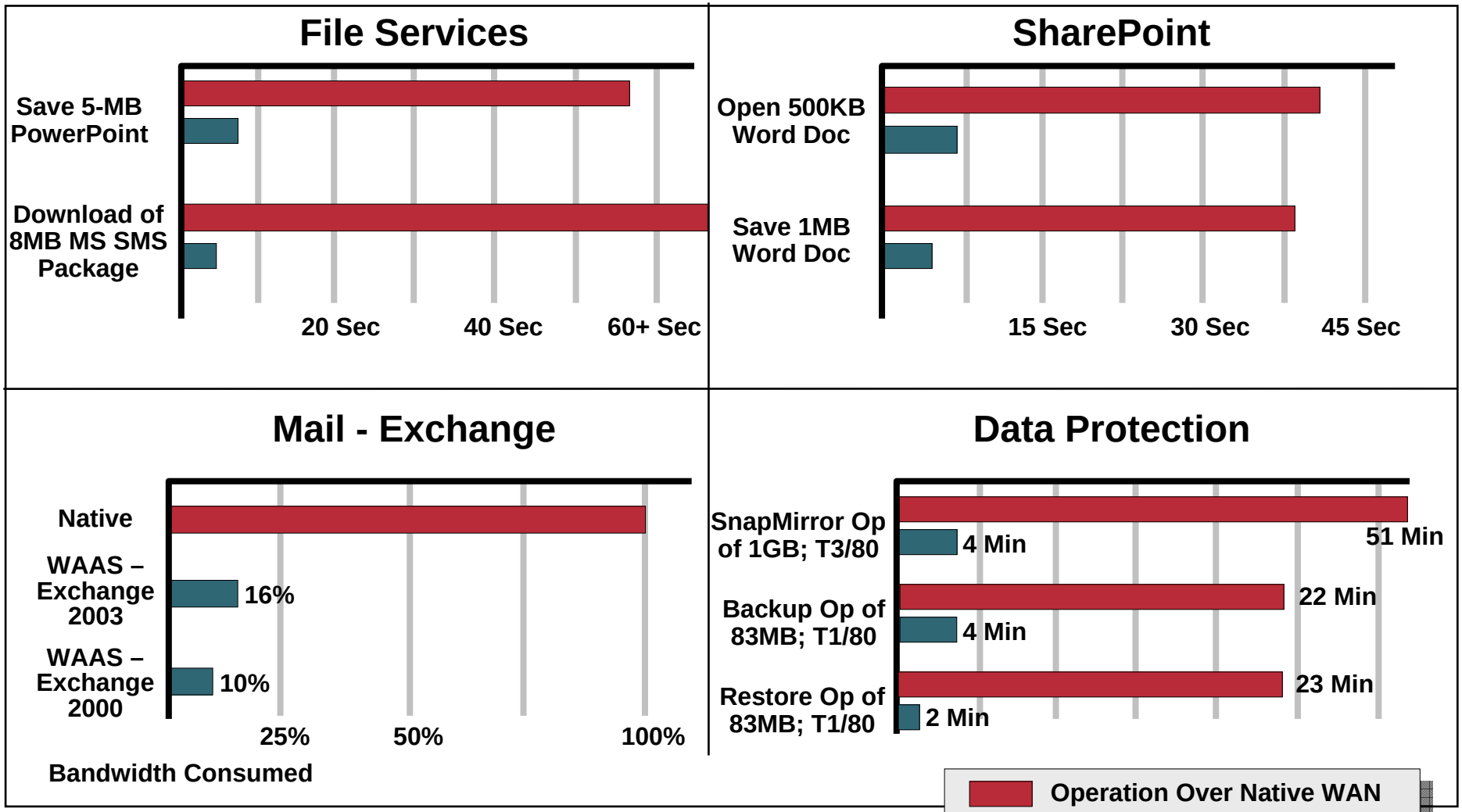


WAAS Accelerates Broad Range of Applications

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

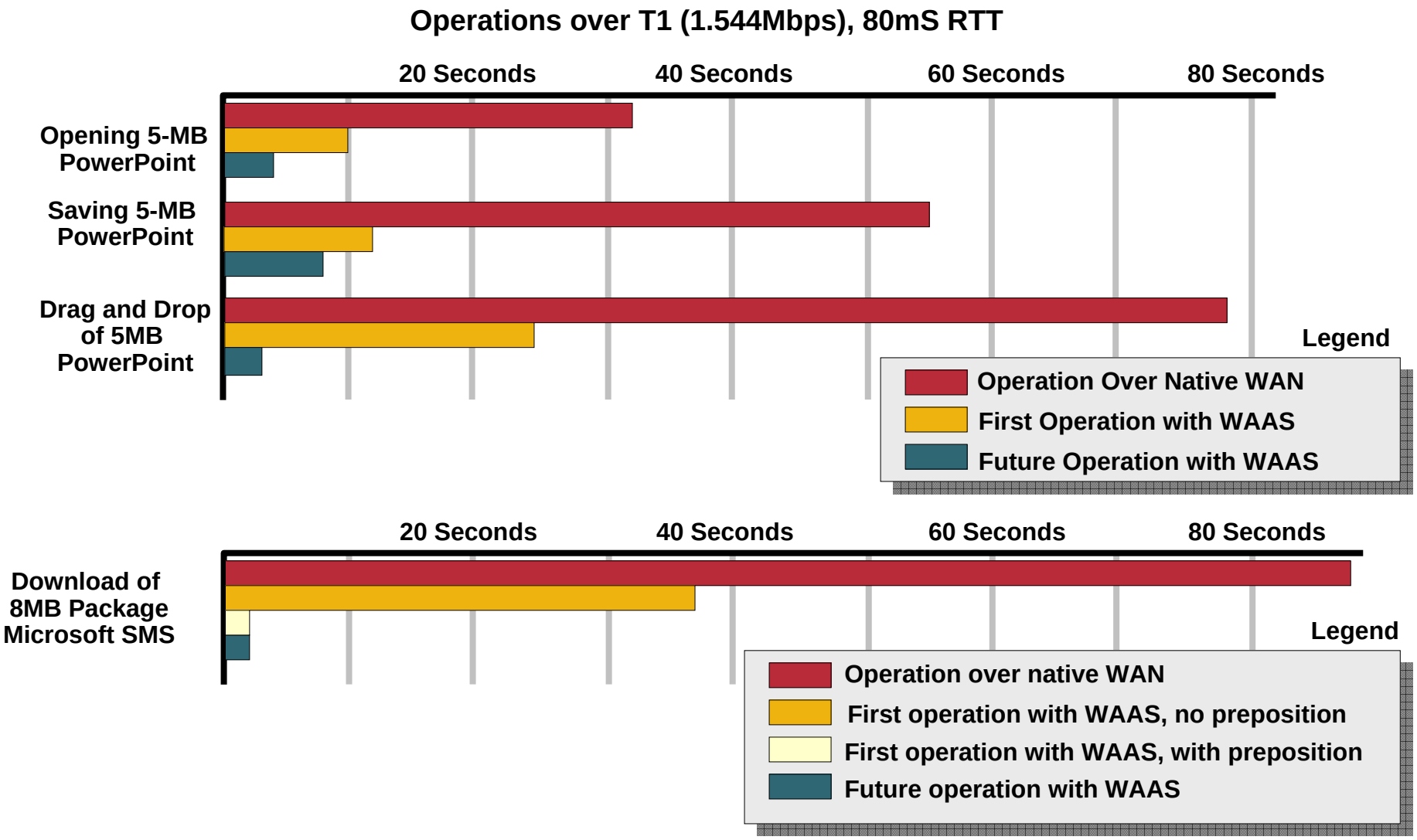
*** Performance improvement varies based on user workload, compressibility of data, and WAN characteristics and utilization. Actual numbers are case-specific and results may vary.**

[Remote] User Experience: LAN-Like Access to Various Applications

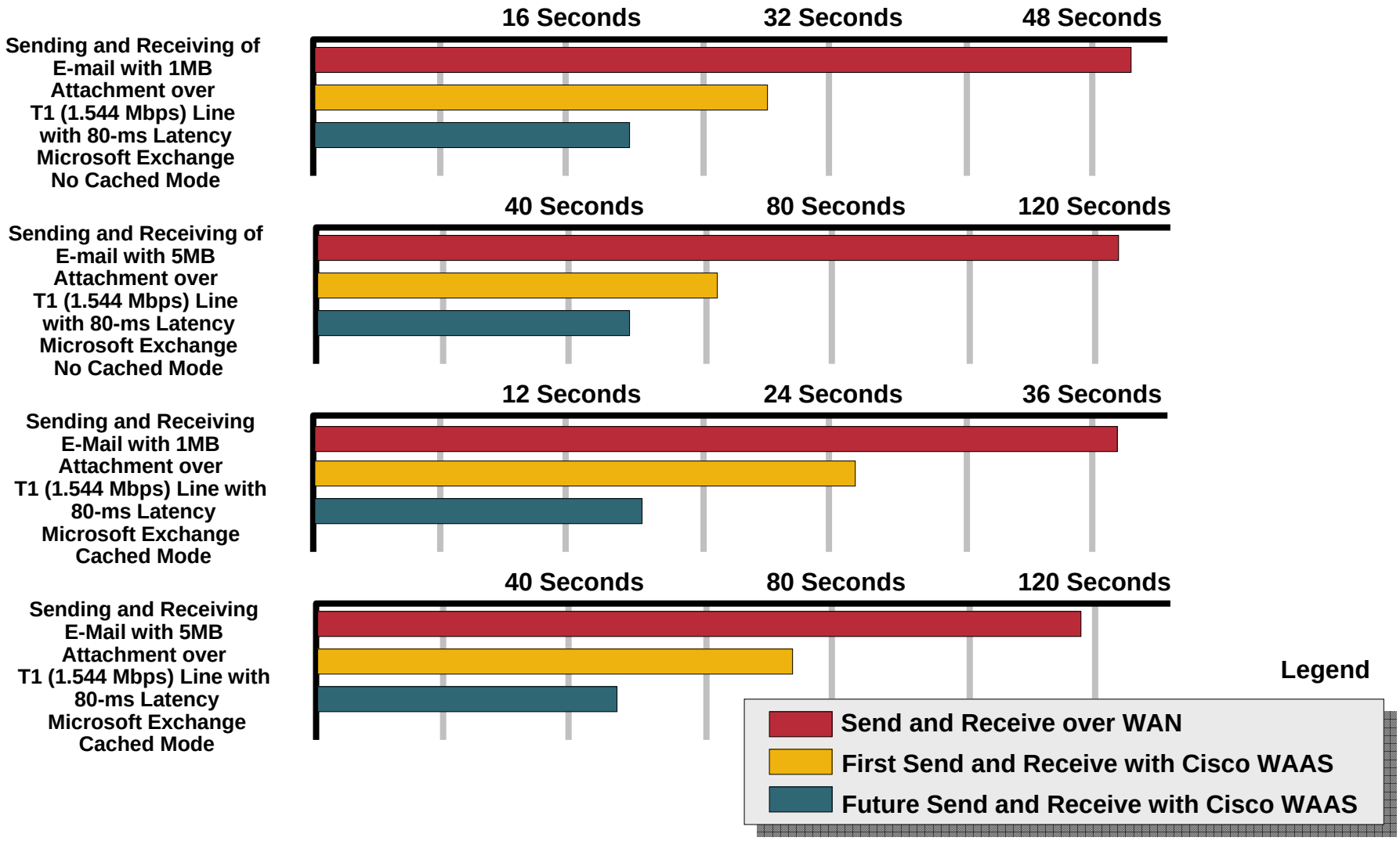


[Network Link—T1, 80ms Latency]

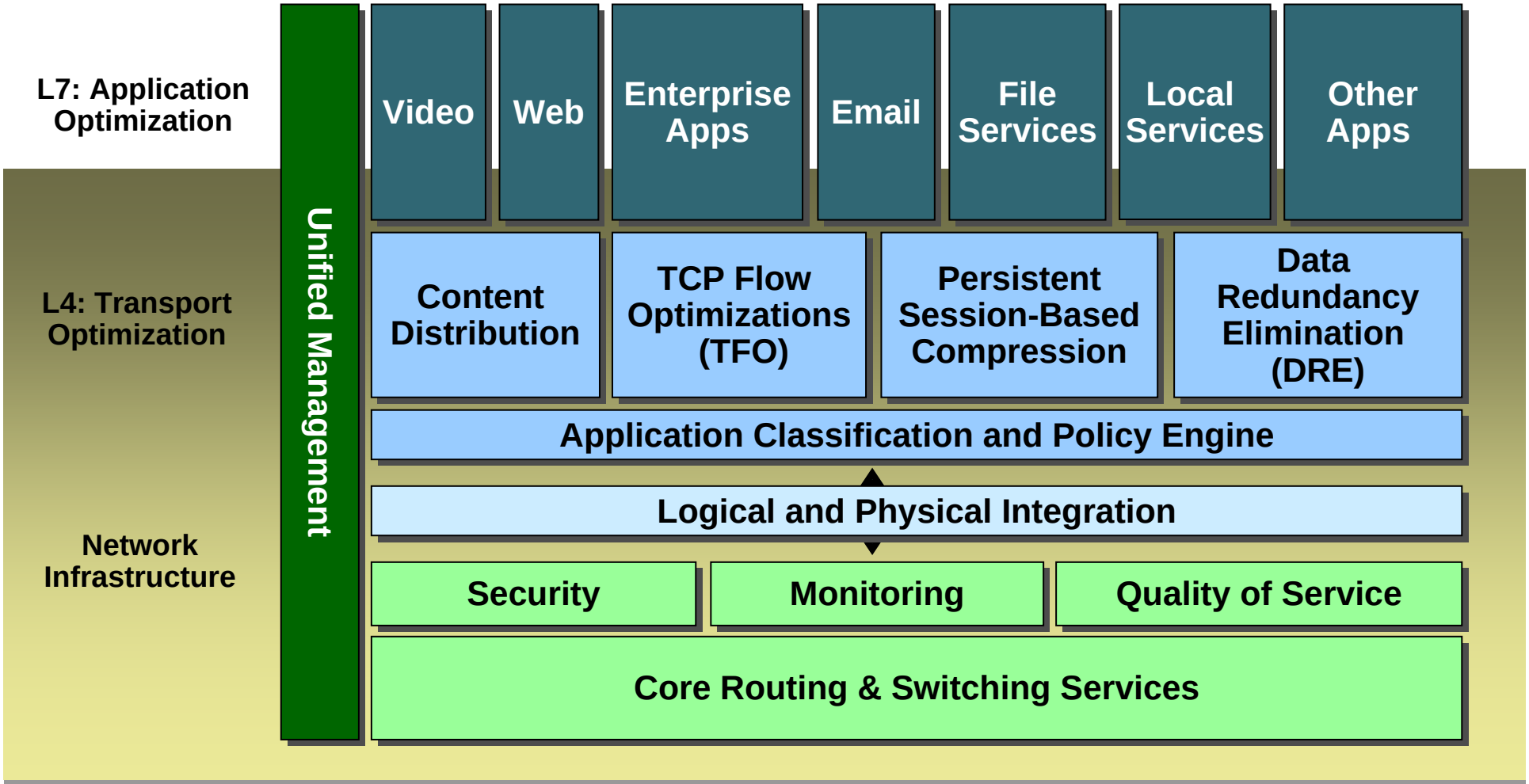
Cisco WAAS Performance – File Services



Cisco WAAS Performance – Exchange



Cisco WAAS Optimization Architecture



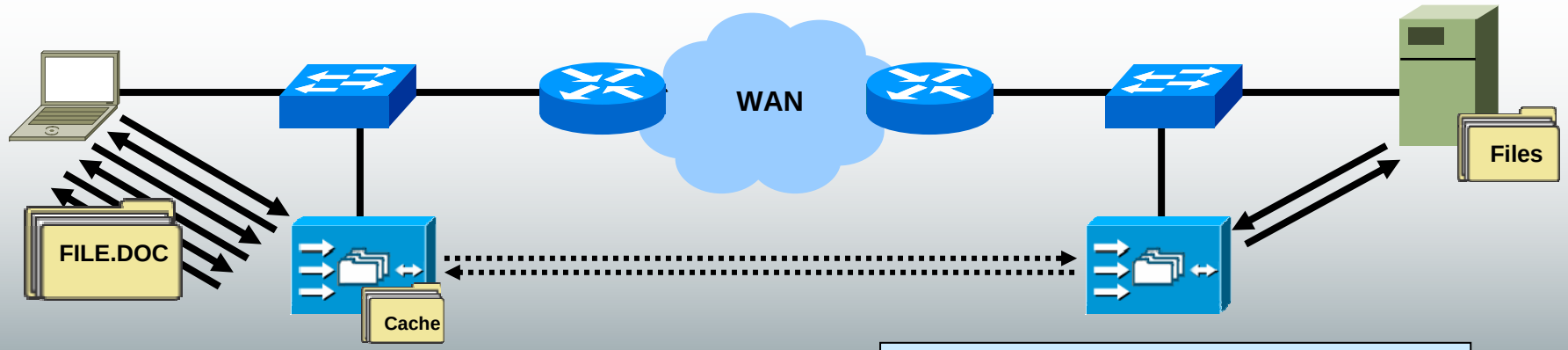
WAAS File Services Introduction

- **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

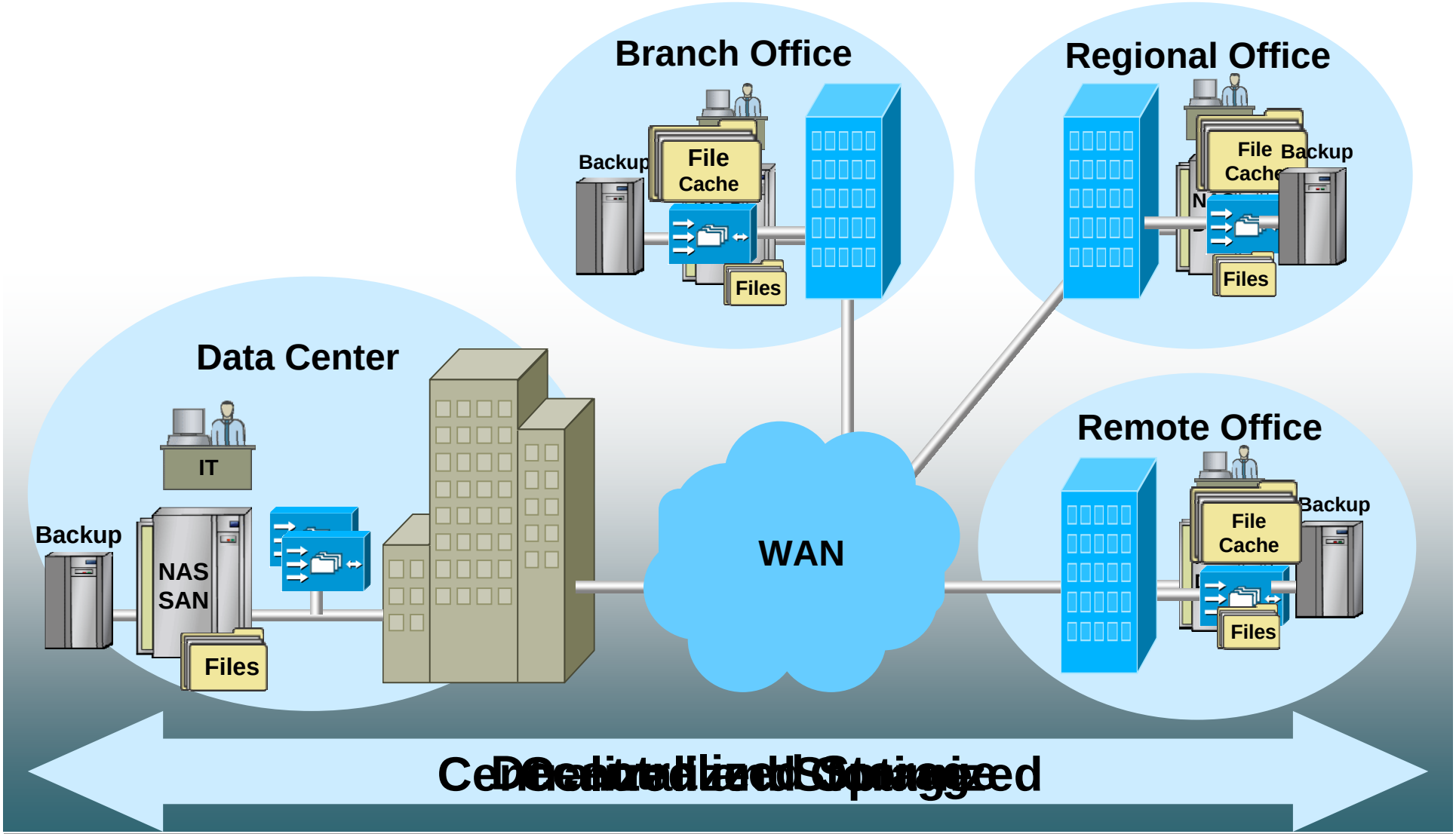
- Sessions maintained end-to-end ensures no security reconfiguration
- Auditing, access-control, and quotas are fully preserved
- Scheduled preposition to prepopulate DRE and edge data cache



