Application optimization using WAAS

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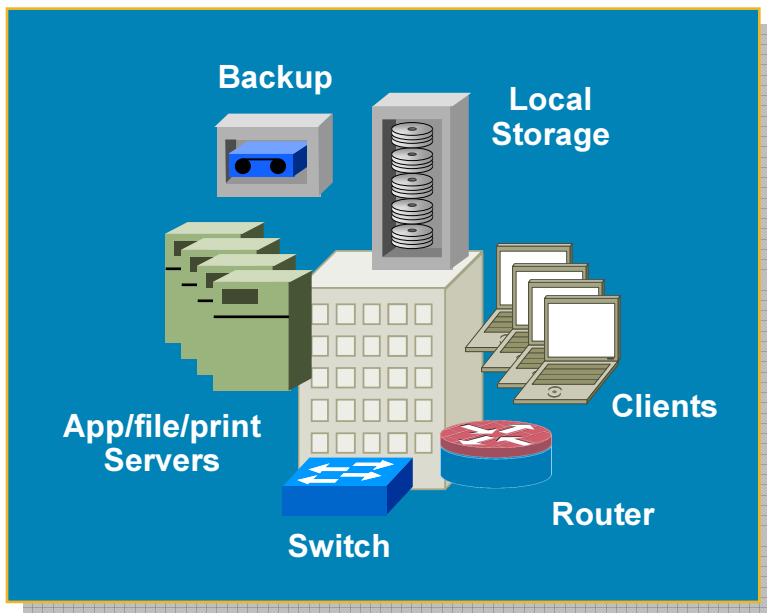**vmilovan@cisco.com**

Agenda

1. WAAS Introduction

2. Improved Application Performance

3. WAAS for DC to DC Replication

4. Virtualized Branch Service

5. WAAS Mobile

WAAS Introduction

Growing Trend: Consolidate Branch Office

Backup

Local Storage

App/file/print Servers

Clients

Switch

Router

"…an average of 6.9 devices per branch"

Source: Nemertes Research

Major Branch Issues

1. Application performance
   - Bandwidth limitations
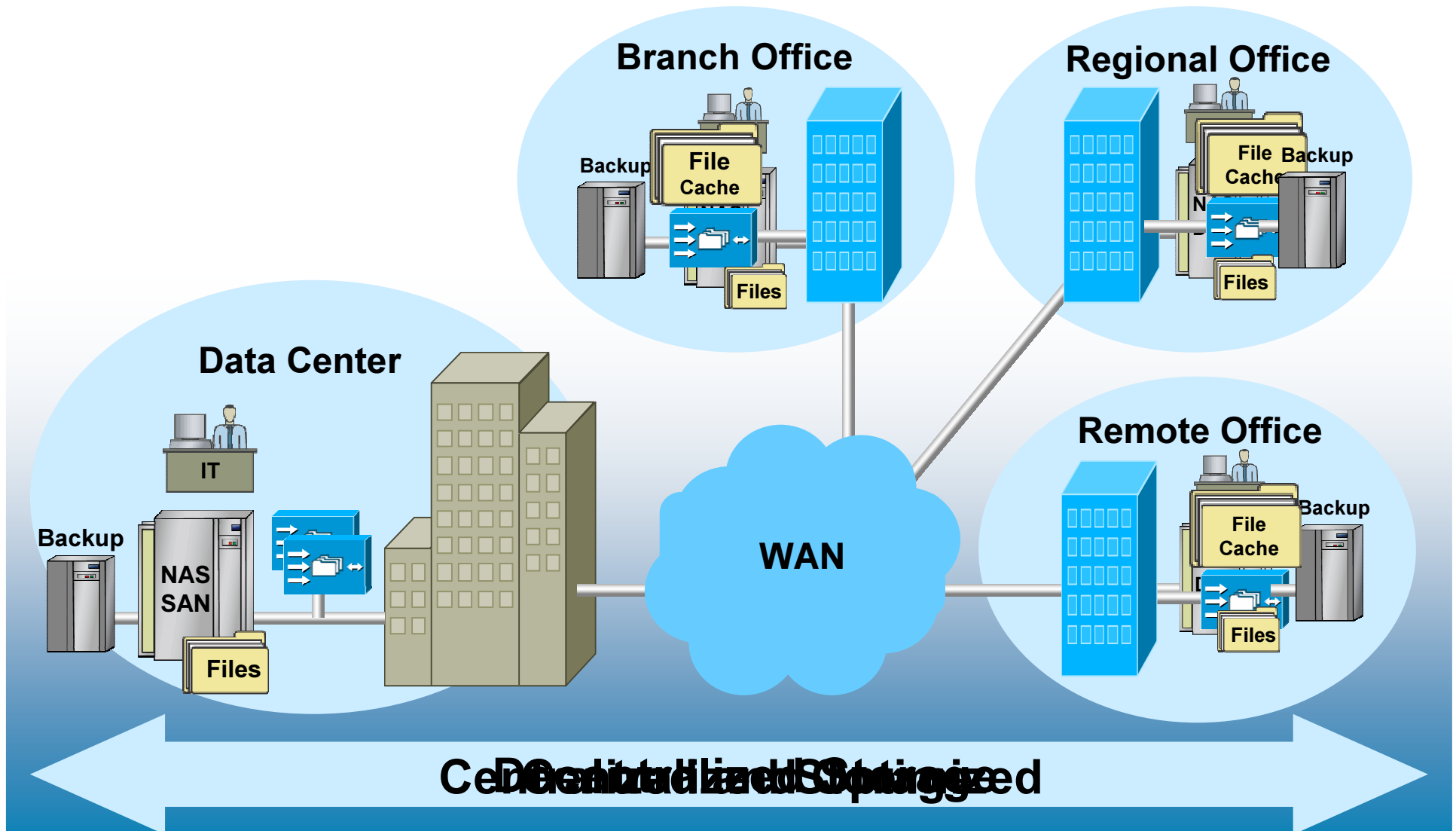   - Latency / jitter / chattiness

2. Infrastructure cost / complexity
   - File, print & email servers
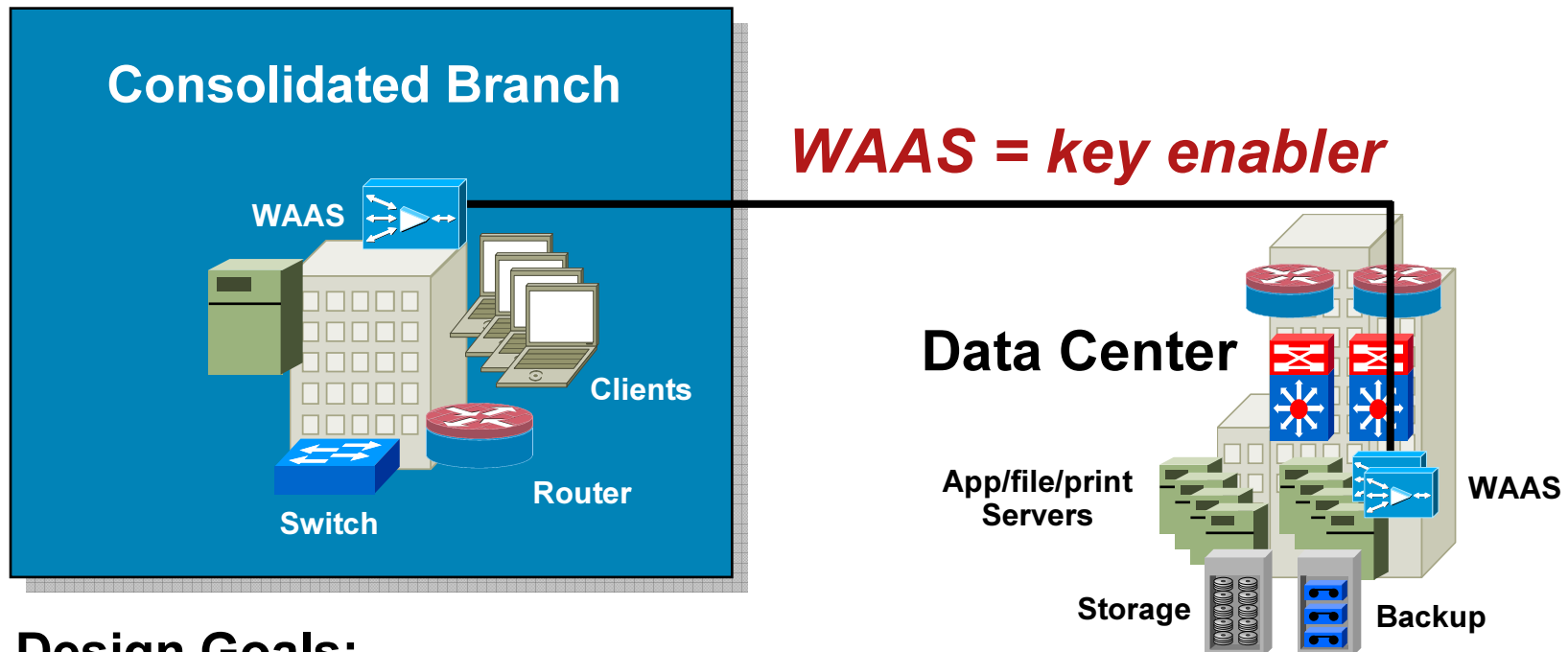   - Storage & backup
   - WAN bandwidth