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

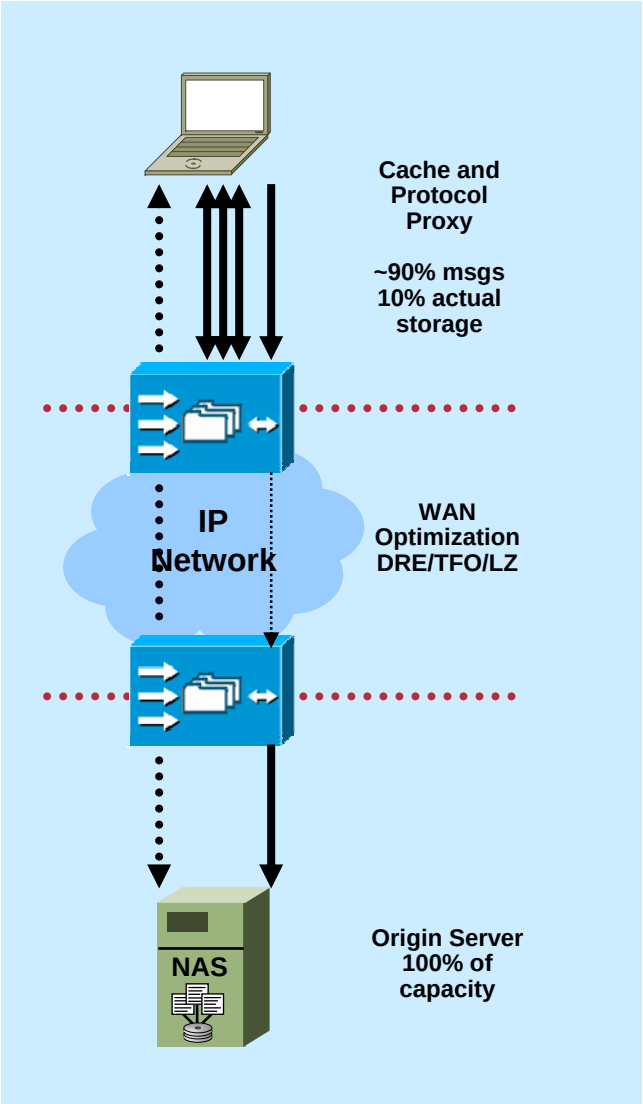
- Advanced WAN optimization layer improves throughput and efficiency
- Data Redundancy Elimination (DRE) eliminates redundant network data
- TCP optimizations to improve protocol ability to fully utilize network

WAAS File Services Introduction



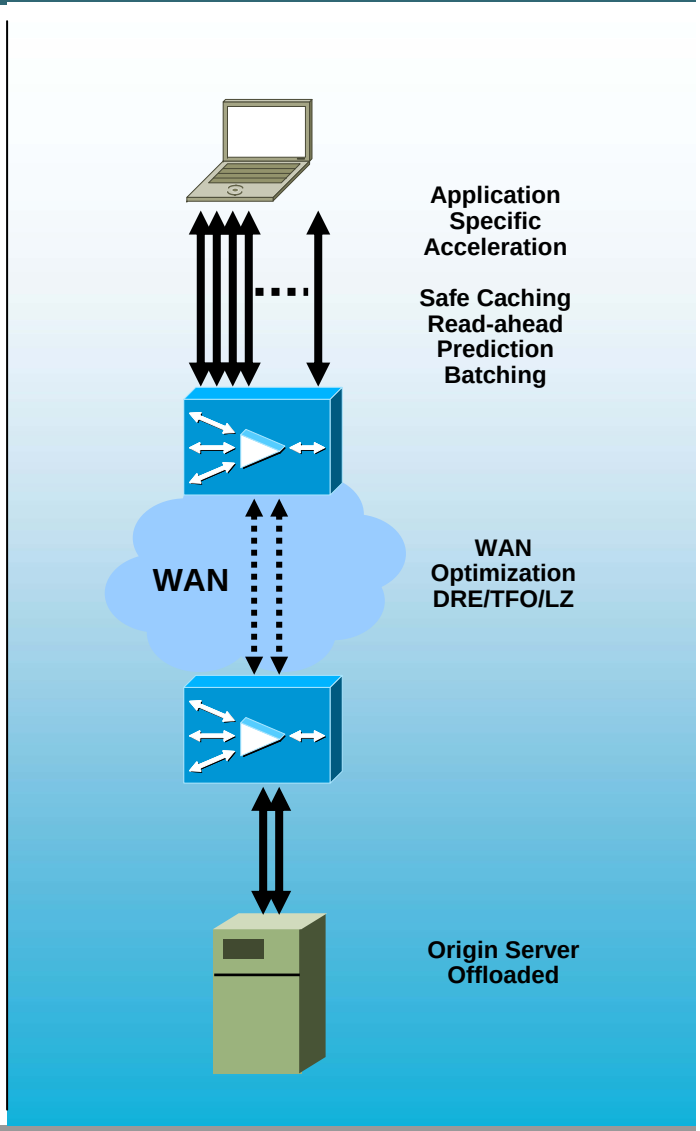
Intelligent Message Suppression

- **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**



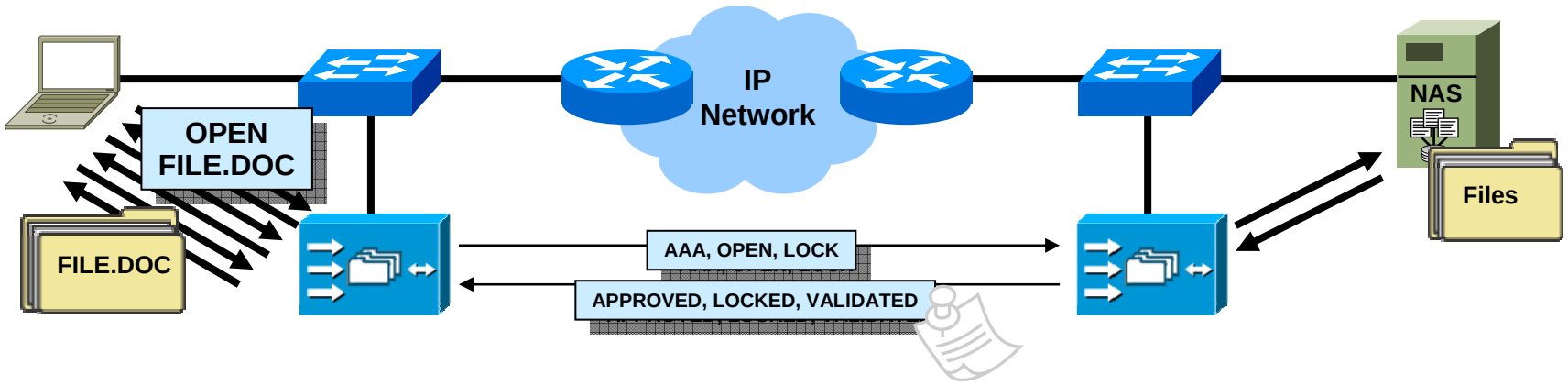
Application-Specific Acceleration

- **Application and protocol awareness**
  - **Eliminate unnecessary chatter**
  - **Save WAN bandwidth**
  - **Pre-populate edge cache as necessary**
  - **Enable disconnected operations**
- **Intelligent protocol acceleration**
  - **Read-ahead, prediction, and batching**
  - **Safe data and metadata caching**
  - **Improves application response time**
  - **Provide origin server offload**
- **WAASv4 application adapters**
  - **CIFS (Windows File Services)**
  - **Windows printing**



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**

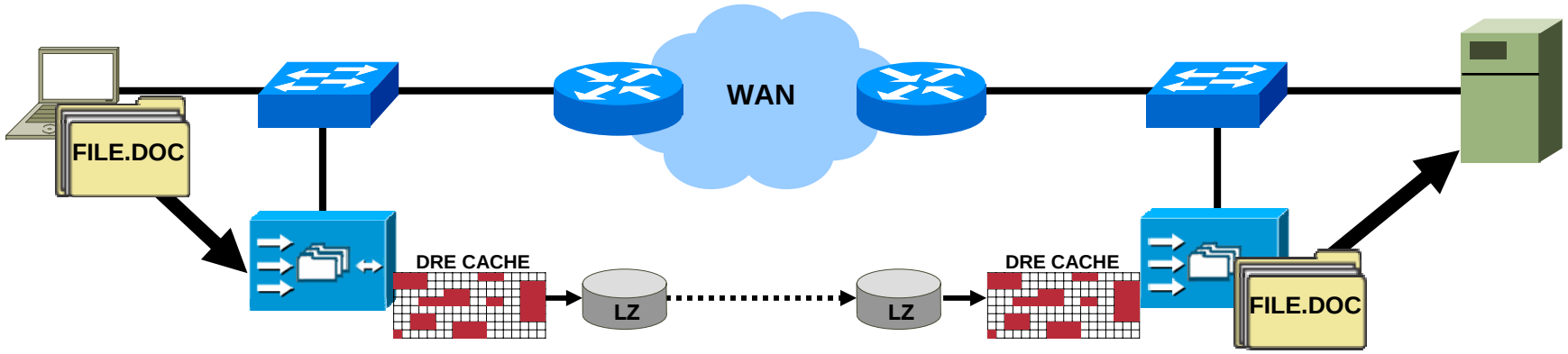


CIFS Integration with WAN Optimization

- **File services adapter leverage WAN optimization capabilities provided by DRE, TFO, and LZ**

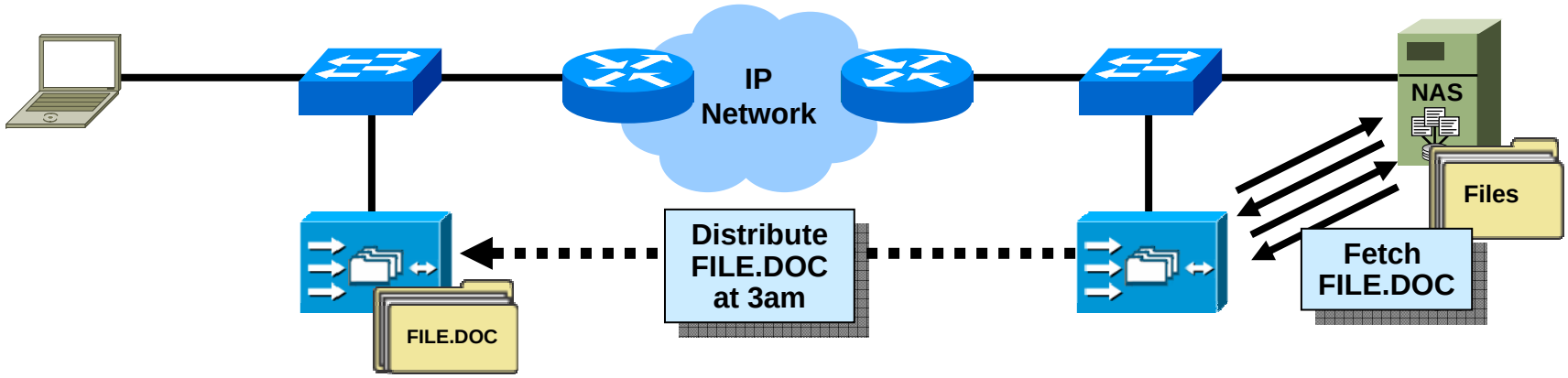
  DRE and LZ improves open and save operation performance through compression and data suppression

  TFO enables the protocol to more effectively, efficiently utilize available WAN resources



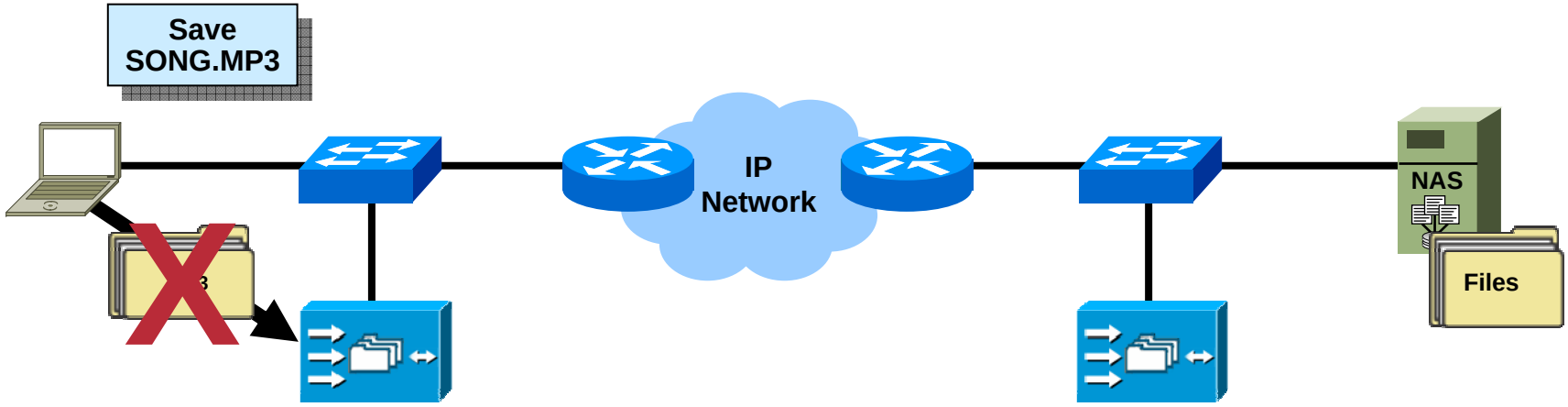
Intelligent File Preposition

- **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**



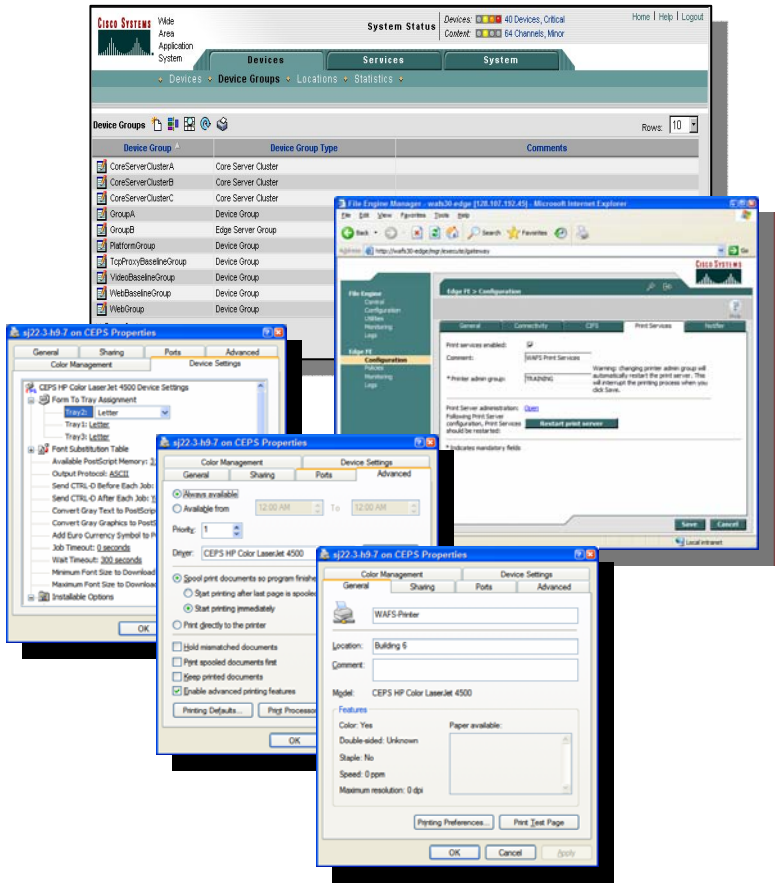
File Blocking

- **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**



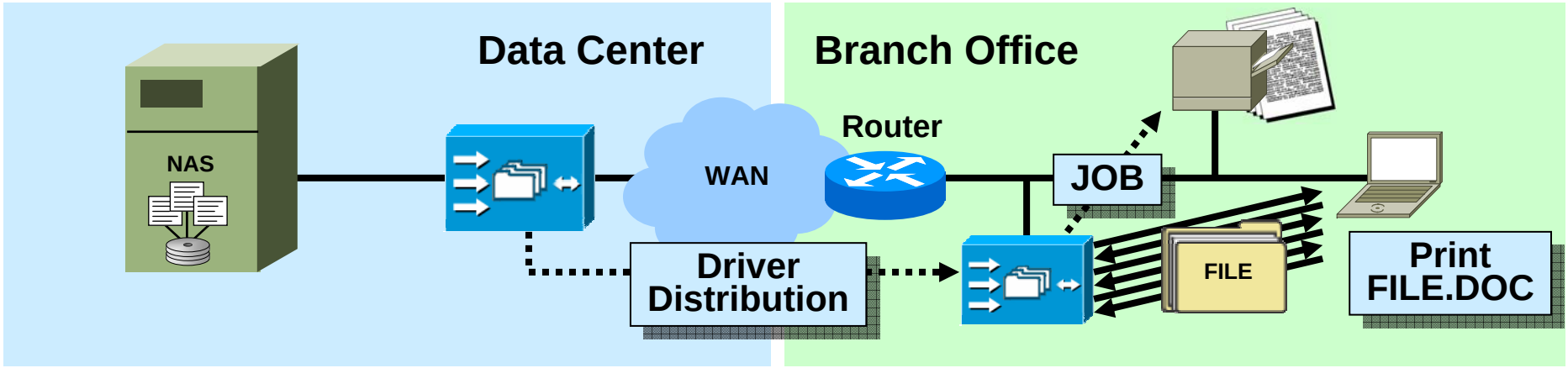
Cisco WAAS Print Services

- **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**



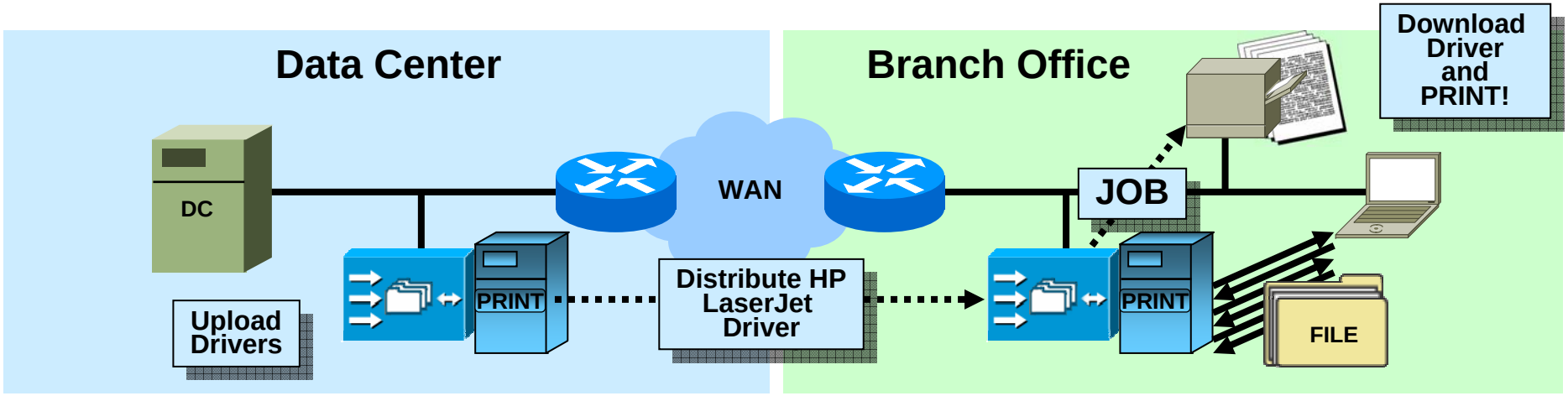
Cisco WAAS Print Services

- **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**



Print Driver Distribution

- **Print drivers are uploaded to the Central Manager WAE and then distributed to edge print servers or groups of devices**
- **Printer drivers are then accessible at the edge of the network for local download (PRINT$ share) to support “Click-N-Print” functionality**



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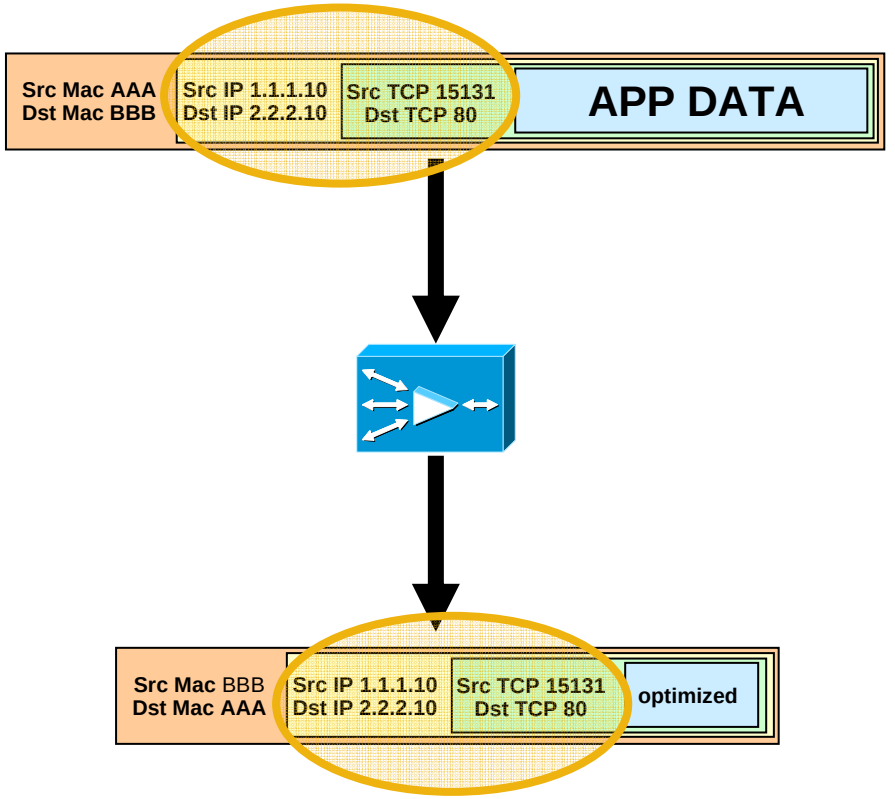
Seamless, Transparent Integration

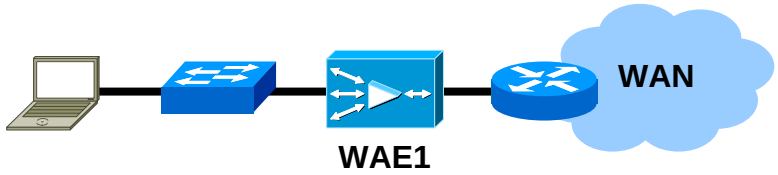
- **Integration into the network fabric with high availability, load-balancing, and failover regardless of interception mechanism**
  - **Physical inline**
  - **WCCPv2**
  - **Policy-Based Routing**
  - **CSM/ACE Modules**
- **Compliance with network value-added features**
  - **Preservation of packet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



Cisco WAE Physical Inline Deployment

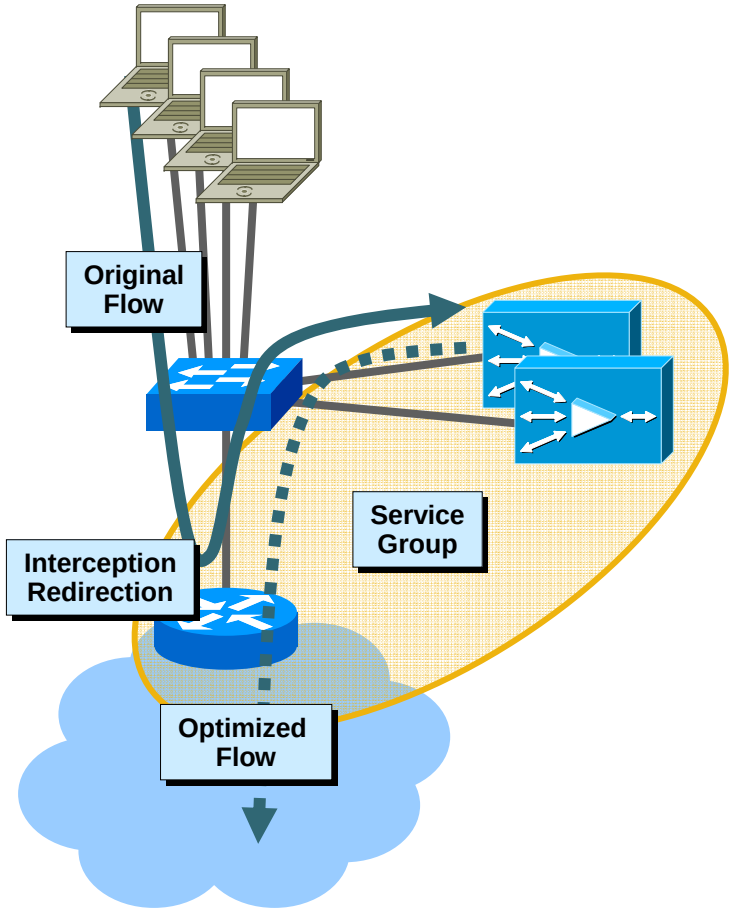
- **Physical inline interception**
  - **Physical in-path deployment between switch and router or firewall**
  - **Mechanical fail-to-wire upon hardware, software, or power failure**
  - **Requires no router configuration**
- **Scalability and high availability**
  - **Two two-port groups**
  - **Serial 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 4-port inline card



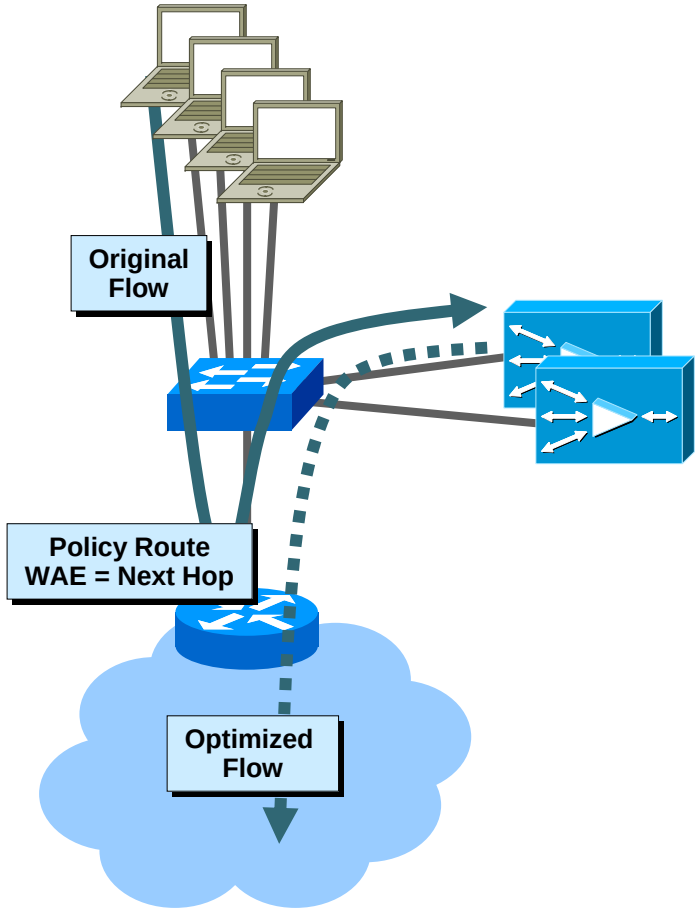
Cisco WAE WCCPv2 Deployment

- **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**



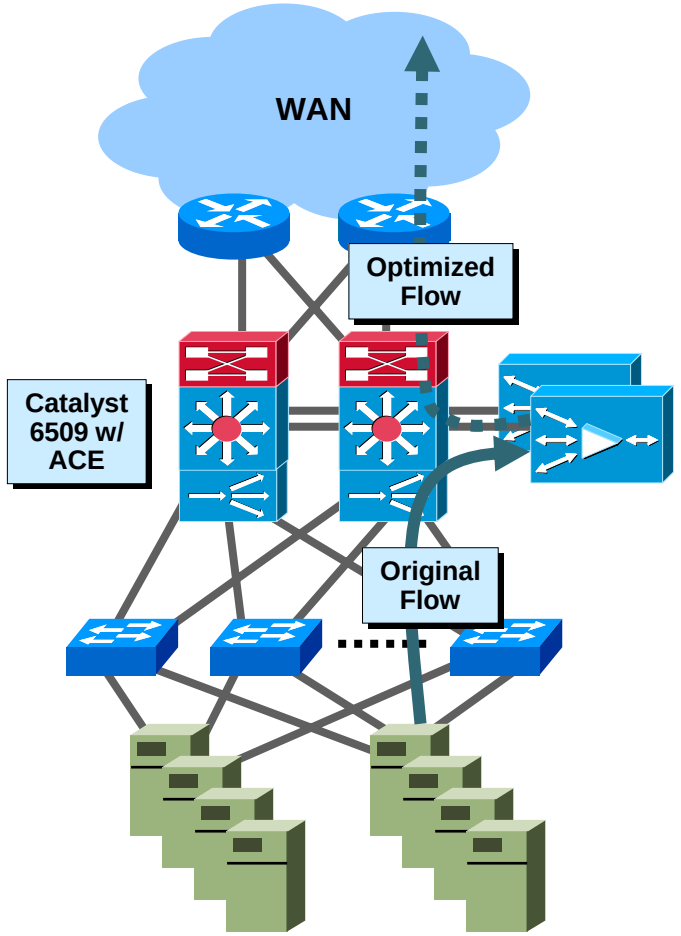
Cisco WAE PBR Deployment

- **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**



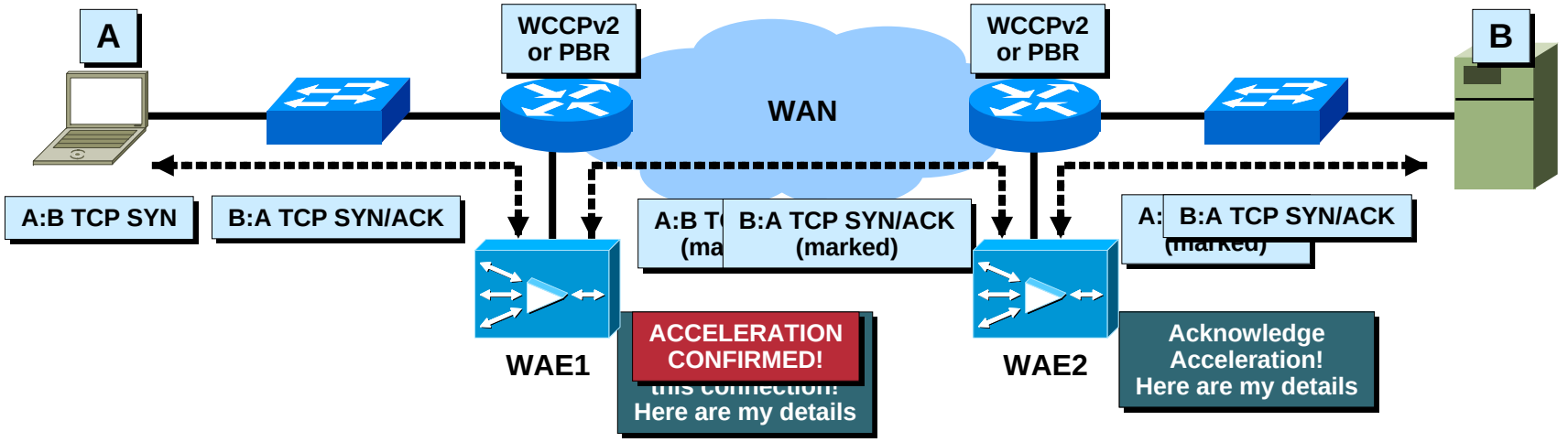
Cisco WAE ACE Deployment

- **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 WAAS Auto-Discovery

- **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

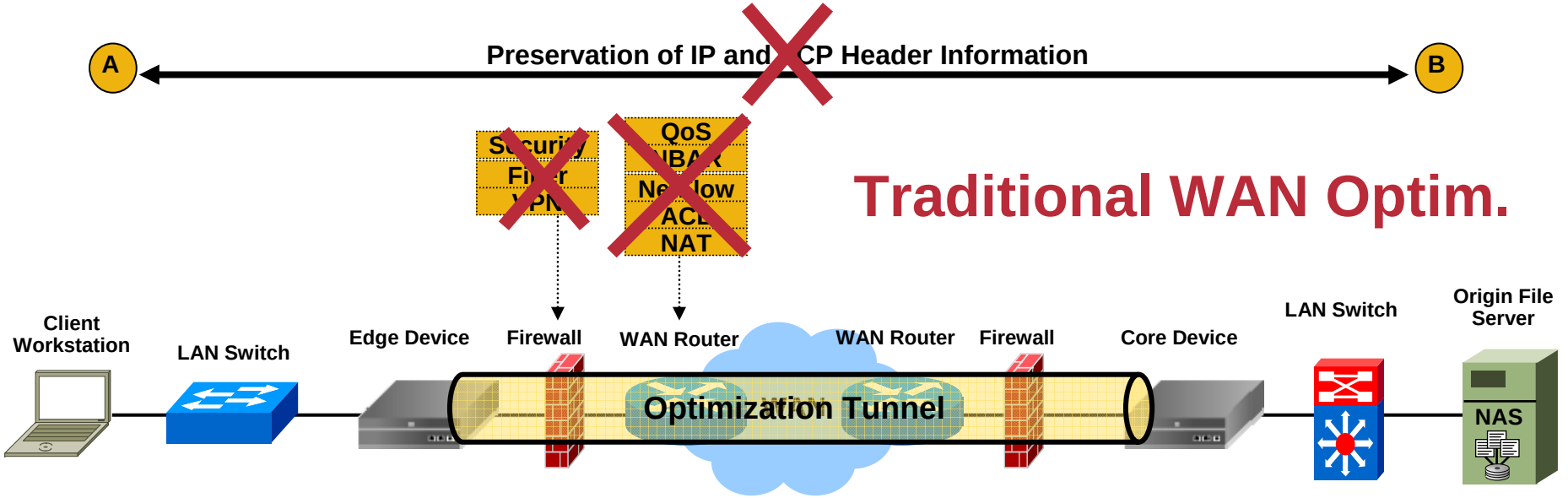
- **Cisco WAEs use TCP option 0x21 (option 33) to automatically discover one another and negotiate policy to apply to a flow**
  - **Many firewalls scrub options from TCP segments as a means of 'normalization'**
  - **Firewalls may need to be configured to permit this option as documented in the Cisco 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 10.88.81.25.2628 > 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

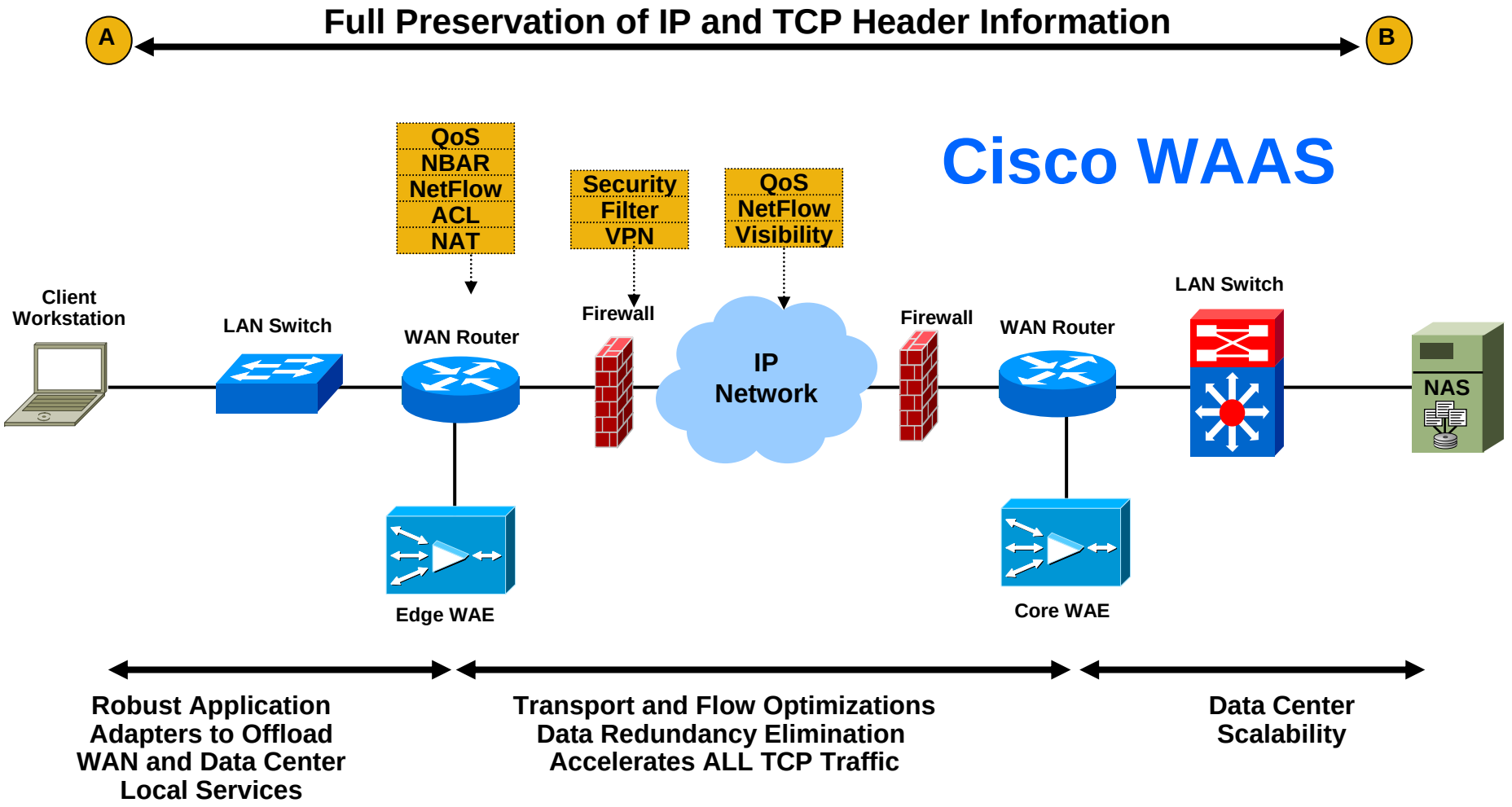


Traditional WAN Optimization changes TCP/IP header information

Result:

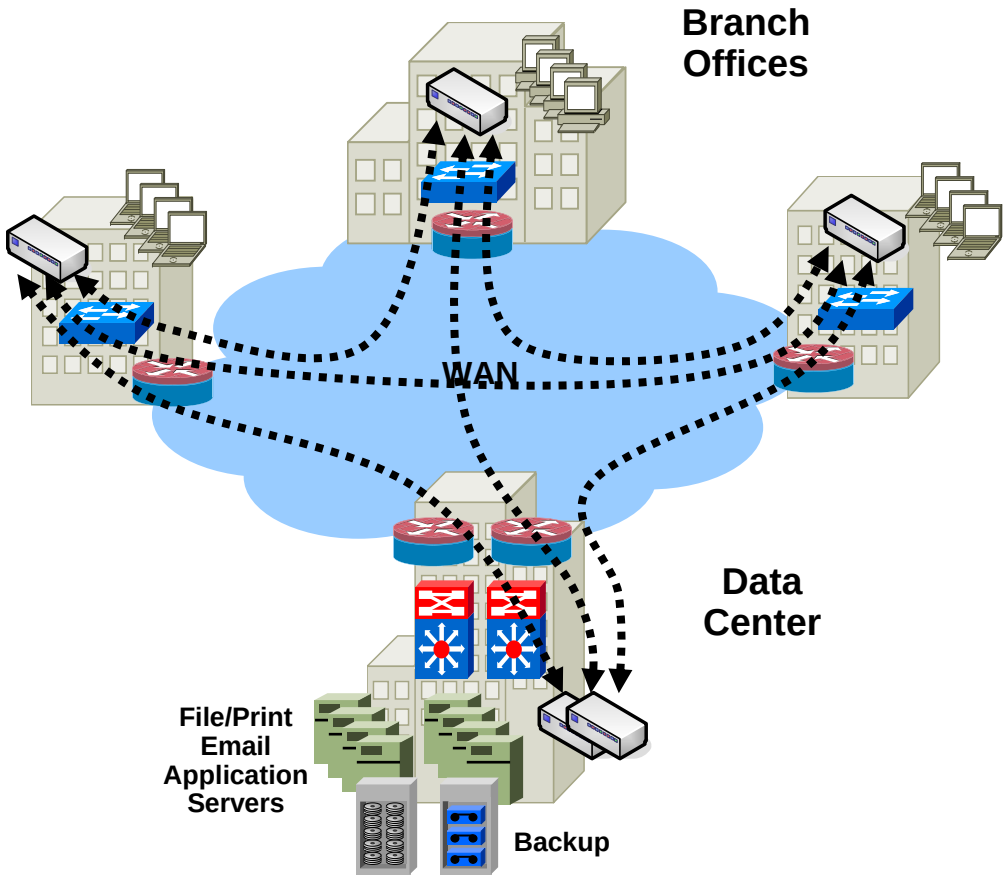
- **Services may not work**
- **Extra integration required**
- **Risk of downtime due to dedicated links**