3. Data protection
   - Failing backups / lost data
   - Compliance

WAAS File Services Introduction

Cisco Vision: The Consolidated Branch

Consolidated Branch

WAAS

Switch

Router

Clients

WAAS = *key enabler*

Data Center

App/file/print
Servers

WAAS

Storage

Backup

Design Goals:

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

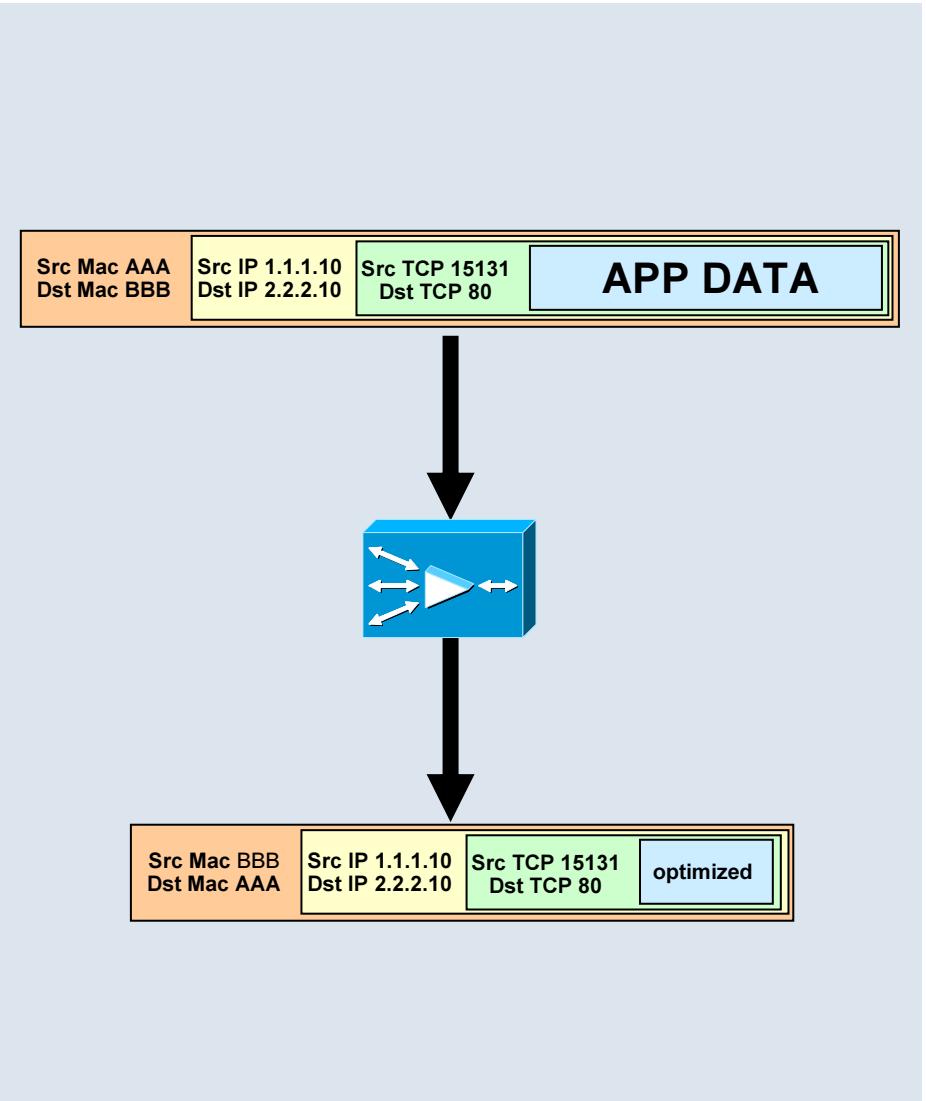**"$1.5 billion market in 2008"**

Source – Gartner

Partnerships with Key App Vendors

1. **cisco.com/go/optimizemyapp**
2. **select "Application Solution Partners" tab**
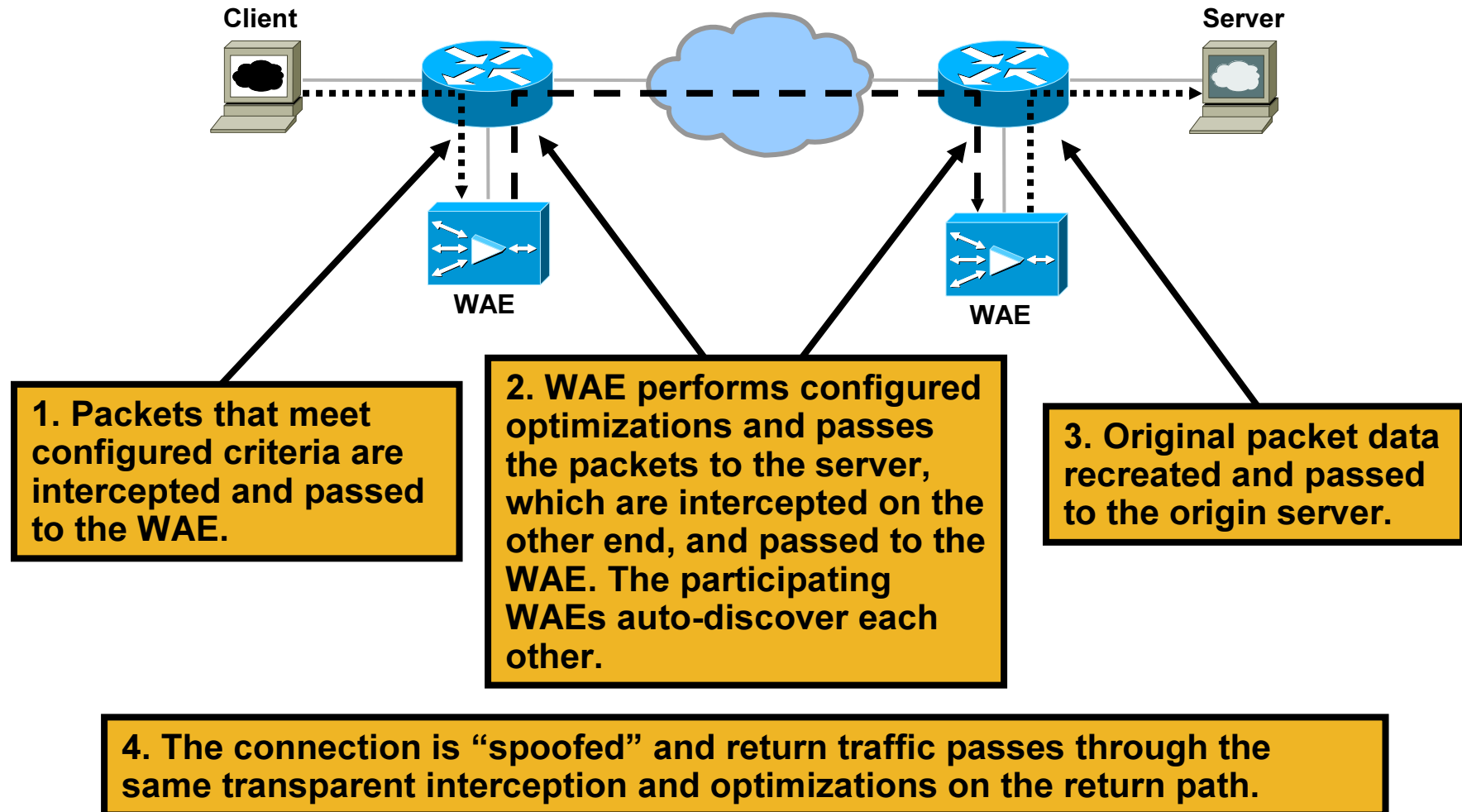3. **click on partner links**
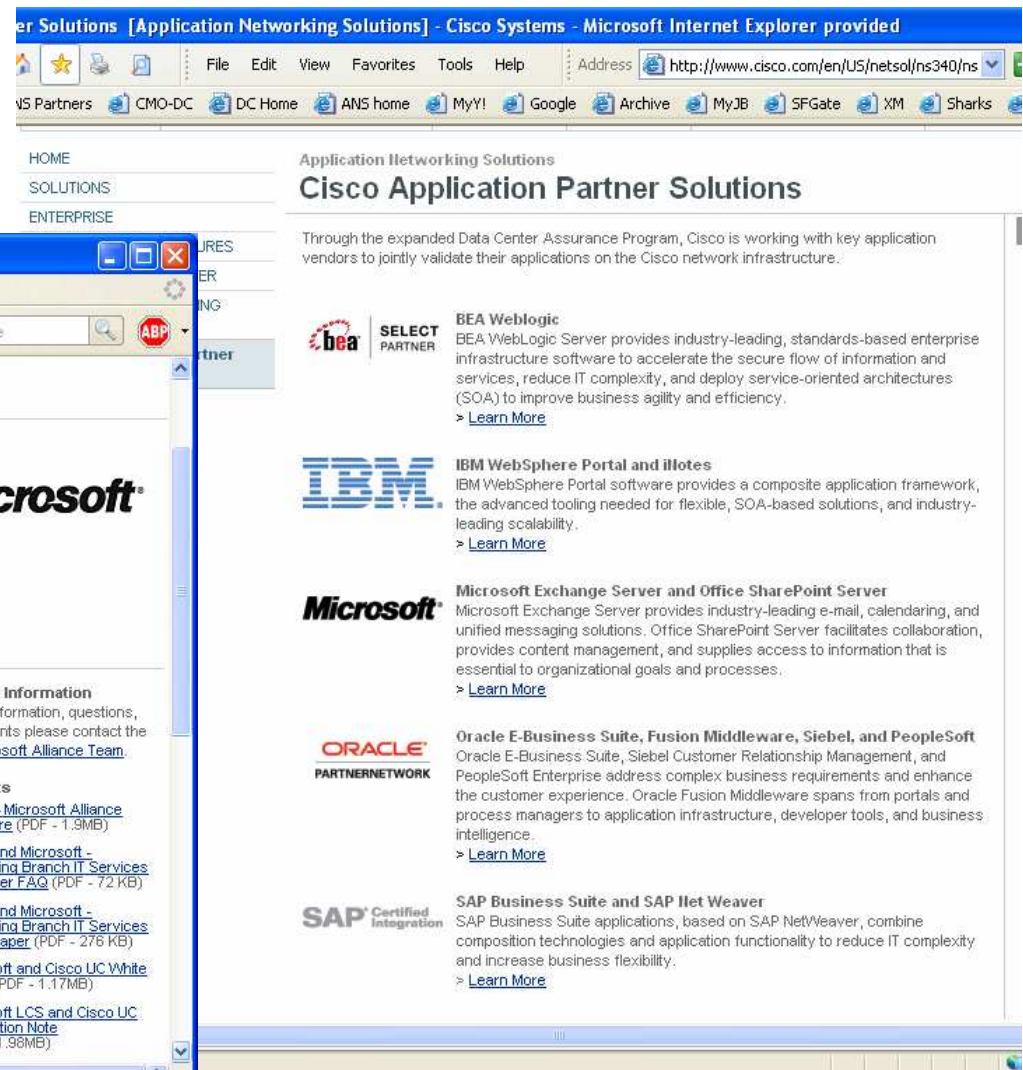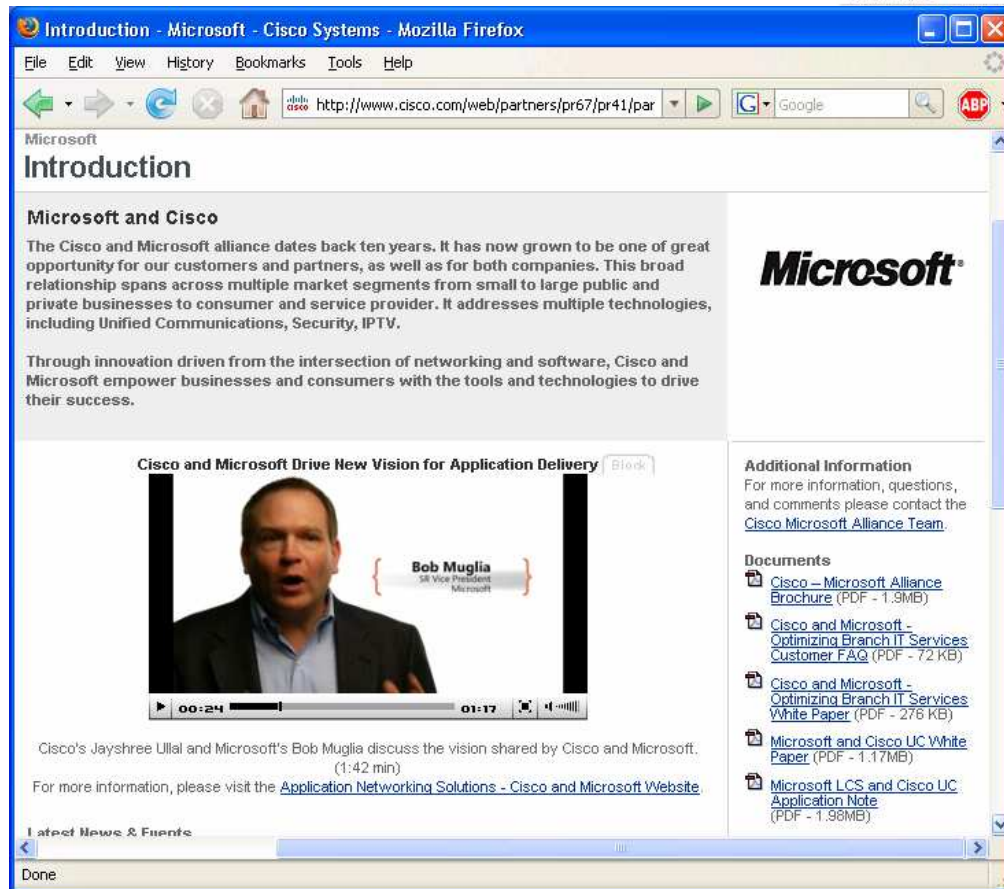
Seamless, Transparent Integration

1. Seamless integration with the packet network with high availability, load-balancing, and failover

   WCCPv2

   Policy-Based Routing

2. Full preservation of L3/L4 packet header information (IP/TCP)