Cisco WAAS
Seamless Network Integration, Service Preservation



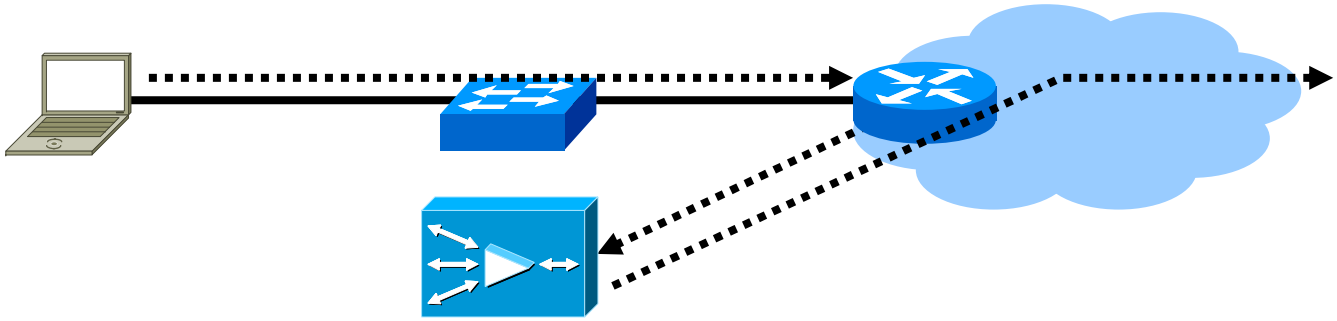
Non-Transparent Optimization Challenges

- **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**



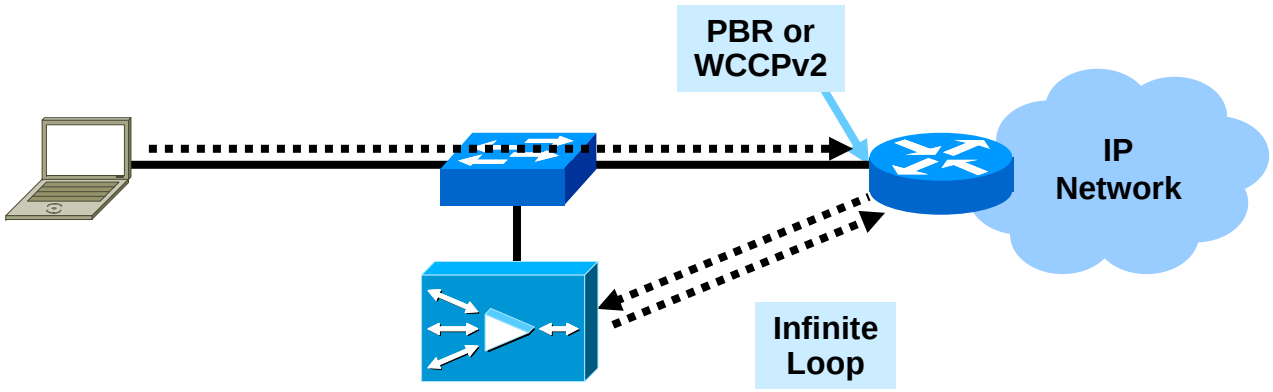
Network Integration Overview

- **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**

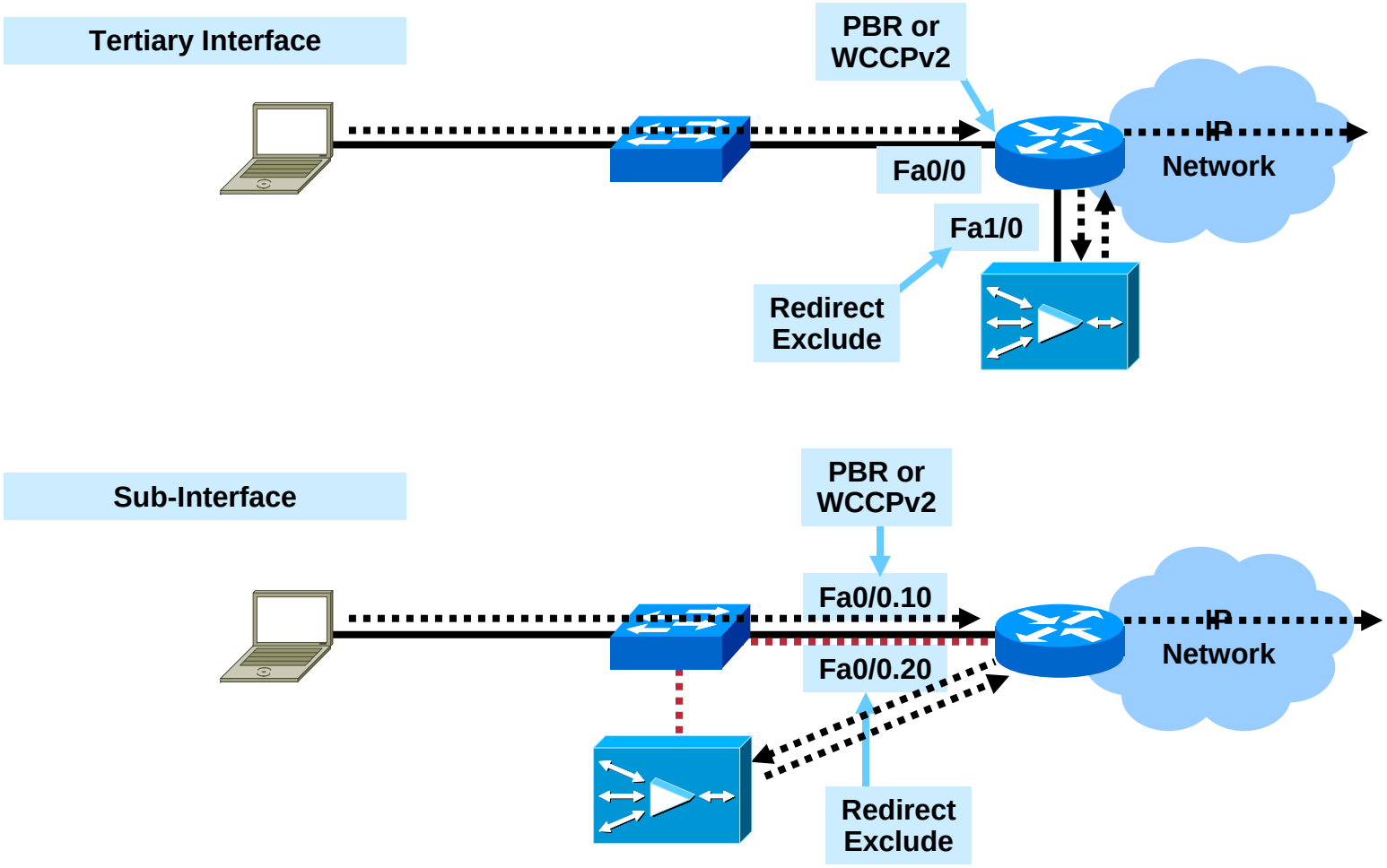


Use of Tertiary IFs or Sub-IFs

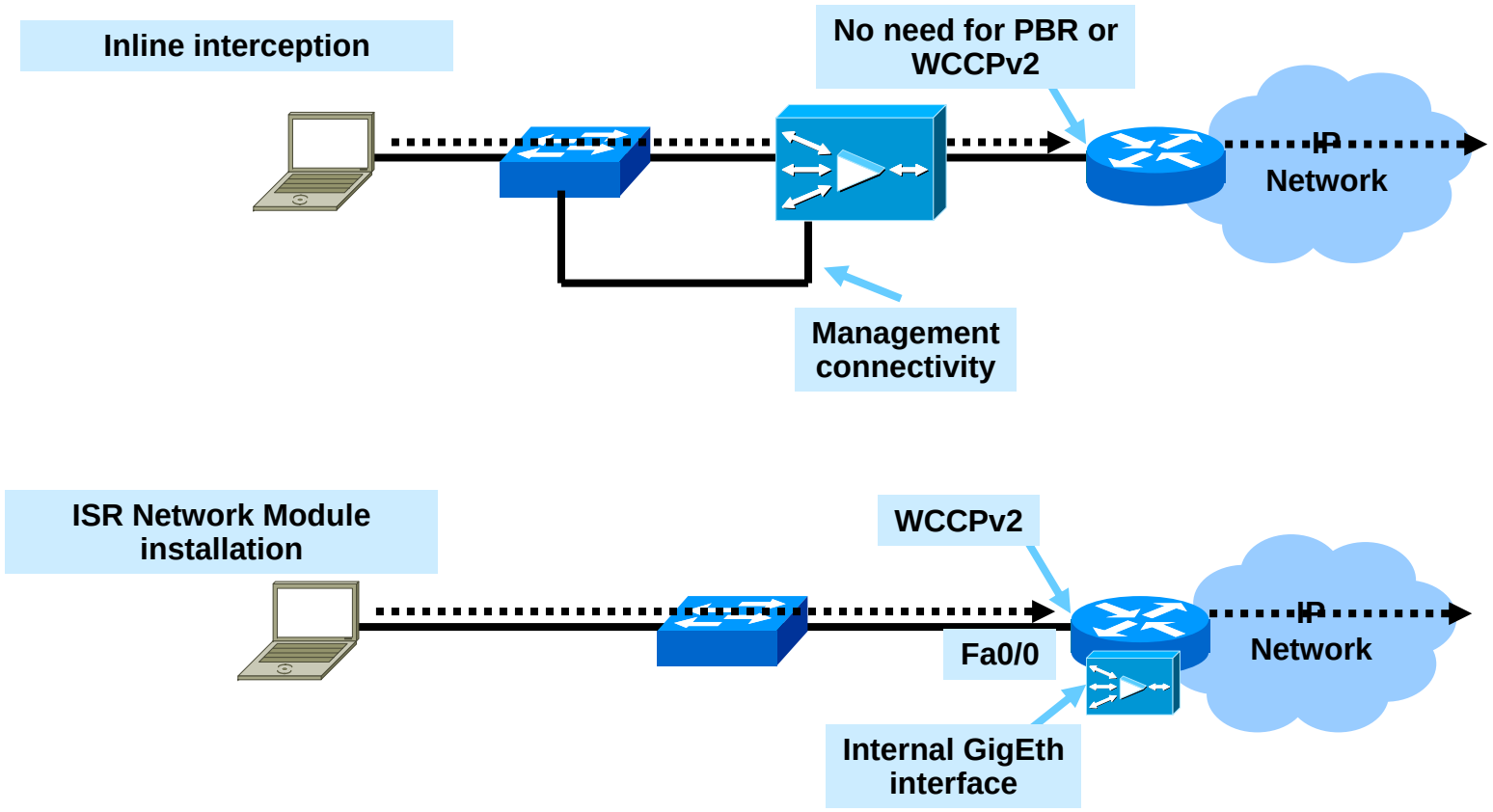
- **With non-inline modes, the WAE must not be attached to the same segment as the interface performing redirection**
- **This is required to avoid routing loops, as we have no way to notify the router to bypass the interception and redirection (shown below)**



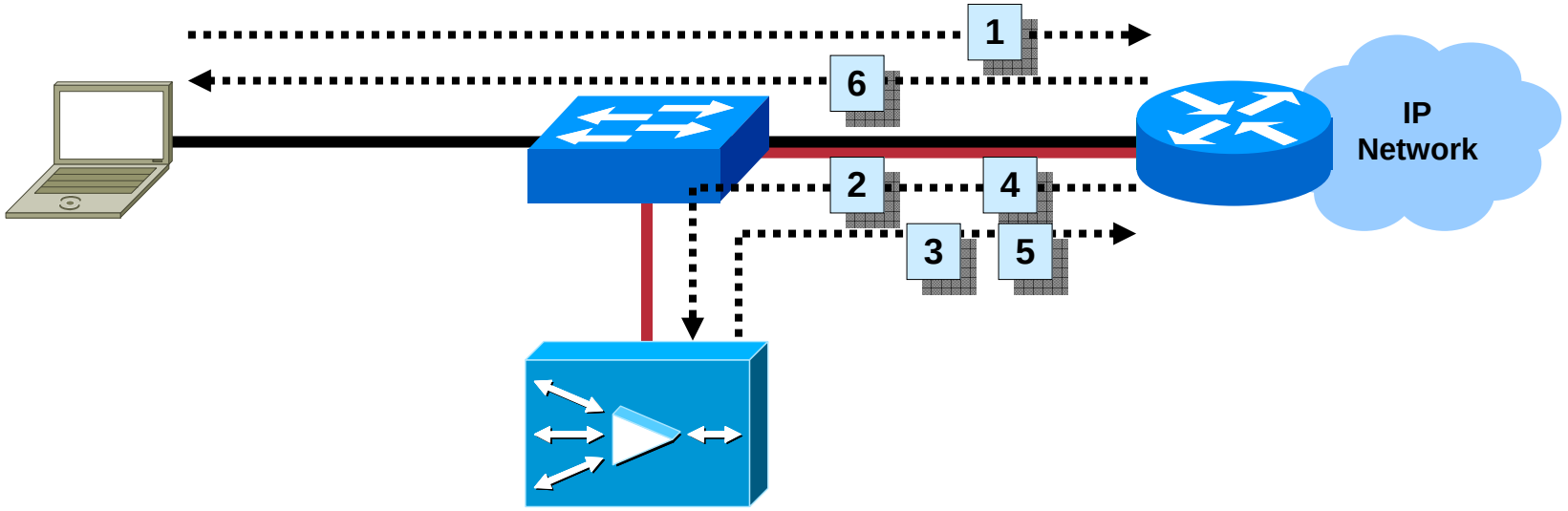
Use of Tertiary IFs or Sub-IFs (Cont.)



Inline and NM interception

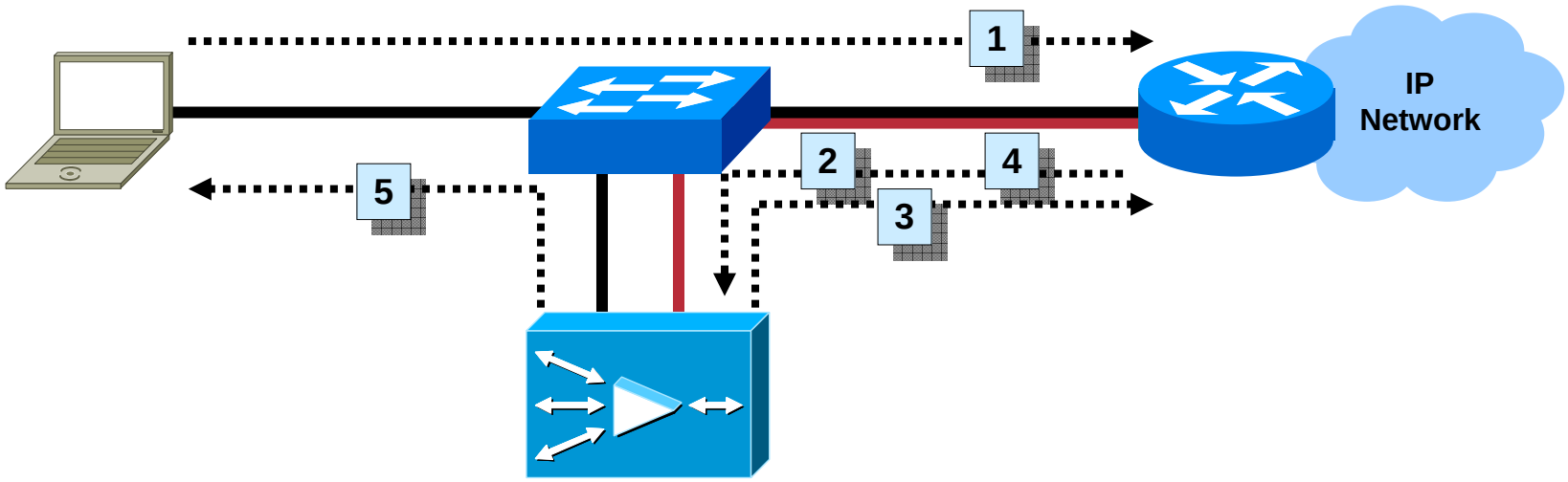


One-Arm Deployment Example



- **Pros**
  - **Simplicity**
  - **Single interface**
- **Cons**
  - **Performance constrained**
  - **Higher router utilization**

Two-Arm Deployment Example



- **Pros**
  - **Better performance**
  - **Lower router utilization**
- **Cons**
  - **Add'l switch port consumed**
  - **Add'l configuration**
  - **Interface adjacency to node**
  - **Usually feasible in branch only**

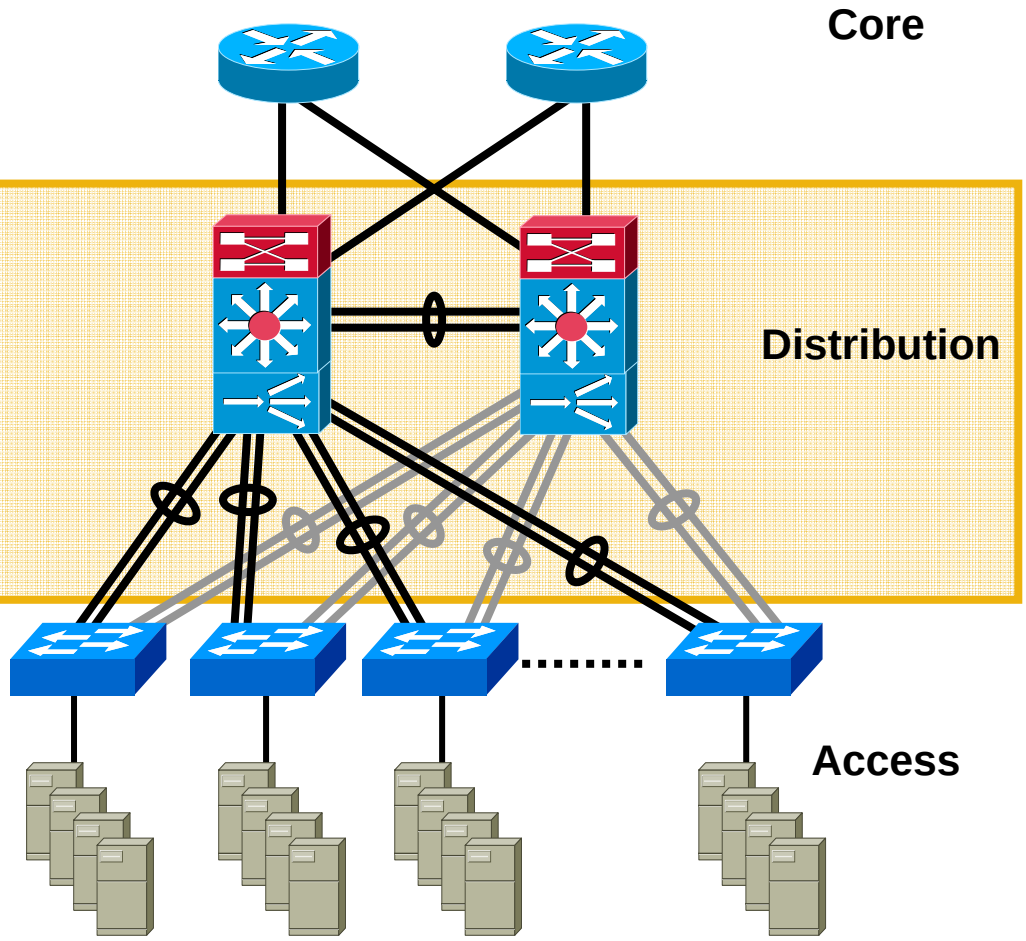
Hierarchical Network Placement Considerations

Locality is key

- **High locality to the core yields a more global level of optimization**
  - **Intercept traffic going to/coming from the WAN exclusively (based on placement of interception)**
  - **Closer to the WAN entry/exit prevents intrasite access from traversing the WAEs**
  - **Provide optimization for all attached distribution, access layers**
- **High locality to the access layer yields a more focused level of optimization**
  - **Optimization restricted to a specific access layer unless significant changes to network routing are introduced**
  - **May cause intrasite access to traverse the WAEs which causes unnecessary WAE resource utilization**

Hierarchical Network Placement Considerations

- Core layer typically reserved for high performance forwarding
- Distribution layer provides optimal deployment location for WAAS – close to core, aggregation for downstream access layers
- Access layer can be used, but too contained to be used for large scale optimizations



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

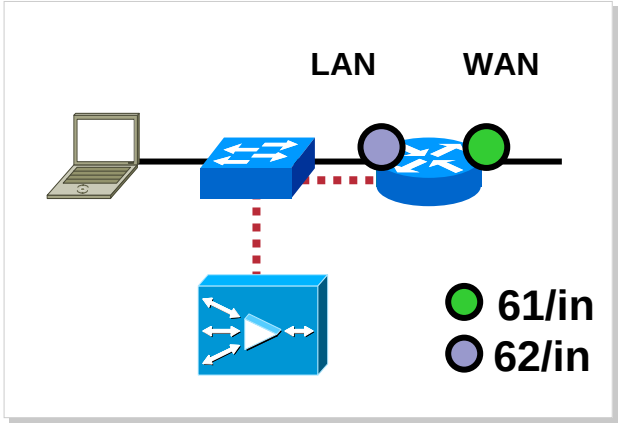
- **Placement of the services should not be overlooked**

WCCPv2 Configuration – Routers

Recommended

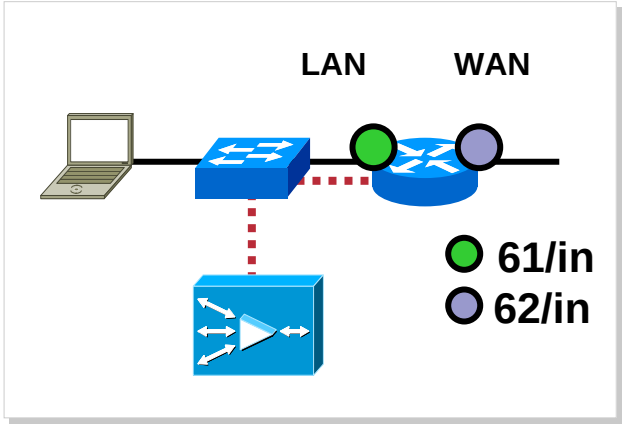
62/in LAN and 61/in WAN
keeps flows to a particular server pinned to the same WAE in both directions of traffic flow yielding better likelihood of compression per server

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 assignemnt, which are default WCCP service configuration parameters**

WCCPv2 Configuration – Router Isolation

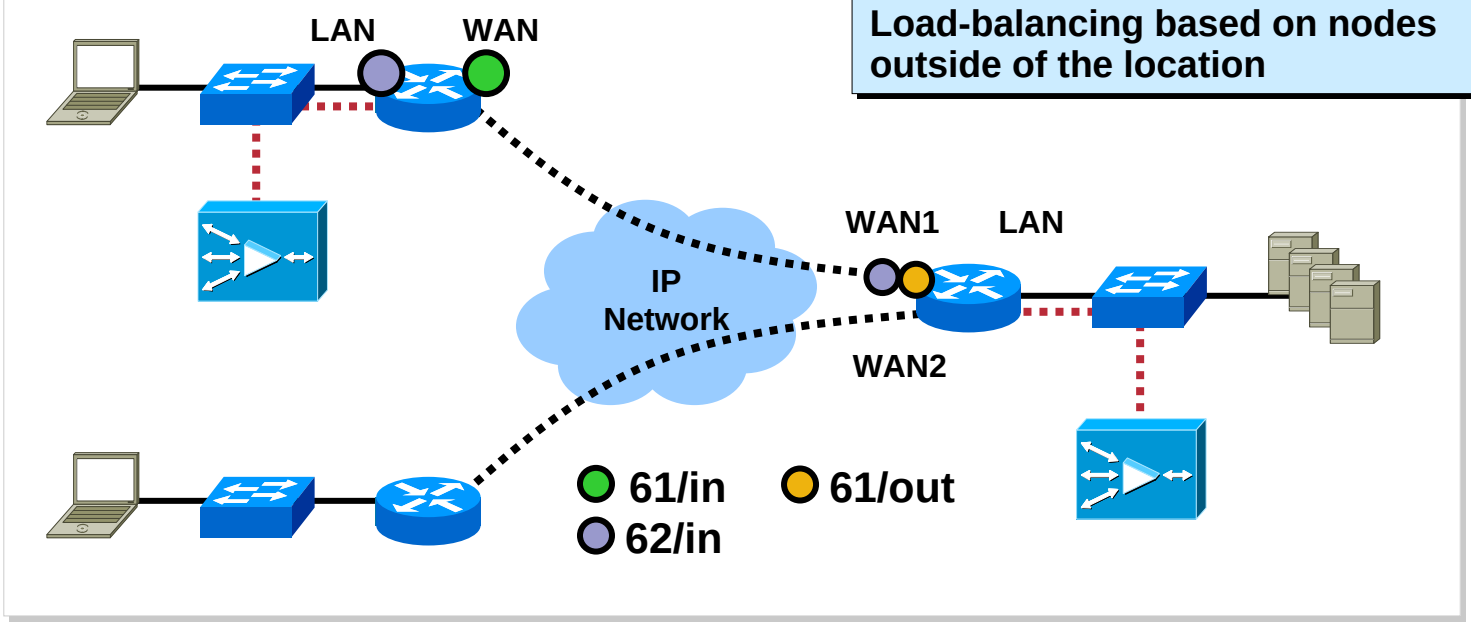
Branch: 62/in LAN and 61/in WAN keeps flows to a particular server pinned to the same WAE in both directions of traffic flow yielding better likelihood of compression per server

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

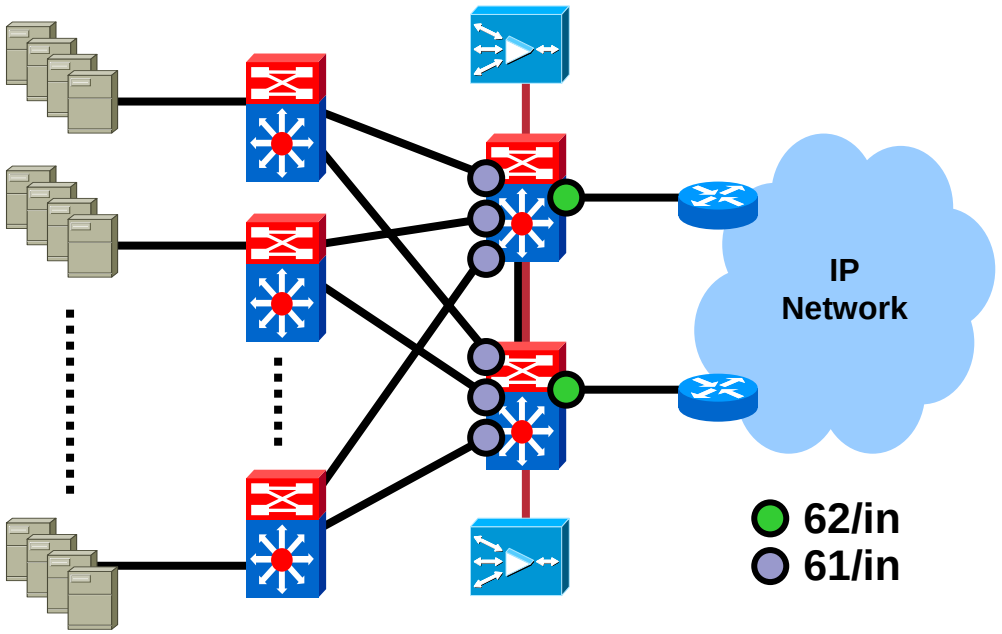
Recommended

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

Load-balancing based on nodes within the location

62/in LAN and 61/in WAN
keeps flows to a particular client
pinned to the same WAE in both directions of traffic flow

Load-balancing based on nodes outside of the location



- **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?