3. Compliance with network value-added features

   Classification - QoS, NBAR, Queuing, Policing, Shaping

   Security - Firewall policies, Access Control Lists

   Reporting - NetFlow, monitoring

Src Mac AAA Dst Mac BBB	Src IP 1.1.1.10 Dst IP 2.2.2.10	Src TCP 15131 Dst TCP 80	APP DATA

Src Mac BBB Dst Mac AAA	Src IP 1.1.1.10 Dst IP 2.2.2.10	Src TCP 15131 Dst TCP 80	optimized

WAAS base network

Client

Server

WAE

WAE

1. Packets that meet configured criteria are intercepted and passed to the WAE.

2. WAE performs configured optimizations and passes the packets to the server, which are intercepted on the other end, and passed to the WAE. The participating WAEs auto-discover each other.

3. Original packet data recreated and passed to the origin server.

4. The connection is "spoofed" and return traffic passes through the same transparent interception and optimizations on the return path.
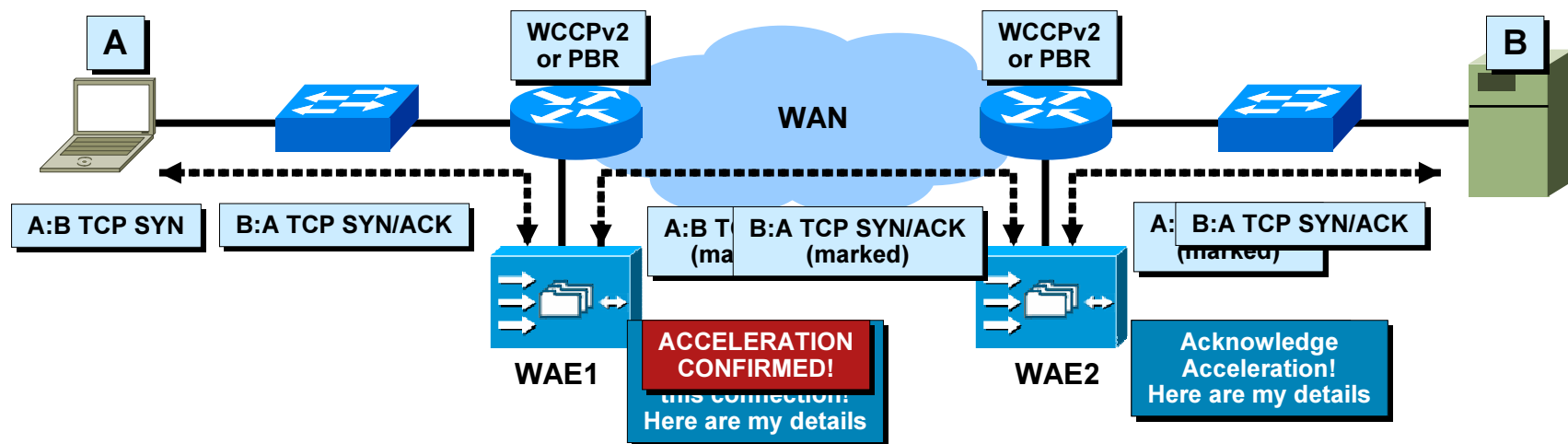
Cisco WAAS Auto-Discovery

1. Cisco WAE devices automatically discover one another and negotiate optimization capabilities

   Performed per TCP connection

   Flexible optimization configuration

   Exchange of peer capabilities and limitations

| A | | | WCCPv2 or PBR | WAN | WCCPv2 or PBR | | B |

A:B TCP SYN   B:A TCP SYN/ACK   A:B T(ma   B:A TCP SYN/ACK (marked)   A: B:A TCP SYN/ACK (marked)

WAE1   WAE2

ACCELERATION CONFIRMED!
this connection! Here are my details

Acknowledge Acceleration! Here are my details

Accelerates Broad Range of Applications

Application	Application Protocol	Improvement
File Sharing	• Windows (CIFS) • UNIX (NFS)	• 2X-400X
E-mail	• Exchange (MAPI) • SMTP/POP3, IMAP • Notes	• 2X-50X
Internet / Intranet	• HTTP, HTTPS, WebDAV	• 2X-50X
Data Transfer	• FTP	• 2X-50X
Software Distribution	• SMS (CIFS, HTTP) • Altiris (HTTP)	• 2X-100X
Database Applications	• SQL • Oracle • Notes	• 2X-10X
Data Protection	• Backup Applications • Replication Applications	• 2X-50X
Other	• Any TCP-based Application like Citrix	• 2X-10X

- **Ensures LAN-like performance for branch-based access of corporate applications**

- **Enables branch server and storage consolidation without affecting workflow and employee productivity**

- **Simple network integration enables lower TCO**

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

WAAS Intuitive Central Management

1. **Comprehensive Management**

   Central configuration

   Device grouping

   Monitoring, statistics

   Alerts, reporting

2. **Easy-to-use Interface**
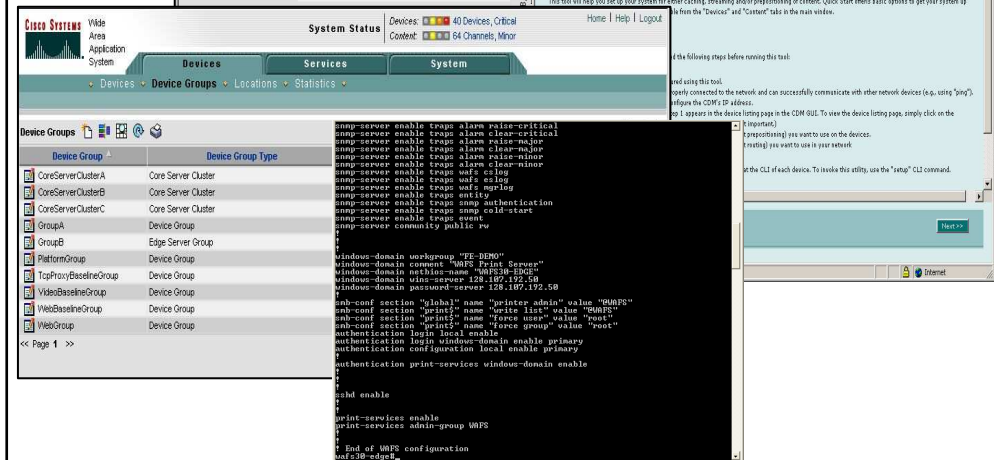
   Graphical U/I, Wizards

   IOS CLI

   Roles-based administration

3. **Proven Scalability**

   1000's of nodes
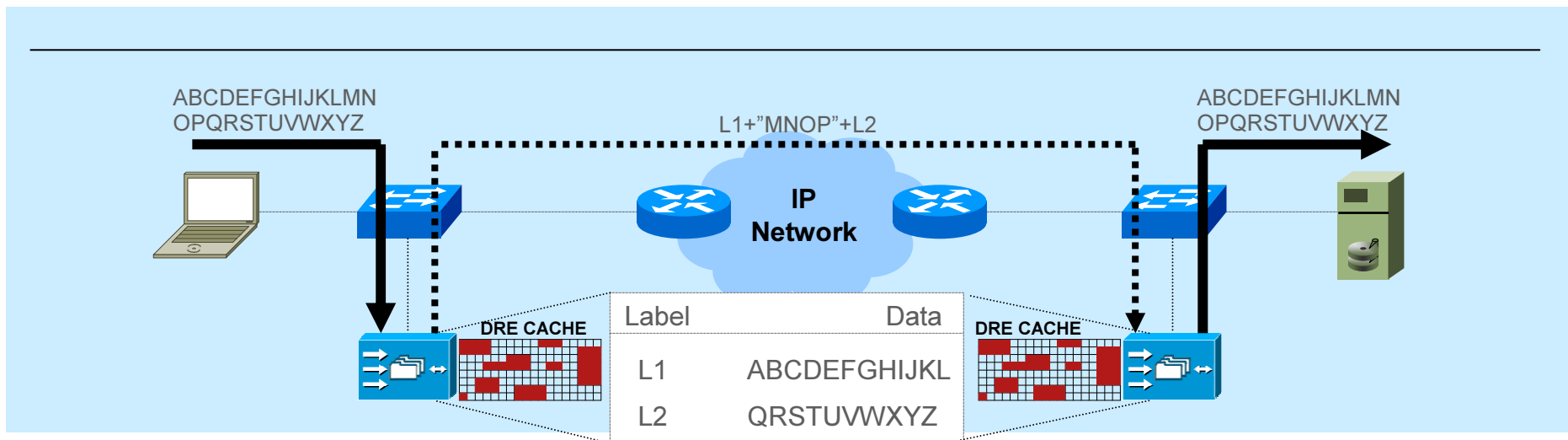
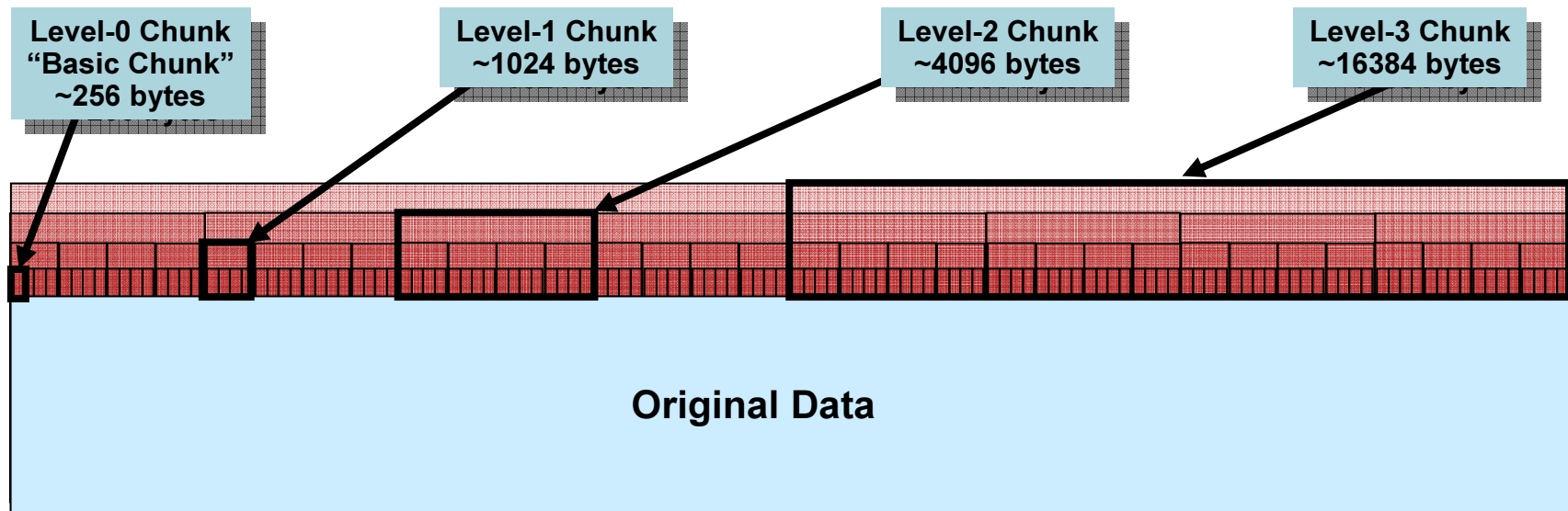   Redundancy and recovery