	WCCPv2	Inline	CSM/ACE	PBR
Number of Active WAEs	32	2 (serial cluster, tested limit)	16000 (not practical but possible)	1
Maximum Number of WAEs	32	2 (serial cluster, tested limit)	16000 (not practical but possible)	8 (IOS dependent)
Maximum Number of TCP Connections (with WAE-7326)	240K	15K	4M	7.5K
Maximum Throughput	Up to 32Gbps (platform dependent)	Up to 2Gbps (two inline pairs)	Up to 16Gbps (platform dependent)	Up to 1Gbps
Recommended Use	Generally Recommended	Only if WCCPv2 can not be used (SP managed or low-end router)	Very large scale data center deployments	Last resort

Agenda

- Enterprise Application Delivery Challenges
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- Network Integration and Deployment
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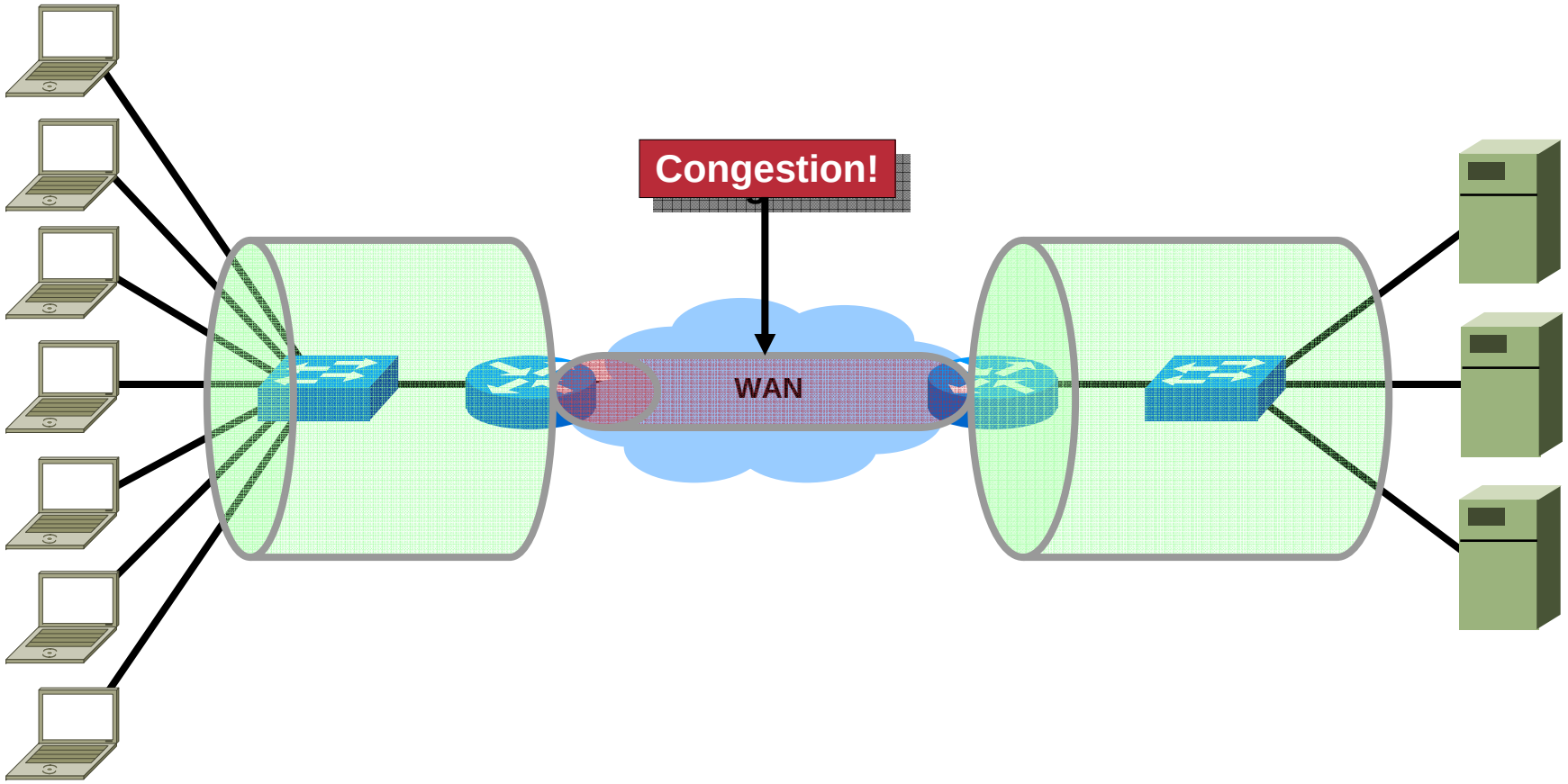
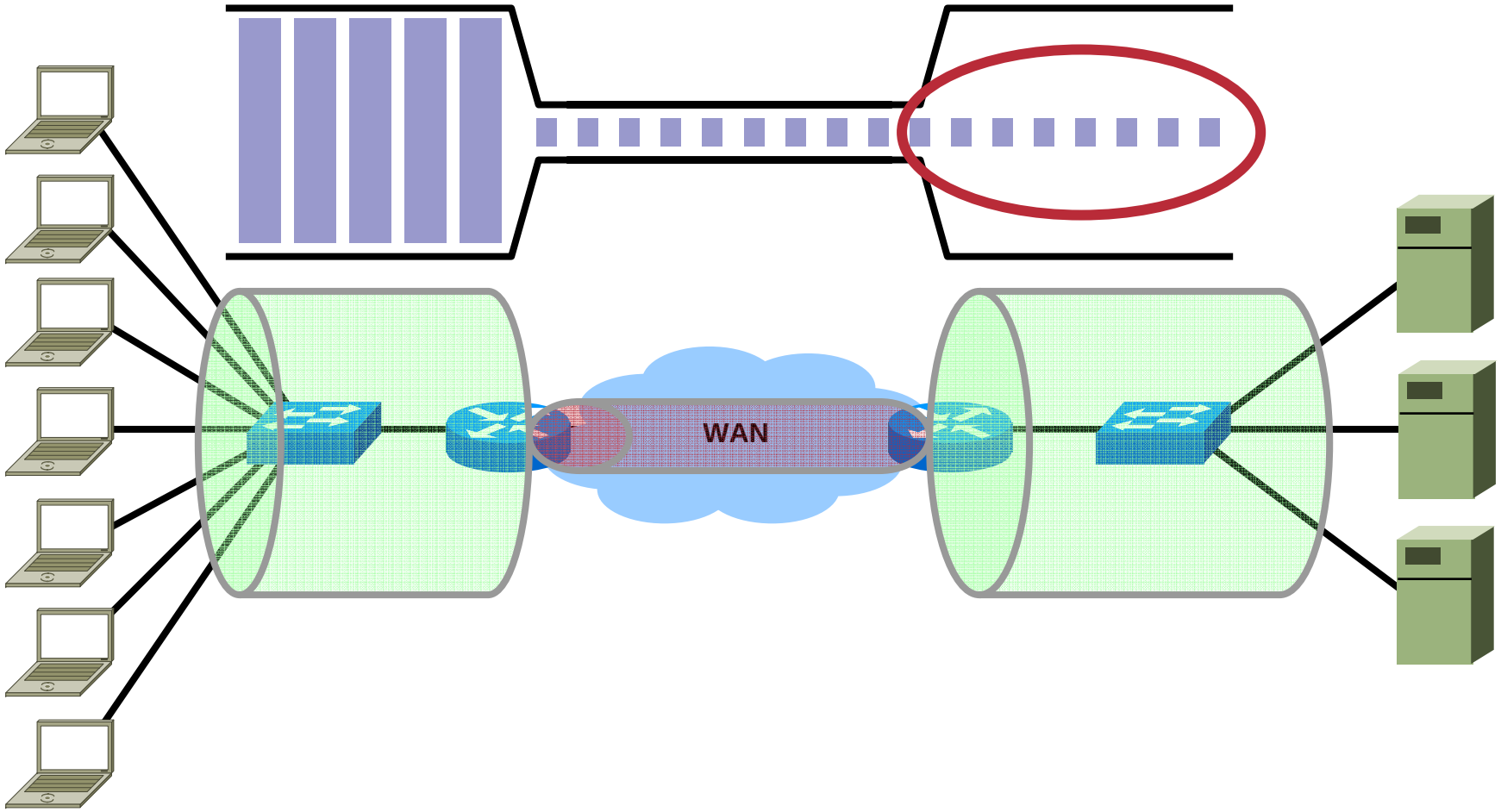
- Q&A

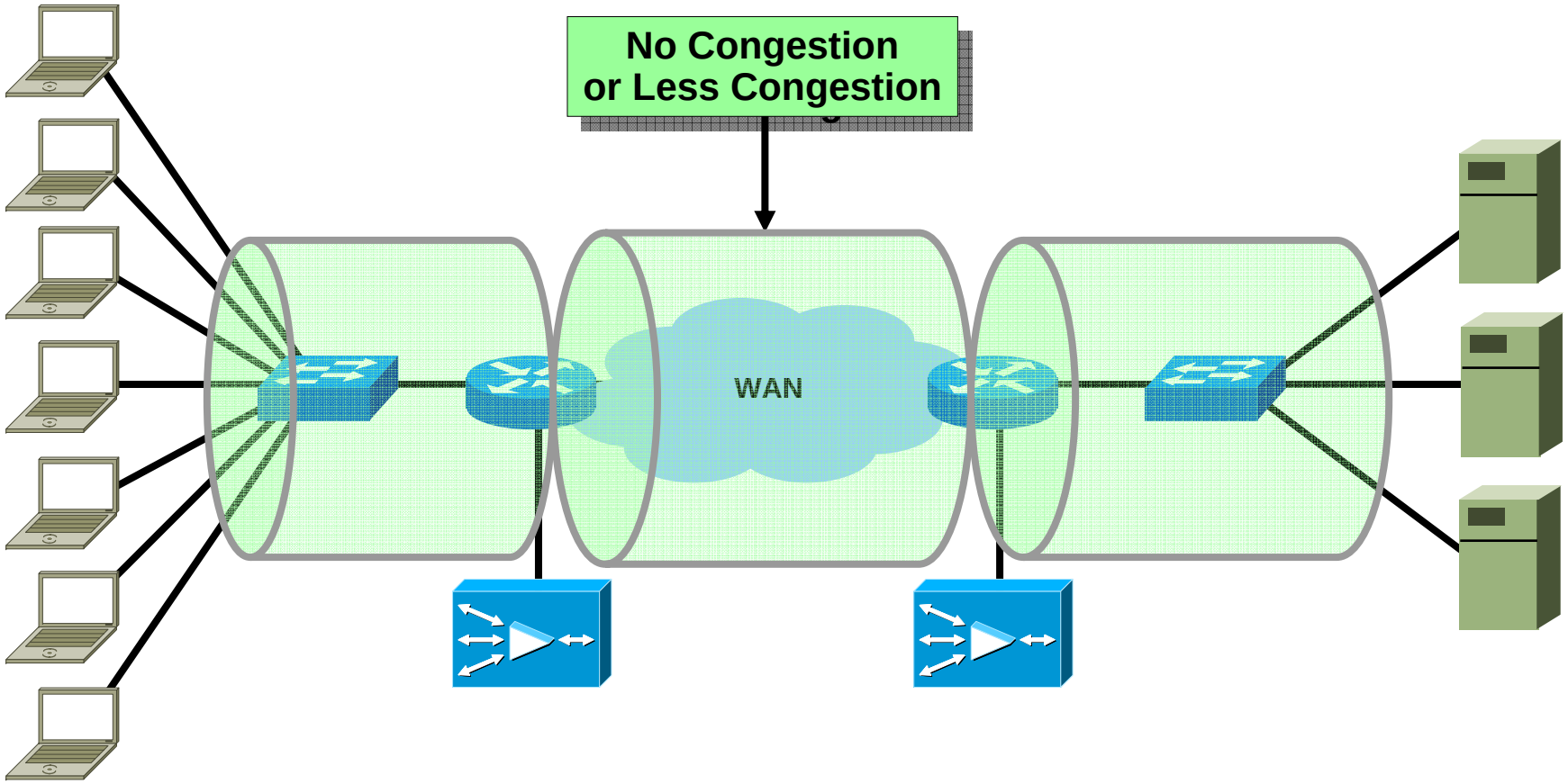
Networks Without Compression



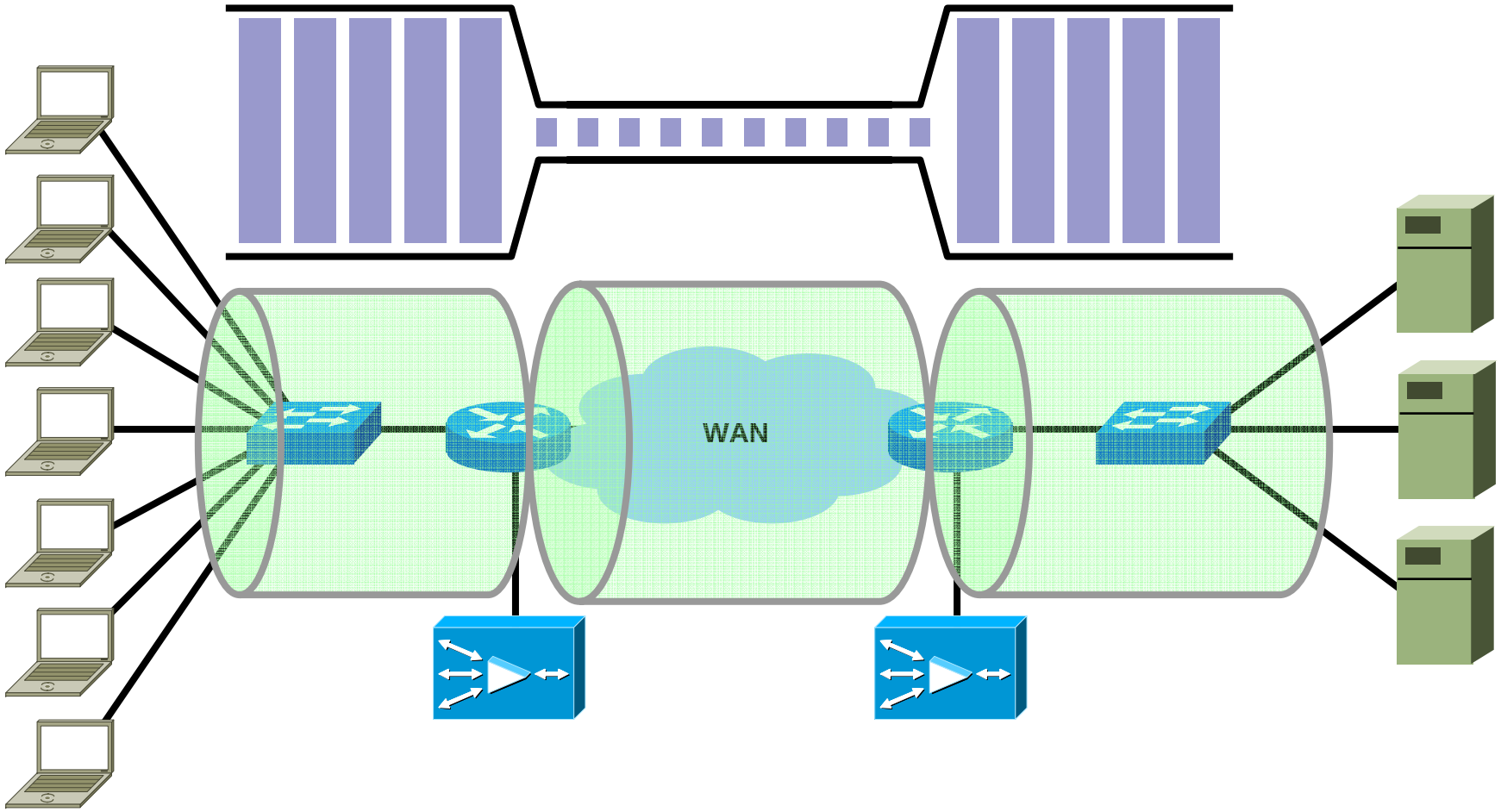
Data Transfer Without Compression



Networks With Compression

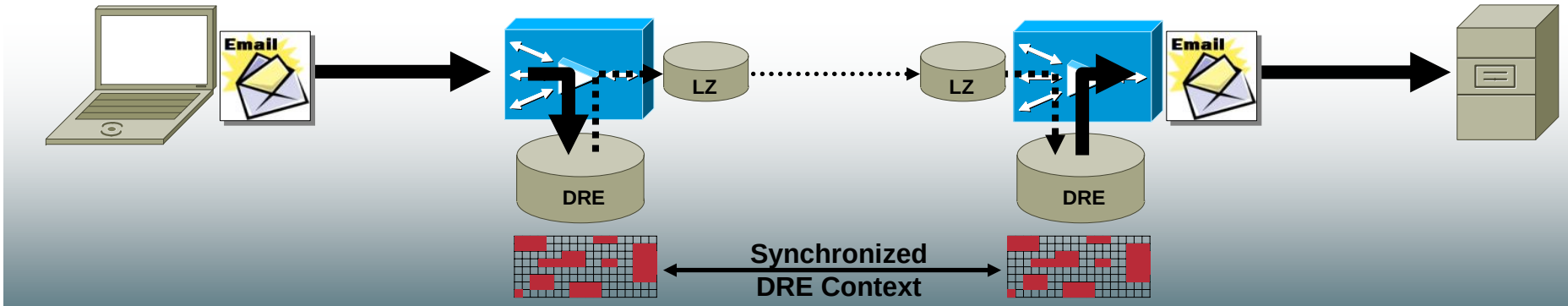


Data Transfer With Compression

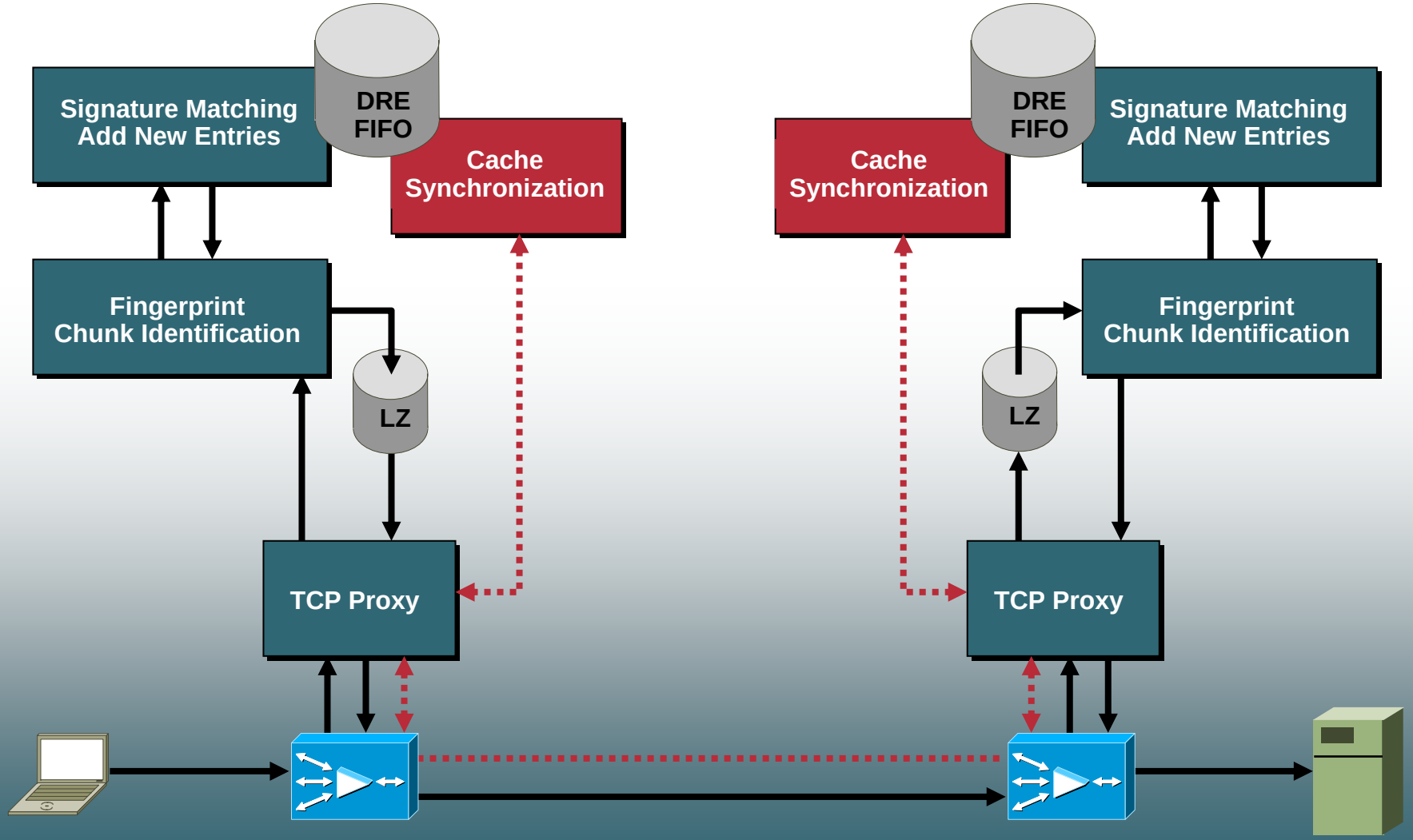


Cisco WAAS Advanced Compression

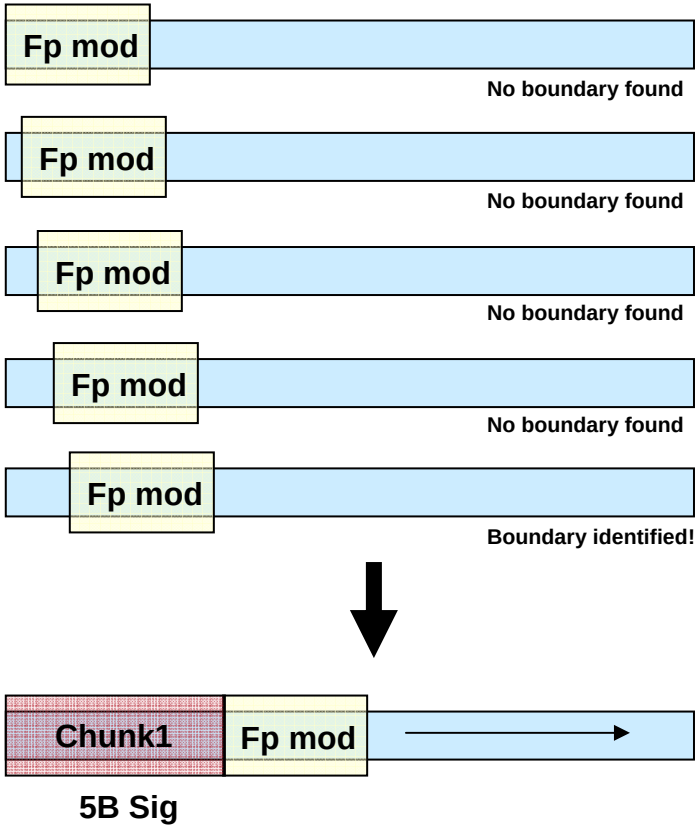
- **Data Redundancy Elimination (DRE): application-agnostic compression eliminates redundant data from TCP streams providing up to 100:1 compression**
- **Persistent LZ Compression: session-based compression provides up to an additional 10:1 compression even for messages that have been optimized by DRE**



Cache Operation Block Diagram

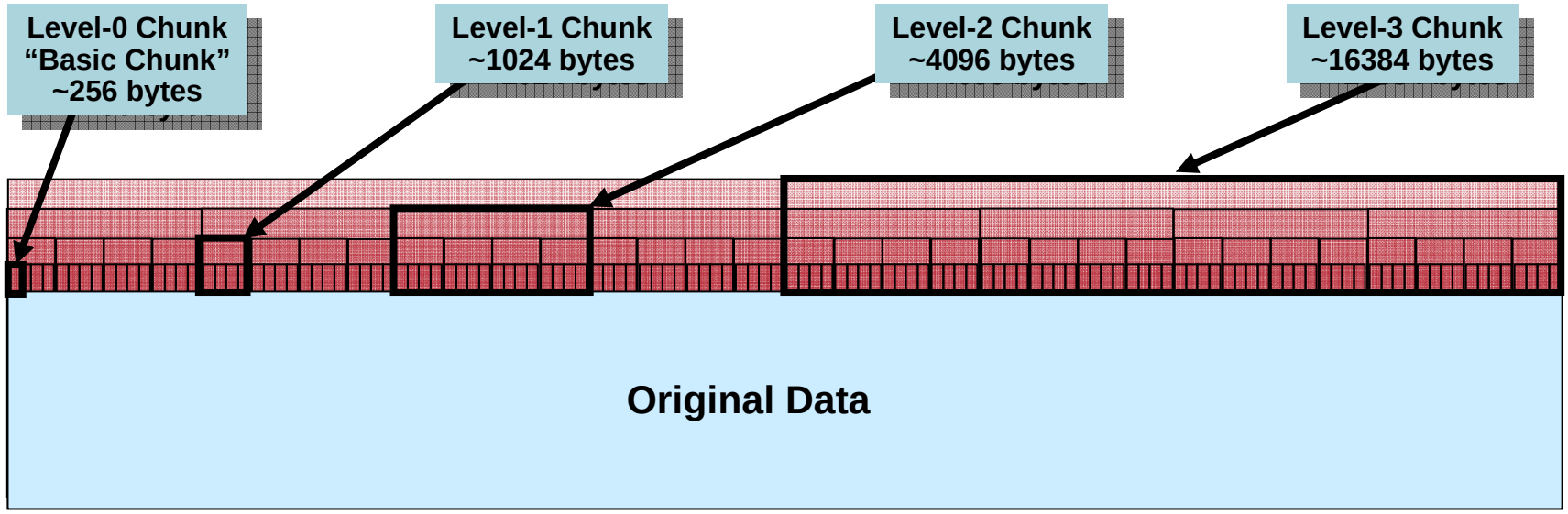


DRE Chunk Identification



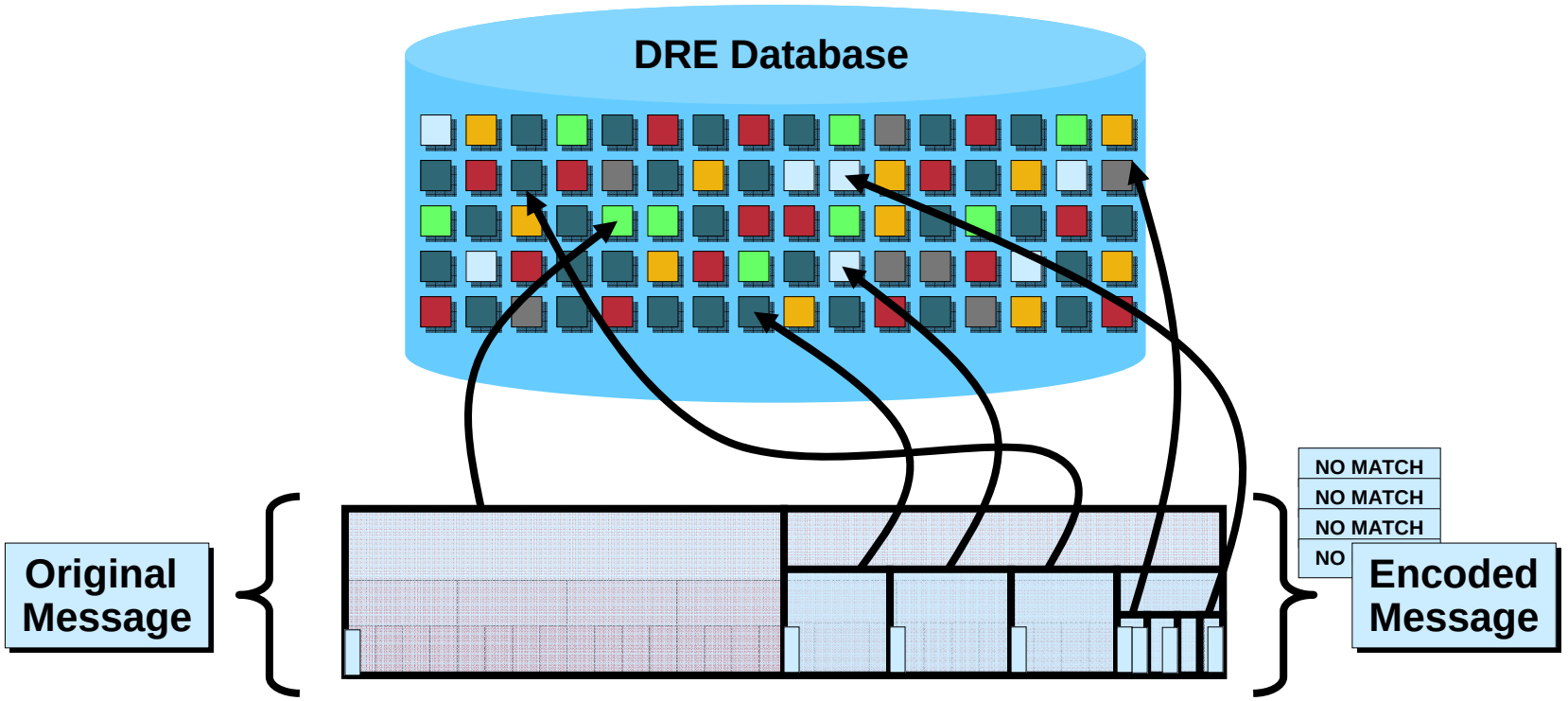
- Analyze incoming data streams using a sliding window to identify “chunks”
- Each chunk assigned a 5-byte signature
- Single-pass used to identify chunks at multiple levels
  - Basic chunks
  - Chunk aggregation (nesting)
- After chunks are identified, DRE will begin pattern matching
  - First look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