Data Redundancy Elimination

Data Redundancy Elimination (DRE)

1. Reduce overall WAN consumption based on redundancy

   Maintain active database of previously sent and received traffic

   Send database index on behalf of traffic that has been seen before

   Realize 5x – 50x compression, minimize WAN bandwidth consumption

2. Compress all outbound traffic with LZ compression

   Additional 2x compression beyond data suppression

   Very good compression for non-redundant data

DRE Chunk Identification
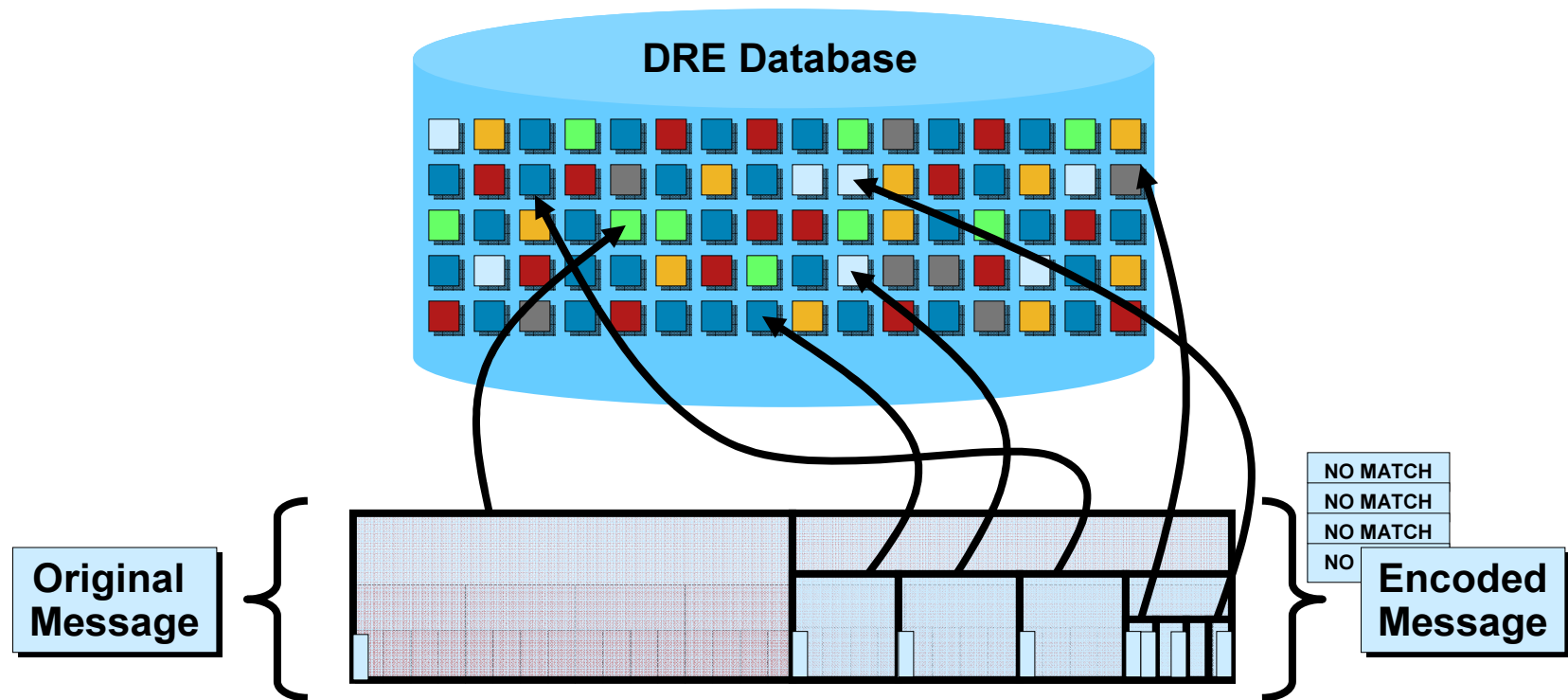
Level-0 Chunk
"Basic Chunk"
~256 bytes

Level-1 Chunk
~1024 bytes

Level-2 Chunk
~4096 bytes

Level-3 Chunk
~16384 bytes

Original Data

1. Each chunk is assigned a 5-byte signature

DRE Pattern Matching

TCP Flow Optimization

Cisco WAAS Transport Flow Optimizations

1. Cisco WAAS Transport Flow Optimizations (TFO) is designed to overcome common challenges associated with standard TCP implementations

   Window Scaling – capitalize on available bandwidth

   Large Initial Windows – maximize transmission after connection establishment for short-lived connections

   Selective Acknowledgement – efficient packet loss recovery and retransmission mechanisms

   Binary Increase Congestion (BIC) – quick return to maximum throughput upon congestion

2. Currently mostly relying on "standard" optimizations

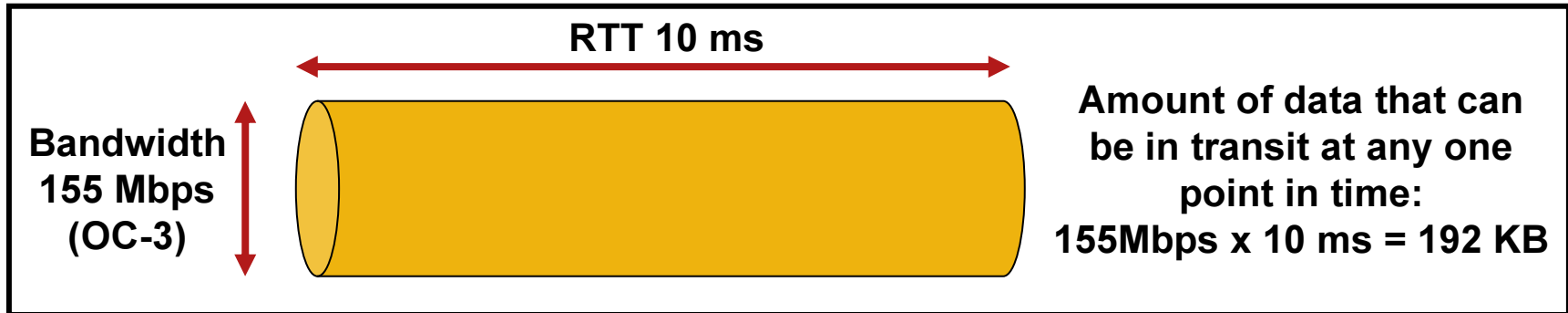# Maximum Window Size (MWS)
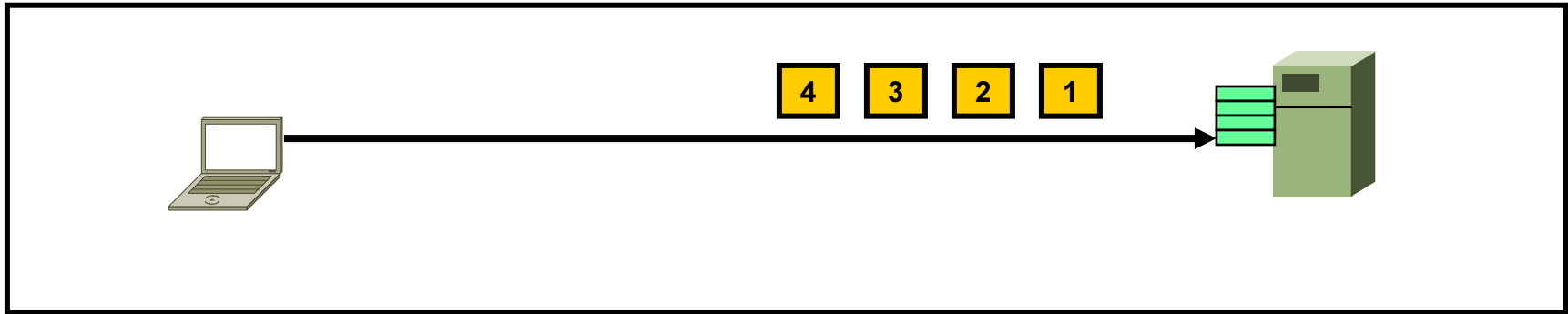
1. The Maximum Window Size (MWS) is the maximum amount of a data a node can have outstanding in the network unacknowledged

2. The node can not continue transmission until previous transmissions have been acknowledged

   Problematic over LFNs – Long Fat Networks "elephants"

   Inability to fully utilize the available network resources

Bandwidth Delay Product (BDP)

RTT 10 ms

Bandwidth 155 Mbps (OC-3)

Amount of data that can be in transit at any one point in time: 155Mbps x 10 ms = 192 KB

1. The Bandwidth Delay Product (BDP) of a network defines the amount of data that can be in flight within a network at any one point in time