DRE Chunk Identification

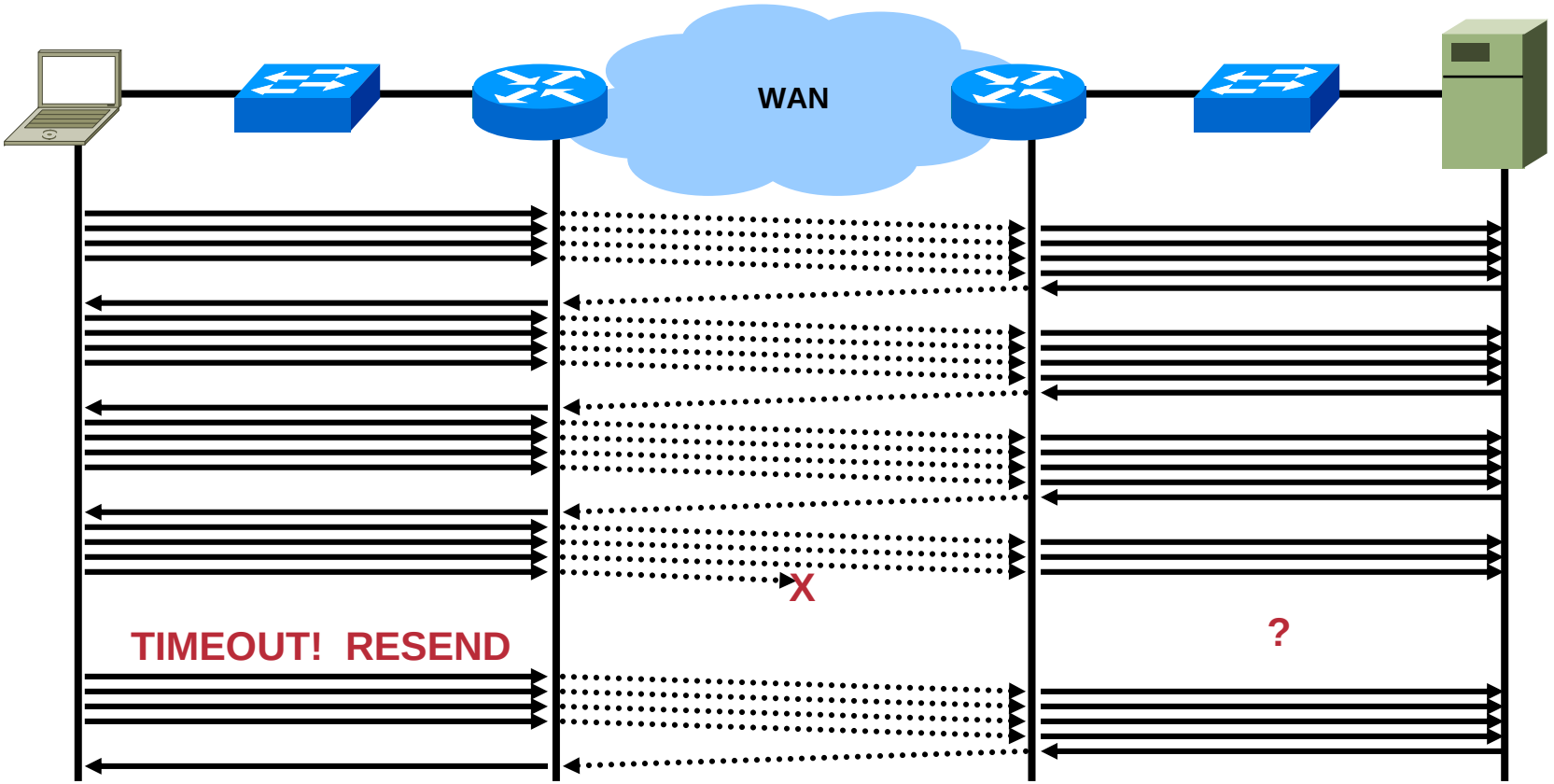


- **Each chunk is assigned a 5-byte signature**

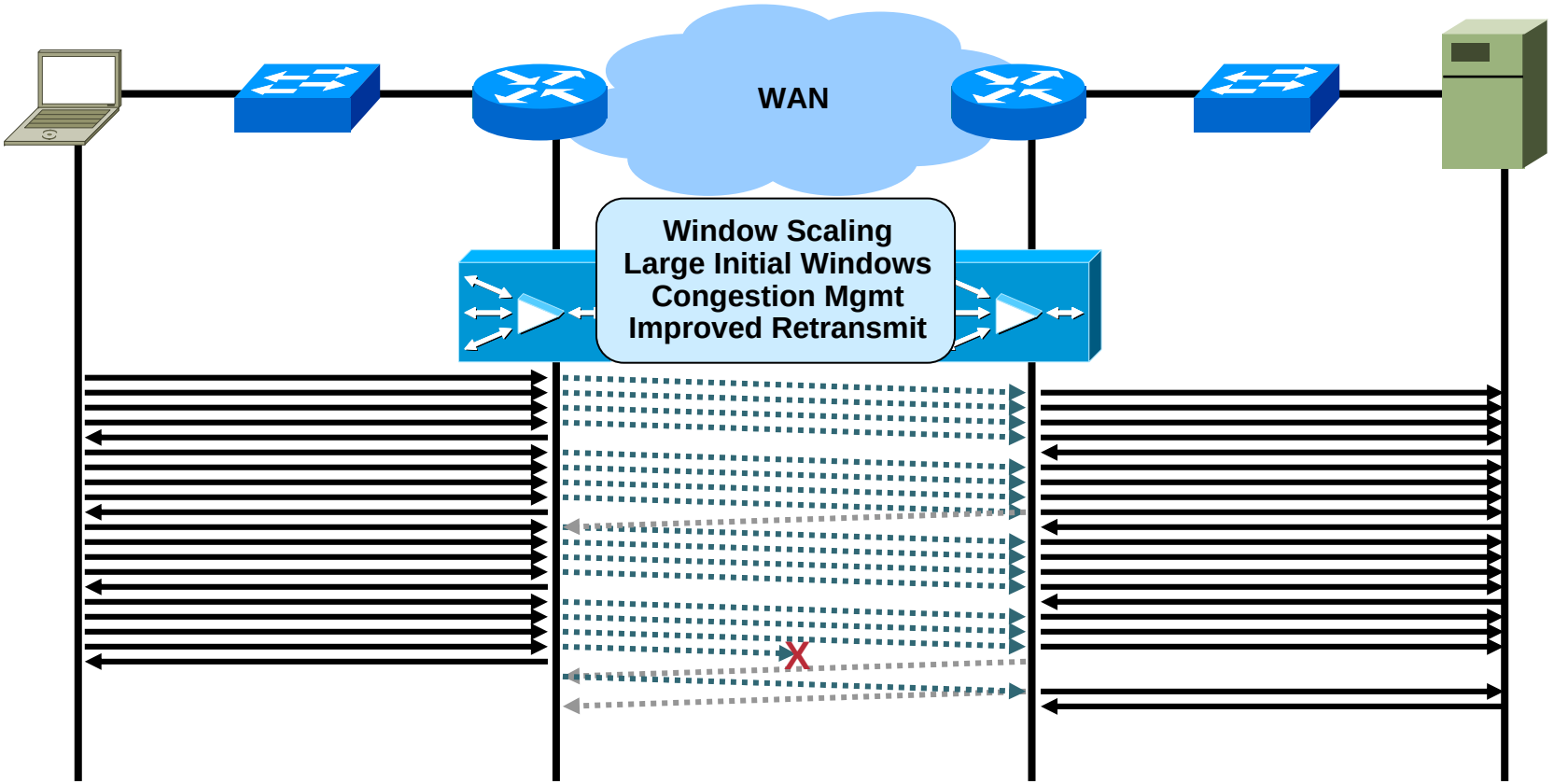
DRE Pattern Matching



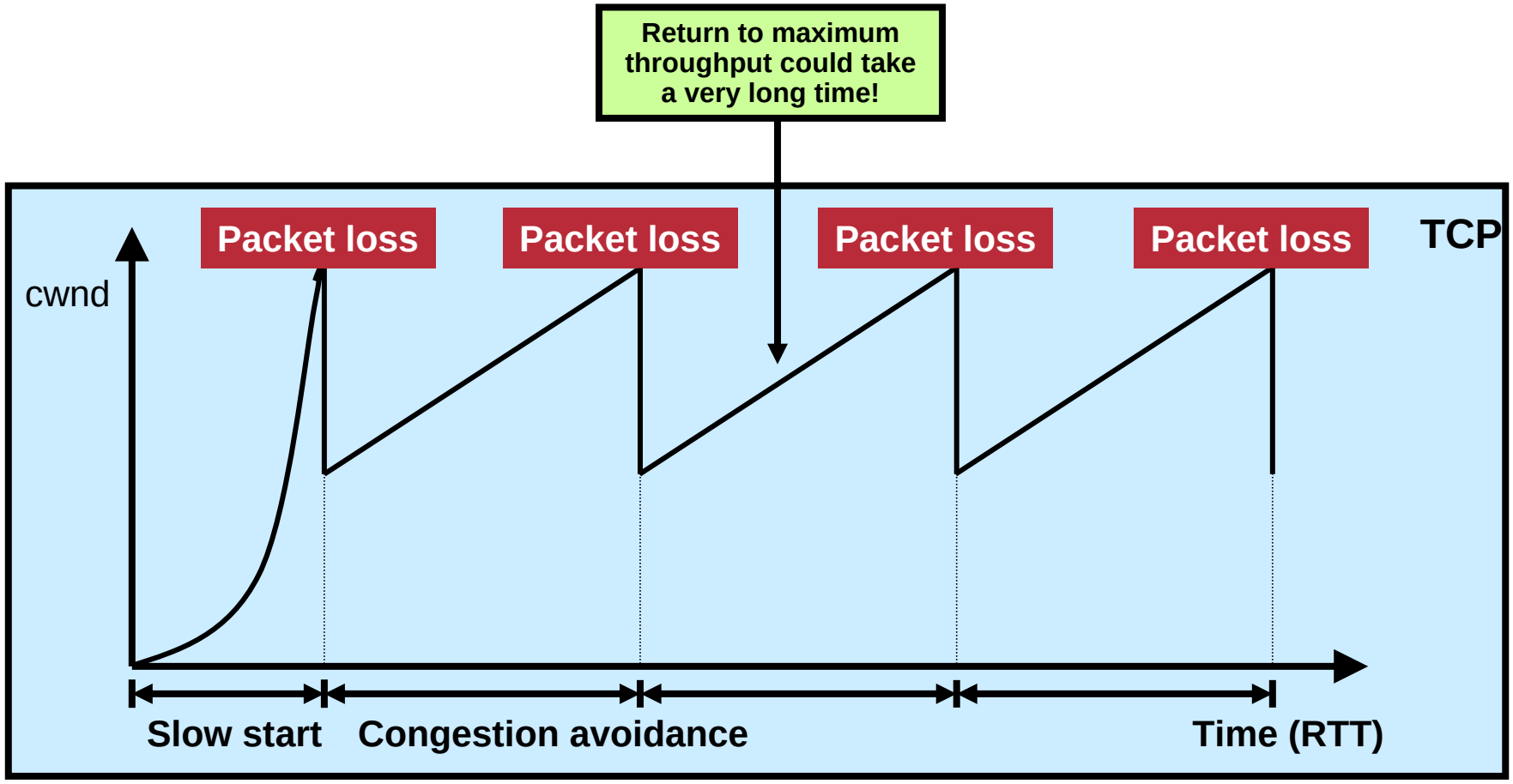
Without TCP Proxy



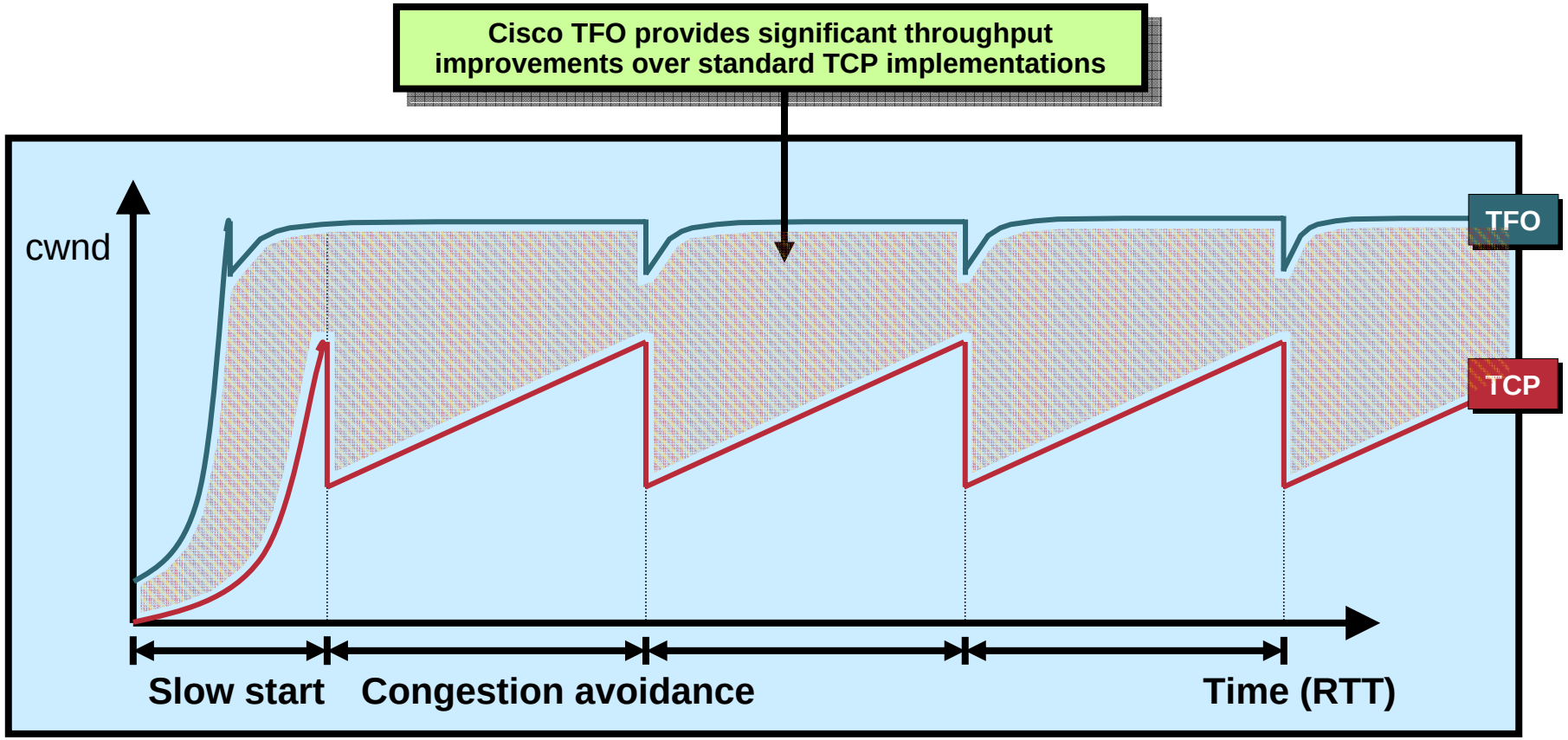
TCP Proxy and TFO



TCP Sawtooth



Comparing TCP and TFO



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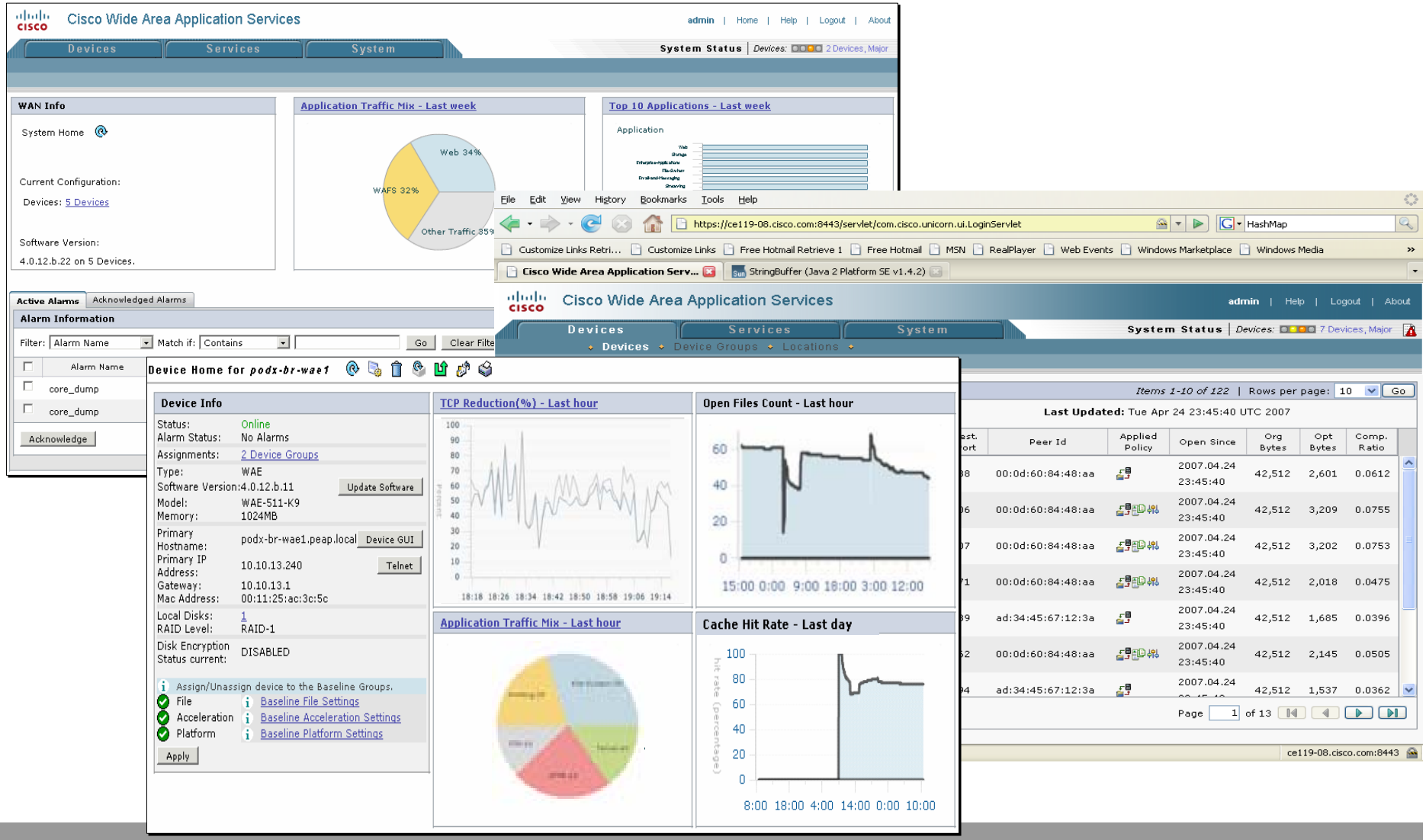
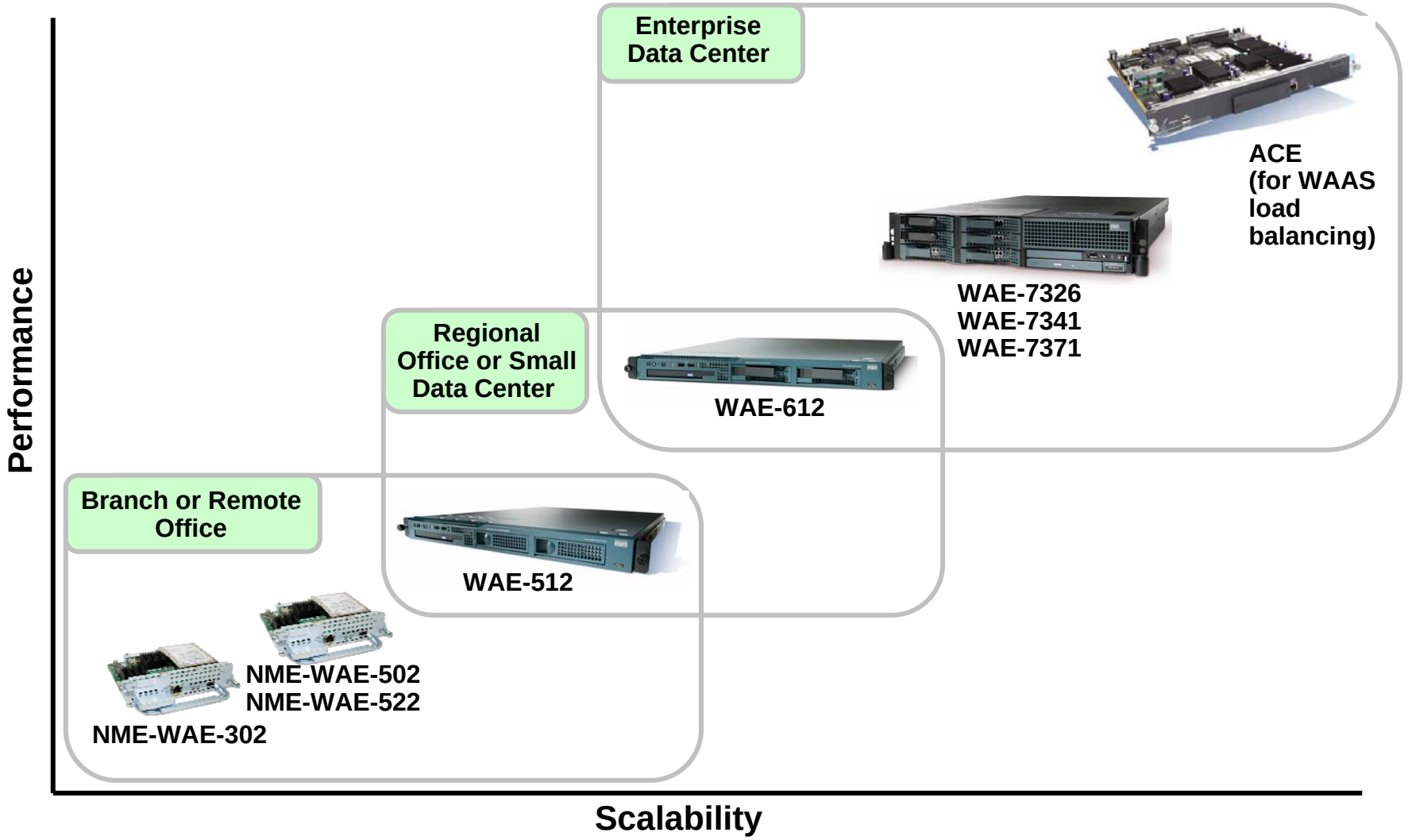
WAAS Intuitive Central Management

- **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**

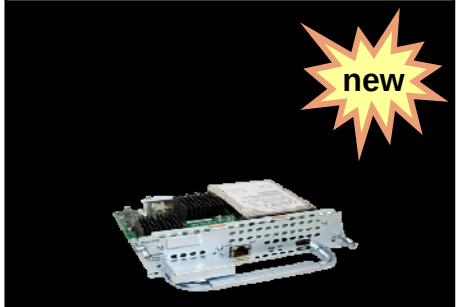
WAAS Intuitive Central Management (cont.)



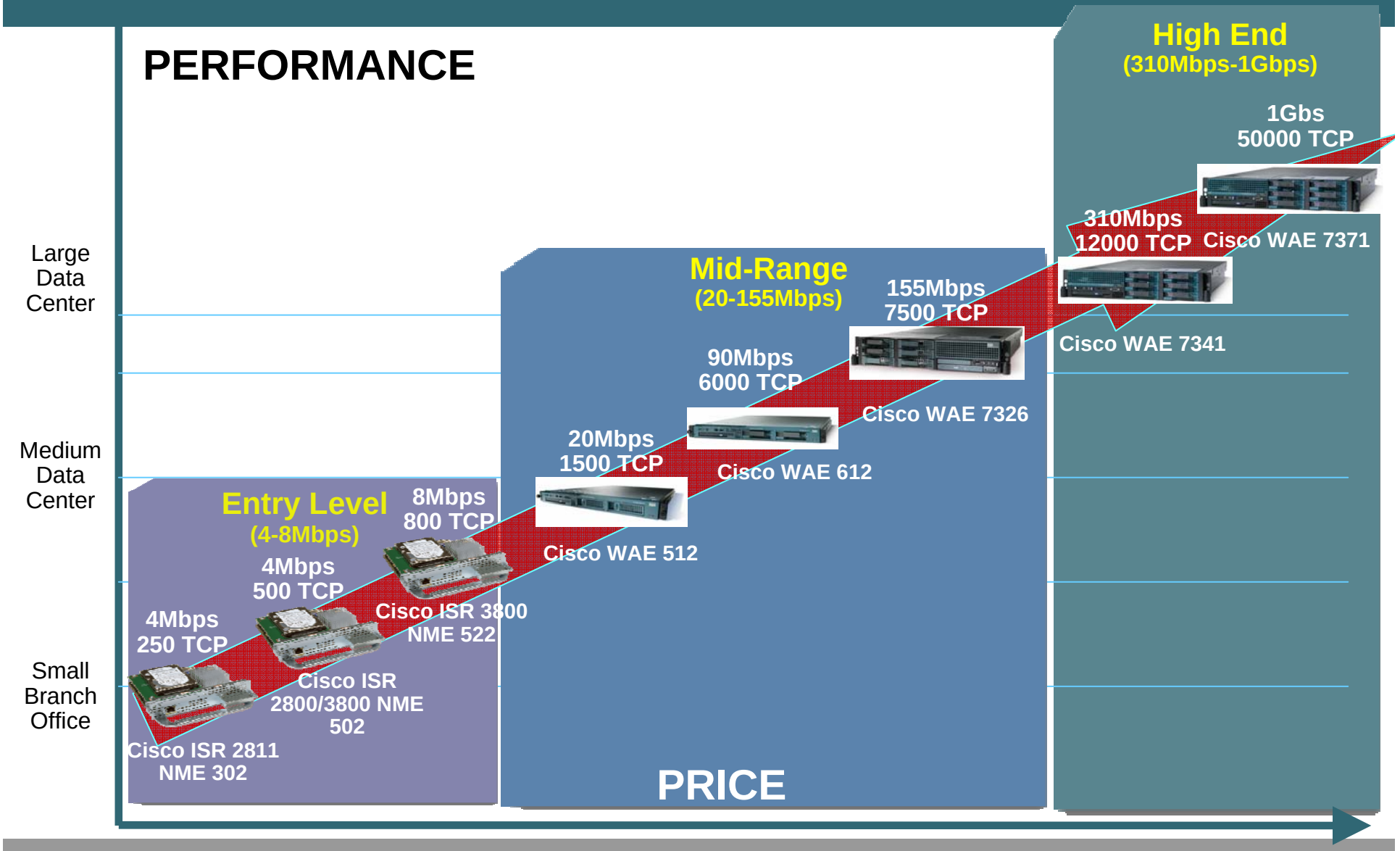
Cisco WAE Family Positioning



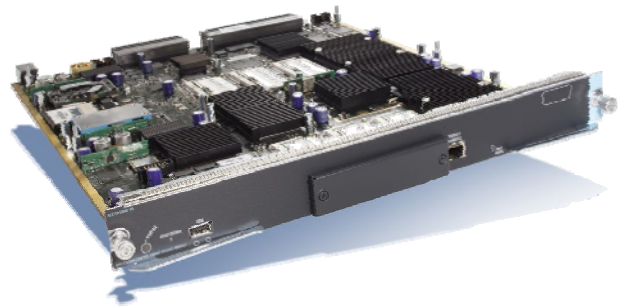
Cisco WAAS NME for ISR routers

NME Modules	Target Usage
	• Large Enterprise Branch • Maximum 800 Concurrent TCP Connections • Server Consolidation • WAN Optimization
	• Mid-sized Branch • Maximum 500 Concurrent TCP Connections • Server Consolidation • WAN Optimization
	• Small Branch • Maximum 250 Concurrent TCP Connections • WAN Optimization

Cisco WAE Model Line Up



Data Center Integration with ACE



Cisco Application Control Engine Linecard for the Catalyst 6500 Family

Catalyst 6500 Series Multilayer Intelligent Switching Platform

- **Application Control Engine (ACE)**

  Provides transparent integration, interception, load-balancing, and failover for up to:

  Up to 16Gbps throughput

  Up to 4M TCP connections

  350K connections/second setup

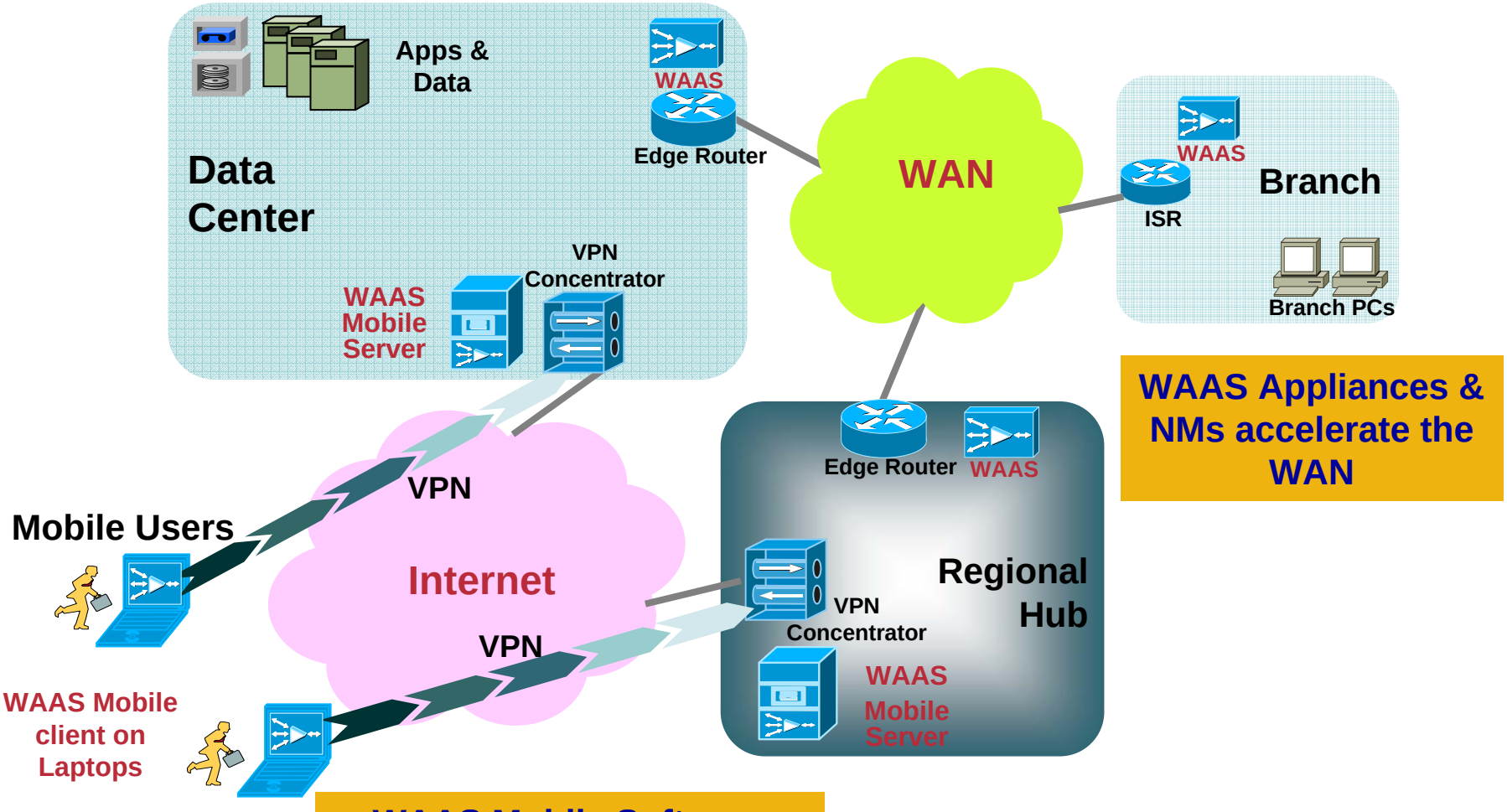
- **ACE Features and Benefits**

  Integration into Catalyst 6500 series of intelligent switches

  Solution for scaling servers, appliances, and network devices

  Virtual partitions, flexible resource assignment, security, and control

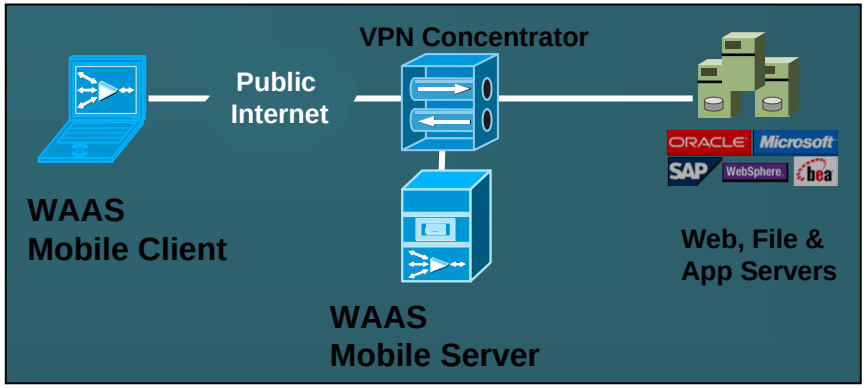
Introducing Cisco WAAS Mobile



Cisco WAAS Mobile Overview

Available Now !

1. Where It Sits



2. What It Does

Installs on Windows Desktop

Accelerates Mobile VPN connections over the Internet

3. Why It's Better

Purpose Built for the Windows PC/Laptop	•Not an appliance software ported to Windows OS •Similar to Cisco's approach with VPN client •Results in reliability & stability on the Windows PC
Industry-leading Performance	•Significantly higher throughput •Better application performance •Tested under a wide range of links
Lowest TCO	•Best reliability, stability and troubleshooting tools reduce cost of support •Centralized policy based management reduces deployment and support cost •Integration with software distribution tools reduces deployment costs

WAAS Virtual Blades Platform Overview

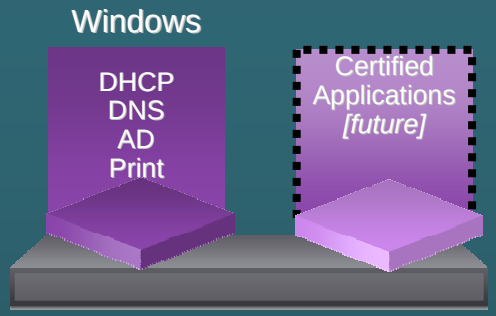
WAN Optimization and Network-Hosted Applications Platform

New

WAE 674

4-8GB memory, 600GB storage

Wide Area Application Services



WAAS Virtual Blade

Software license on WAAS

Hosted Windows Services

(Add'l Certified Apps - *future*)

CISCO Microsoft

Jointly developed architecture

Joint customer support

Optimized central and local IT services

"Cisco and Microsoft solutions serve our employees in our headquarters as well as in branch offices. I am excited to see these two companies working together to simplify the management of branch office resources so we can quickly deploy Windows Services to remote offices and -- more importantly -- better service our remote users."