    If MWS > BDP, then application may not be throughput bound (i.e. application can "fill the pipe")

    If BDP > MWS, then application will not be able to fully utilize the network capacity (i.e. application can not "fill the pipe")

WAAS TFO Window Scaling

1. Cisco WAAS TFO window scaling (based on RFC 1323) scales the TCP window to 2MB to overcome problems with filling LFNs (Long Fat Networks)

2. Window Scaling applies a binary shift to the decimal value supplied in the data field

Link Utilization After Window Scaling
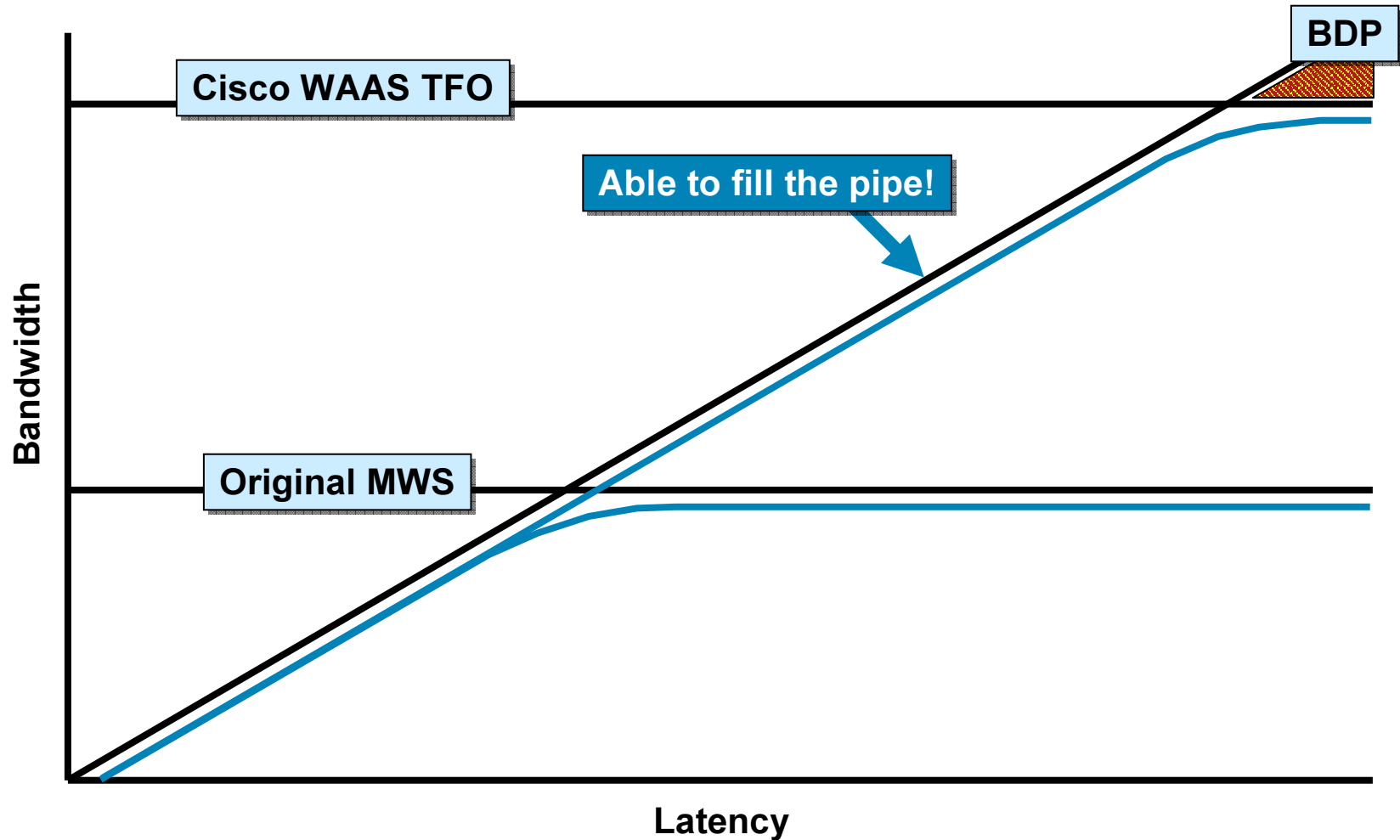
Selective Acknowledgement

1. Cisco WAAS employs Selective Acknowledgement and extensions to improve acknowledgement of transmitted data, improve delivery of missing segments, and minimize unnecessary retransmission
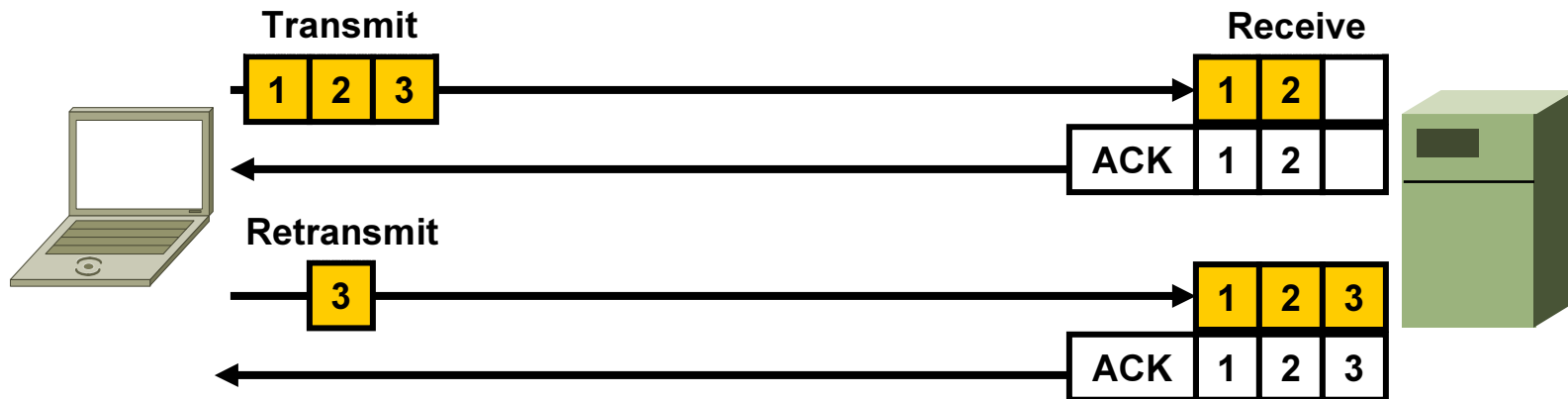
Cisco WAAS Large Initial Windows

1. While 80% of network traffic is typically associated with long-lived connections (elephants), approximately 80% of network connections are short-lived (mice)

2. Short-lived connections transmit smaller numbers of packets and are torn down before ever leaving the slow-start phase of TCP

3. Cisco WAAS Large Initial Windows, based on RFC3390, increases initial window size to expedite entry into congestion avoidance mode for high throughput

Cisco WAAS Large Initial Windows
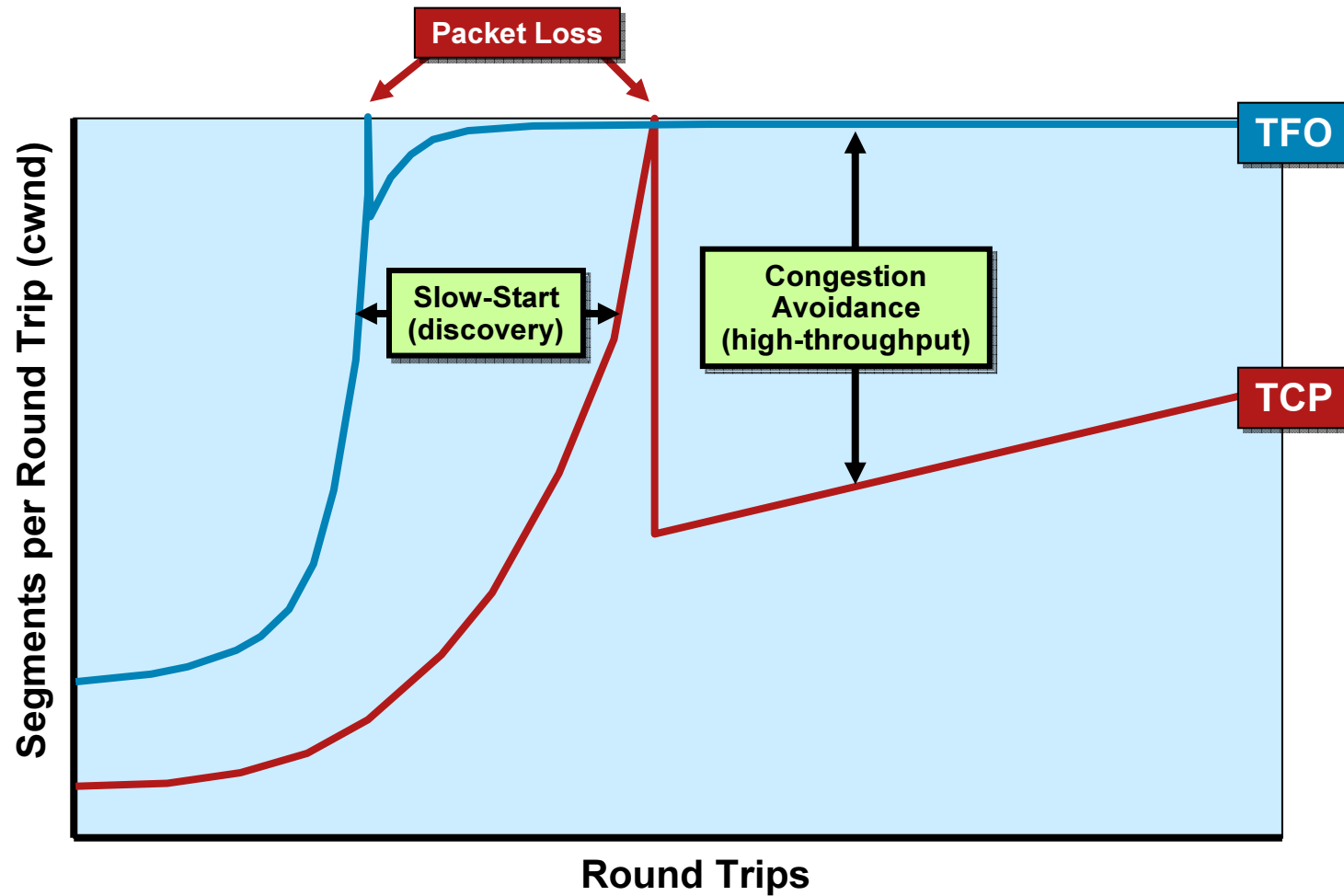
Improved Application Performance

MAPI Acceleration in WAAS 4.1

1. **Problem**

   MAPI uses MS-RPC, a chatty request-response protocol

   Protocol negotiates dynamic ports – requires L7 classification for monitoring and optimization policy

   Data encoding is negotiated by client and server and varies by version - difficult to get pattern matches at L4 only

   WAN

   Service discovery – port 135 (End-point Mapper)

   MAPI negotiation – over discovered port
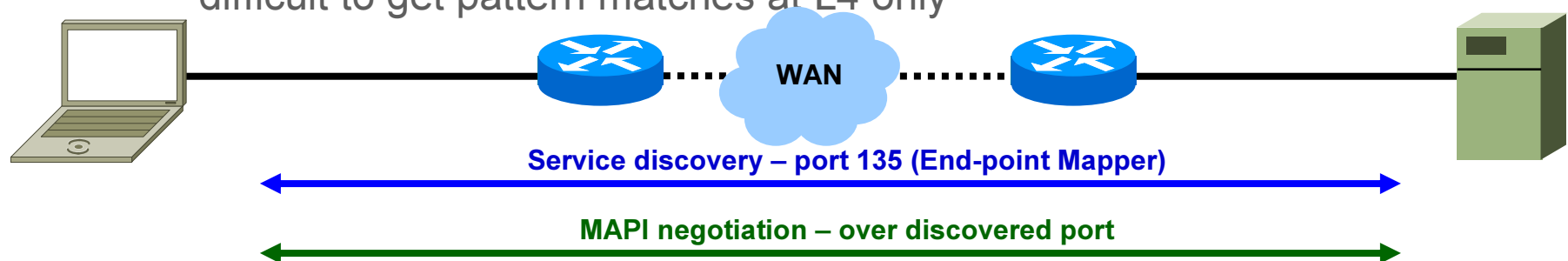
2. **Use Cases**

   Visible server response time issues for interactive users in Outlook 2000 mitigated in 2003/2007 by "Exchange Cached mode"

   But cached mode increases BW usage – e.g. "Morning Rush" scenarios

   Updates of Offline Address Book (OAB) = significant BW usage.

MAPI Acceleration in WAAS 4.1

1. ## Solution

    Improved Reduction and Compression

    Better compression with our MAPI AO than native MAPI compression

    Highly Effective Pattern Matching – overcomes headers, native encoding

    Accelerated Send/Receive and Address Book download

    Attachments and large messages optimized by read-ahead and async-write operations.
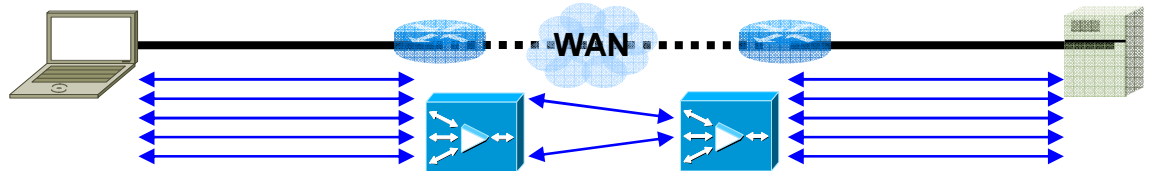
2. ## Benefits

    No coherency or integrity compromise

    Optimizes native Outlook 2007 operations!

    Note: Requires encryption to be disabled on server

3. ## Competitive Advantage

    No reverse engineering (MSFT license) = native protocol compliance

    Transparent, automatic optimization based on dynamic L7 classification.

    MAPI integrated w/DRE - provides better compression

    No security hole of keeping sessions open after users have logged out

HTTP Acceleration in WAAS 4.1

1. **Problem**

   - Slow page load on Interactive Web applications

     Browsers serially open and close connections to fetch small objects (e.g graphics)

     Latency in a connection open/close could be higher than object transmit time.

2. **Use Cases**

   - Business applications such as Siebel, Business Portals and other web applications

   - Servers which do not allow persistent connections due to scalability limitations or configuration

   - Dynamic content results in frequent object access by browsers on page loads

3. **Solution and Benefits**

   - **Fast Connection Reuse** – eliminates need to repeatedly establish new connections

   - **Pipelining** used over the open WAN connection per client-server pair

     Same connection is used for multiple requests

   - **No changes required on Client and Server**

4. **Competitive Advantage**

   Maintains HTTP client-server traffic transparency - no connection reuse **across users**.

   More scalable – no limited-size connection pool per device

   Provides optimization stats and response time savings

   Integrated with SSL AO for HTTP Proxy connect support – allows explicit HTTP security proxies – required for web security proxies.

Transparent CIFS Acceleration

1. New, Transparent CIFS adapter

    No configuration required

    Enabled by default on all new devices

    Bi-directional operation for mesh deployments

    Full integration with TFO auto-discovery flow

    Preposition credentials per job with CLI/GUI parity

2. Current WAFS mode available as legacy mode

    Note: not interoperable with the transparent mode)

3. All advantages of WAFS - without the complexity!

    Server Offload at Datacenter

    Local serving of large objects without WAN impact

    Significantly reduced storage requirements on head-end WAE

    Prep **No More CIFS Tunnel!** out retransmission

NFSv3 Acceleration

1. Network File System (NFS) Protocol

   Used by Unix, Linux and… Macs

2. Eliminate NFS bandwidth/latency challenges

   Enhanced payload compression

   Read-Ahead and Write-to-Cache for optimal data transfer

   File attributes (meta-data) caching

   Transparent to client and server - no config required.