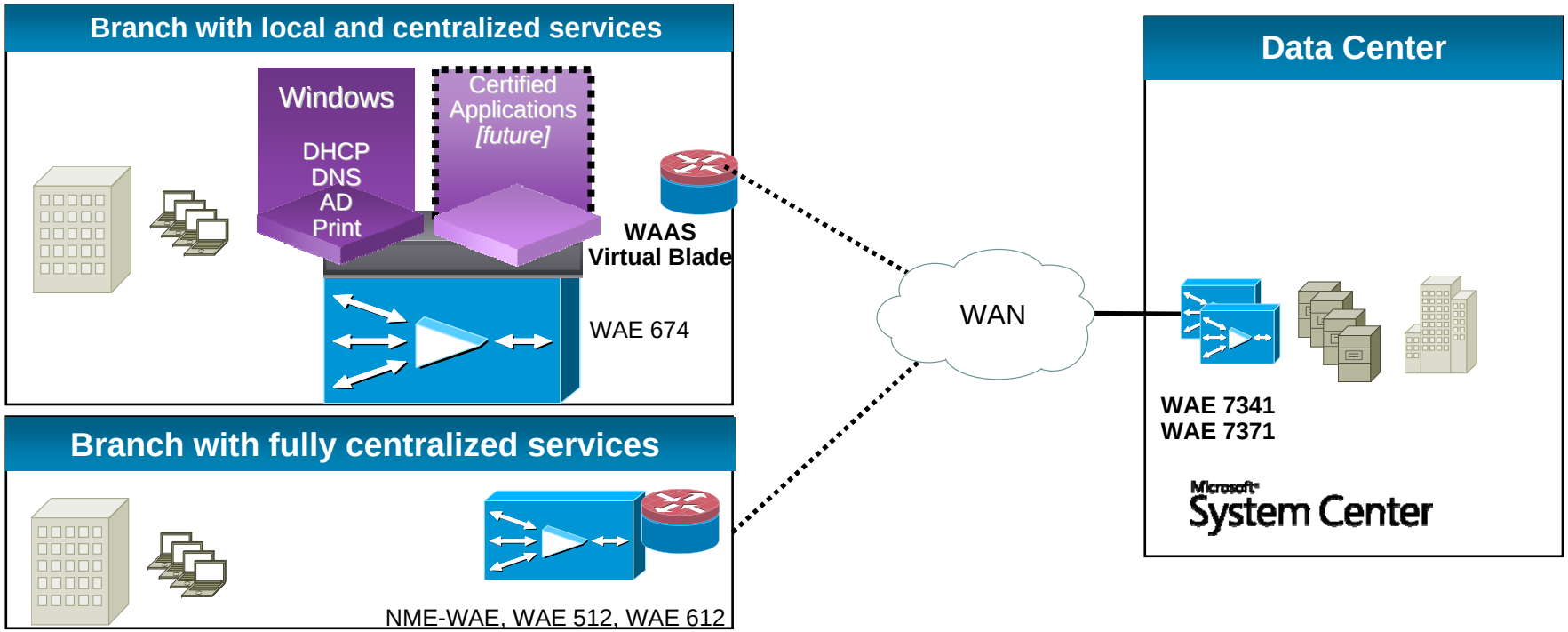
-Dwight Wheelers, Network Architect

MONSANTO

Customer benefits:

- Performance
- Agility
- Cost

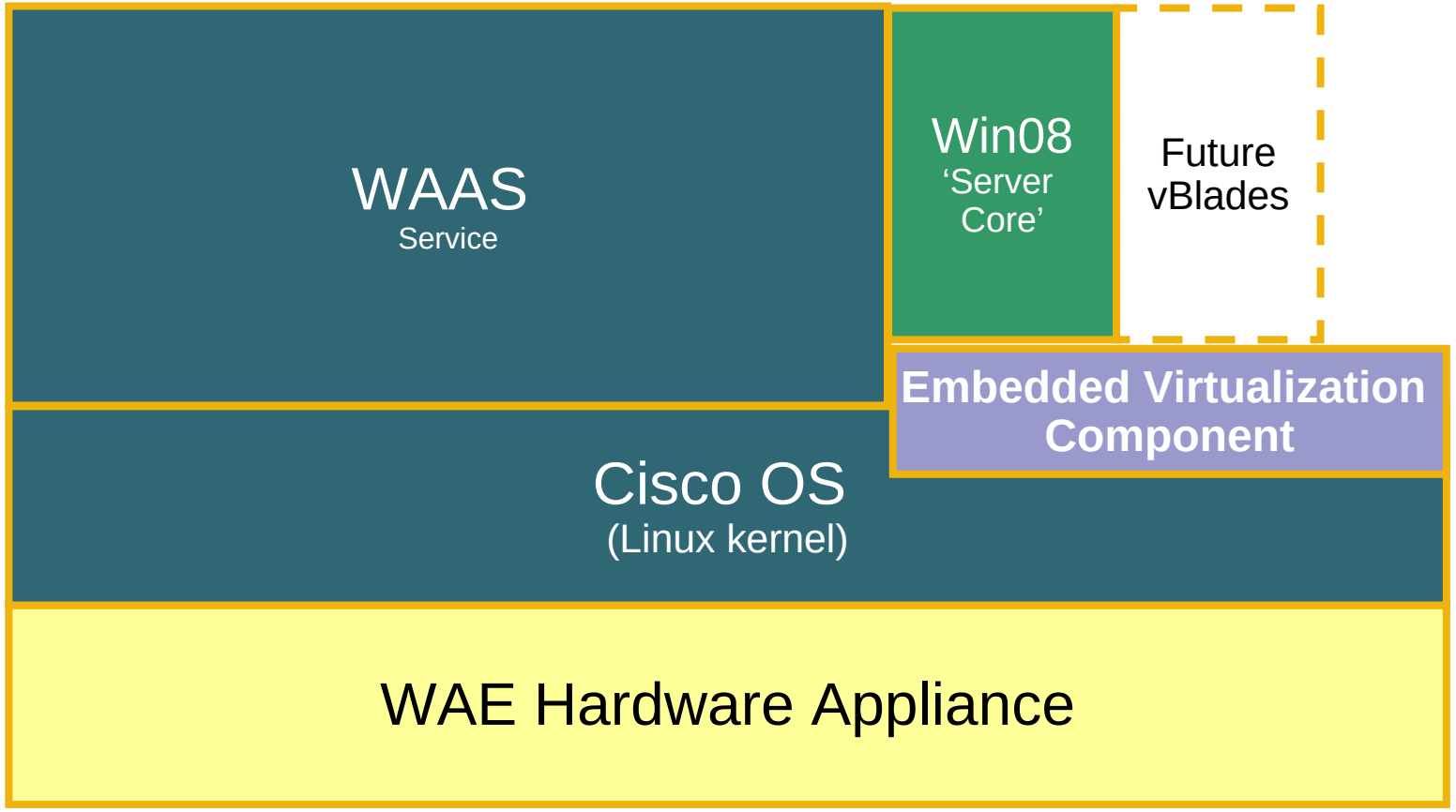
WAAS Virtual Blade Usage Example



Solution	Description
Features	•**Local Windows Server 2008: DHCP, DNS, Active Directory, Print** •**Centralizad applications and data** •**WAN optimization and application acceleration**
Benefits	•**Optimized application performance** •**Improve agility through software-based services rollout** •**Further lowered TCO**

WAAS 'Embedded Virtualization'

1. Leverages new Linux Kernel Virtual Machine technology
2. Leverage proven Linux scheduler and memory management
3. Simpler and faster (typically 15-20%) for network services
4. Microsoft and Cisco to validate "Embedded Virtualization" for Windows



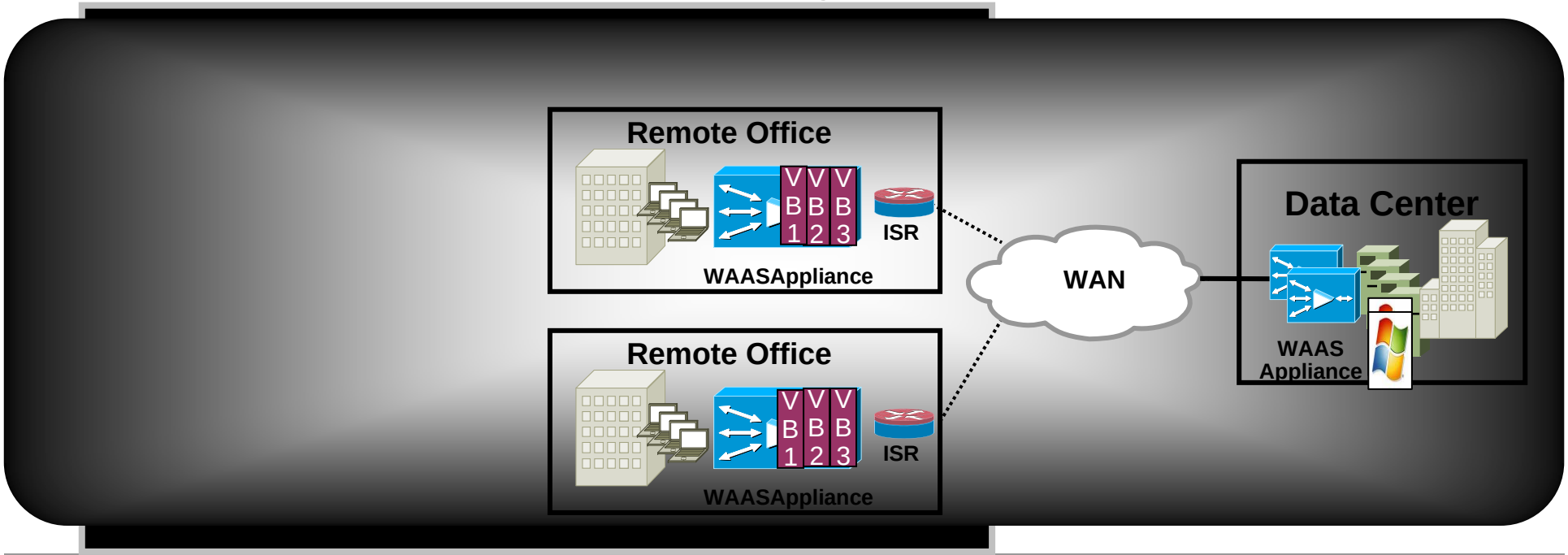
Virtual Blade – Sample Flow
Allocate Resources and Deploy Image

- **Allocate resources and start Virtual-Blade instance**

  Easy & Simple - from WAAS CM or from CLI

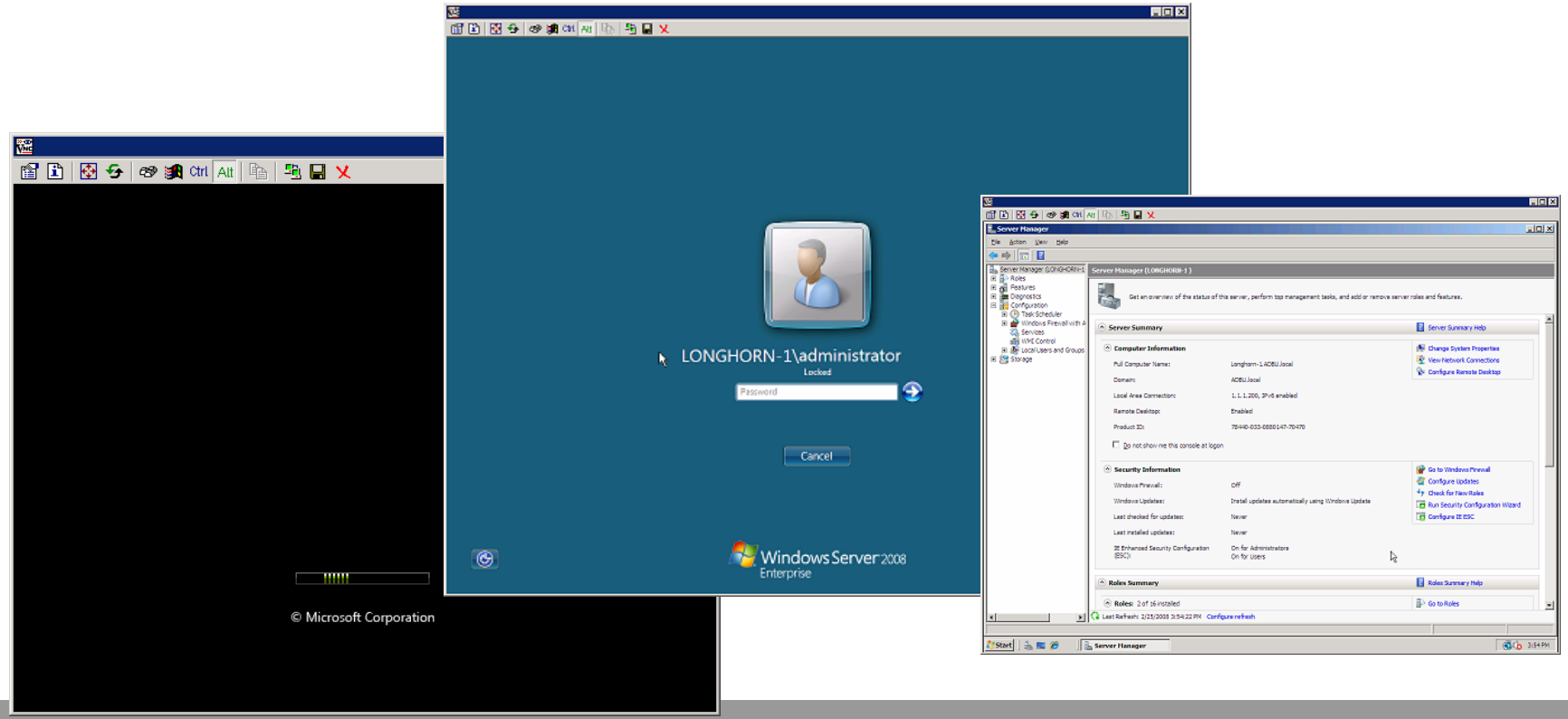
- **Centrally deploy server image over to WAE**

  From CLI or WAAS CM, using FTP or HTTP



Virtual Blade – Sample Flow
Boot Server and Configure

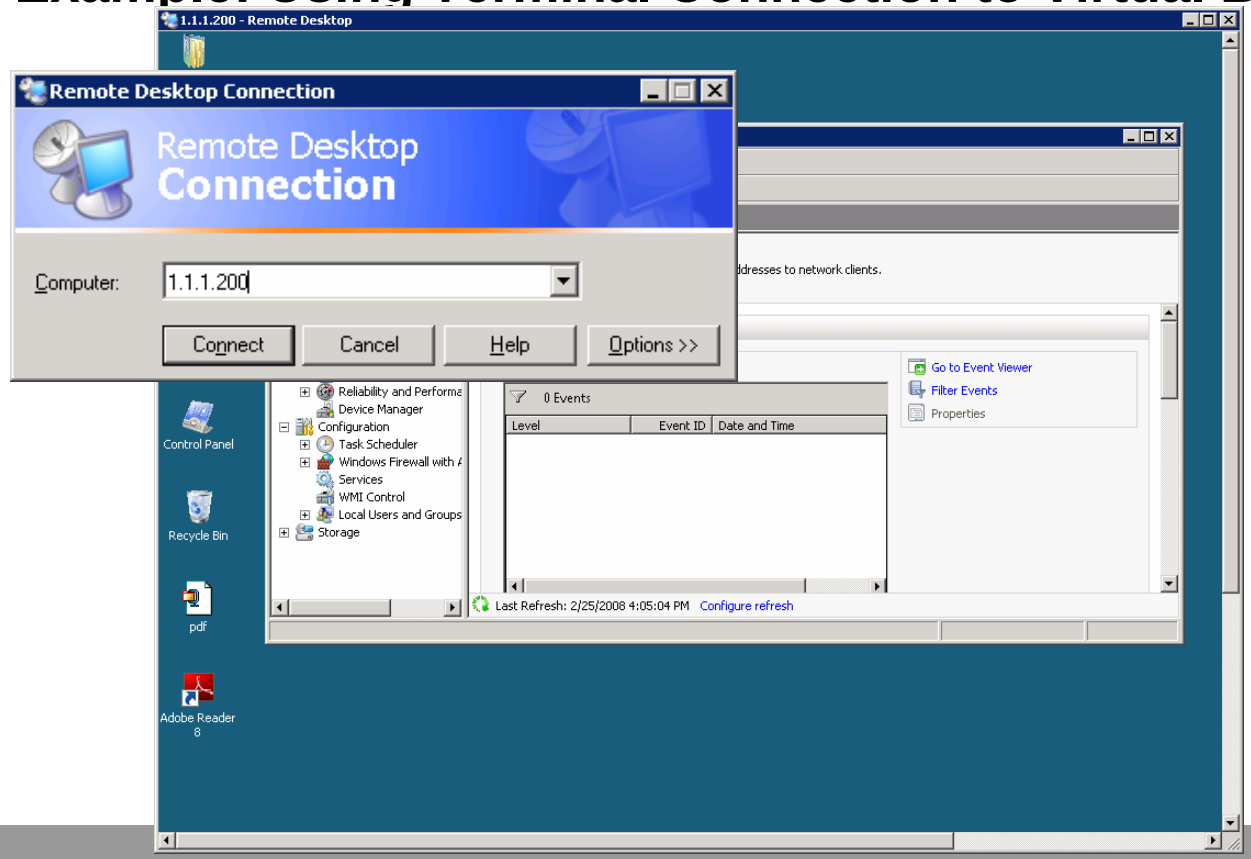
- **Boot Virtual Blade**
- **Access Virtual Display to finalize service settings**
  - **Using VNC, pointing to WAE IP with Virtual Blade display#**



Virtual Blade – Sample Flow
Centrally Manage

- **Remote access and management using Windows Management facilities**

Example: Using Terminal Connection to Virtual Blade IP



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

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

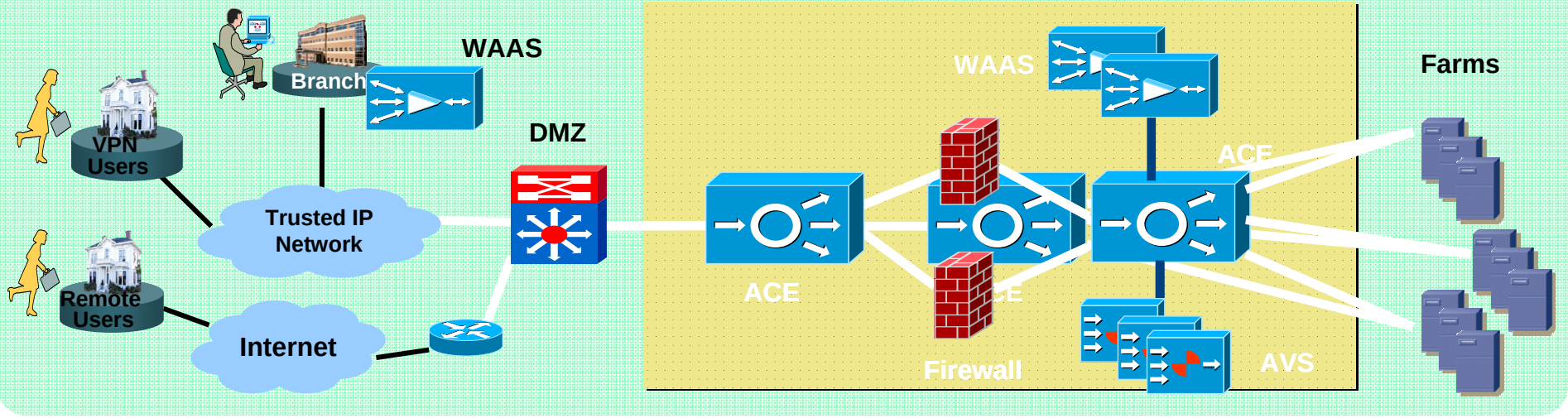
Benefits

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

	Year 1	Year 2	Year 3
Projected Costs Per Branch			
Labor			
Branch Installation	$150		
Data Center Installation (allocated)	$5		
Other Professional Service (allocated)	$100		
Other One Time Cost			
Hardware and Software			
Branch Units List Price (allocated)	$6,500		
Data Center Units List Price (allocated)	$2,733		
Central Manager Units List Price (allocated)	$130		
SW License List Price (allocated)	$6,450		
Product Discount (Hardware and Software)	**45%**	**45%**	**45%**
Support			
Hardware	$894	$894	$894
Software	$542	$542	$542
Support Discount	35%	35%	35%
Total Projected Costs Per Branch	**$9,885**	**$933**	**$933**
Savings Summary			
Reduced HW & SW Costs	$10,400		
Reduced Operational Costs	$1,860	$1,410	$1,410
Reduced BW Costs	$1,039	$1,039	$1,039
Total Annual Savings	**$13,299**	**$2,449**	**$2,449**
Net Benefit (NO NPV)	**$3,413**	**$1,516**	**$1,516**
Cumulative Net Benefit (NO NPV)	**$3,413**	**$4,929**	**$6,445**
Net Benefit (NPV)	**$3,413**	**$1,353**	**$1,208**
Cumulative Net Benefit (NPV)	**$3,413**	**$4,401**	**$5,138**
2 & 3 Year ROI (NPV)		**41%**	**45%**
Project breakeven occurs within	**8.9**	**months**	
Number of Branch Offices			**60**
Total Enterprise Wide 3 Years Savings (NPV)			**$ 308,257**

Solutions For the Data Center

Delivering Application High-Availability, Scalability, Security, Acceleration and Optimization



ACE

- Highest Performance
- Virtual Partitions
- Integrated Security
- Server Off Load

ACE + FWSM

- Integrated DC protection
- ACE + FWSM provides 10 plus Gigabit aggregate throughput

ACE + AVS

- Scalability and Availability for AVS
- Web Application Security and Acceleration

ACE + WAAS

- Scalability and availability for WAAS
- Health probes for WAAS farm

Agenda

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Questions?

Time for break!

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