   Tested with IBM AIX, Linux, Solaris & leading NAS vendors
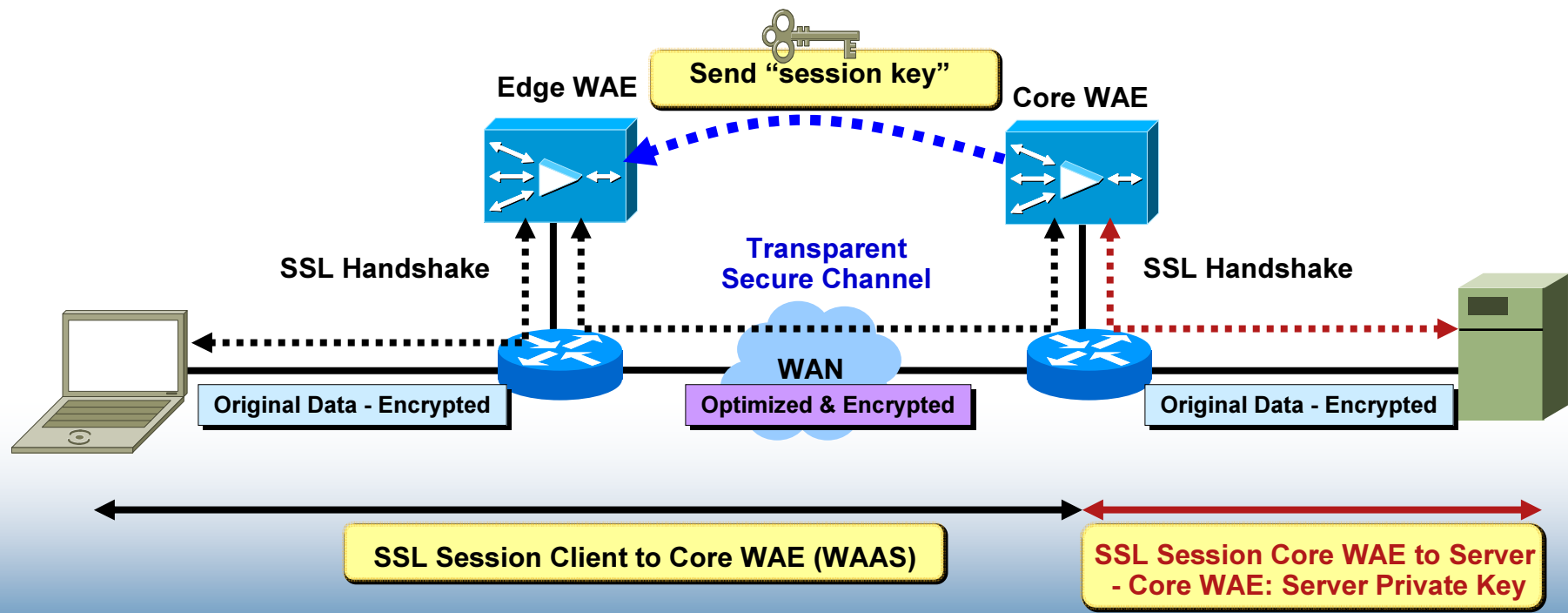
3. Typical Use Cases

   Large file transfers – e.g. scientific data

   Software development & distribution

   CAD applications

SSL Acceleration

1. Core WAE acts as a Trusted Intermediary Node for SSL requests by client.

2. Private Key and Server Certificate are stored on the Core WAE device.

3. Core WAE participates in SSL Handshake to derive "session key"

4. Distributes the "session key" securely in-band to the Edge WAE over the established connection between the Edge WAE and Core WAE.

Send "session key"

Edge WAE

Core WAE

SSL Handshake

Transparent Secure Channel

SSL Handshake

Original Data - Encrypted

WAN

Optimized & Encrypted

Original Data - Encrypted

SSL Session Client to Core WAE (WAAS)

SSL Session Core WAE to Server
- Core WAE: Server Private Key

DC to DC Replication
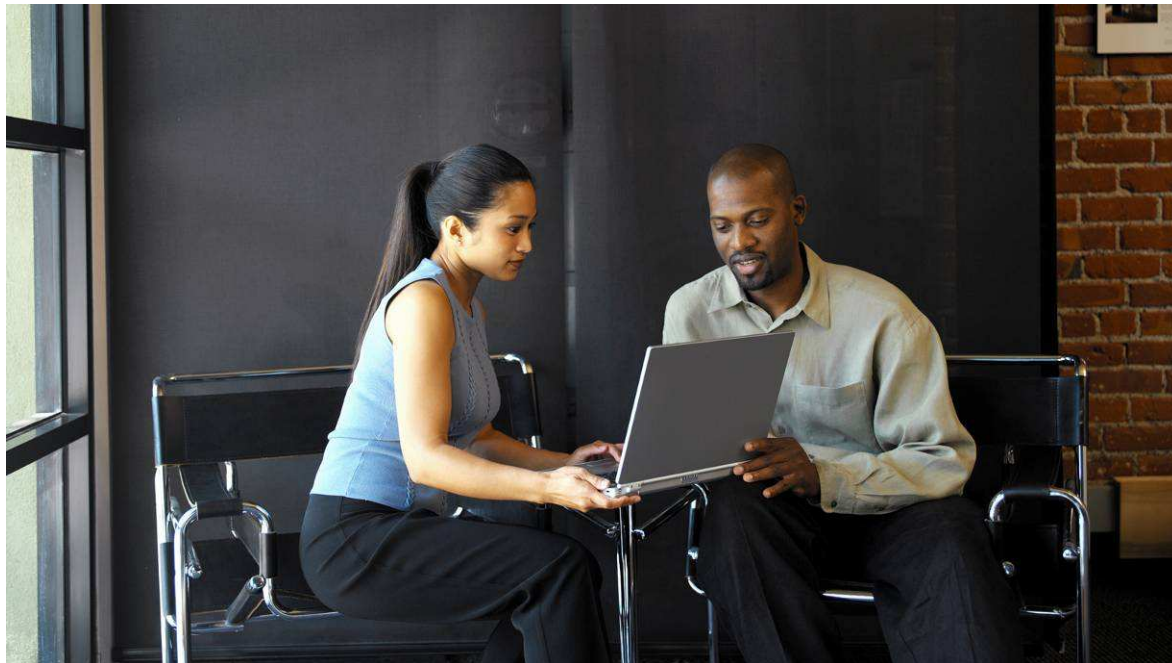
Replication Accelerator

1. Special device mode for DC-2-DC replication and backup

   On 4.0.x train - for WAE-7341 & WAE-7371

2. Optimized for High Speed Links; Low Connections, Low Fan-out

3. EMC SRDF and NetApp SnapMirror testing

   EMC eLab planned

Case A:

1. SRDF using EMC Symmetrix Native IP

2. Cisco testing in May'08
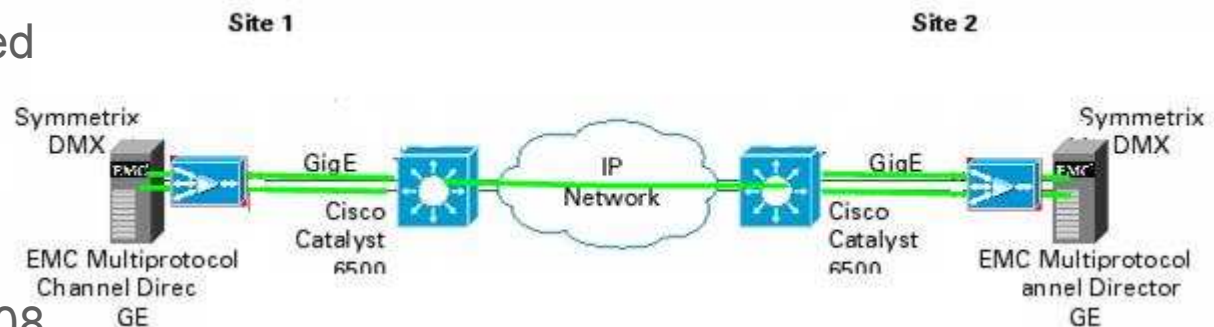
Case B:

1. SRDF using EMC Symmetrix FC → MDS FCIP

2. Validation targeted for 2H CY2008

34
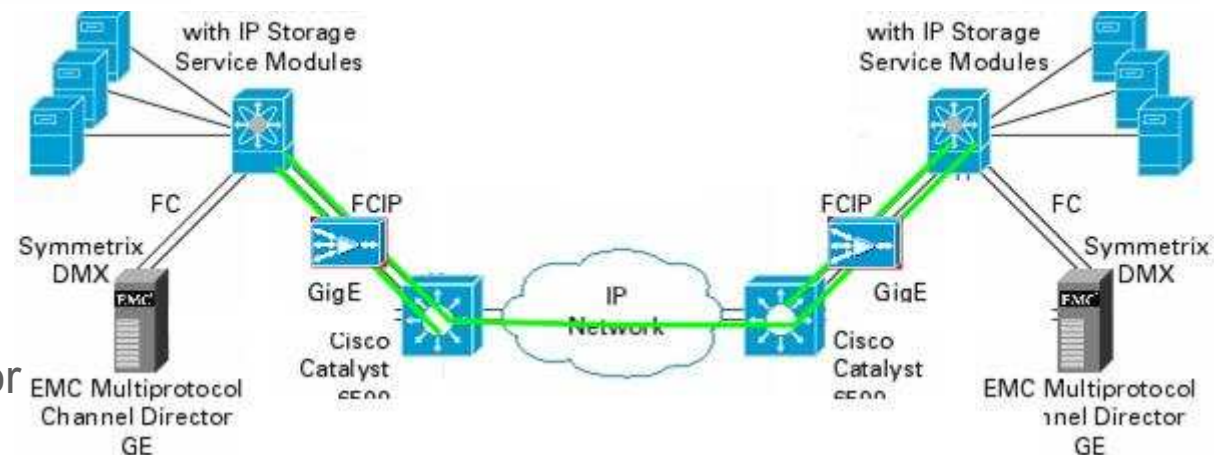
WAAS Virtual blades
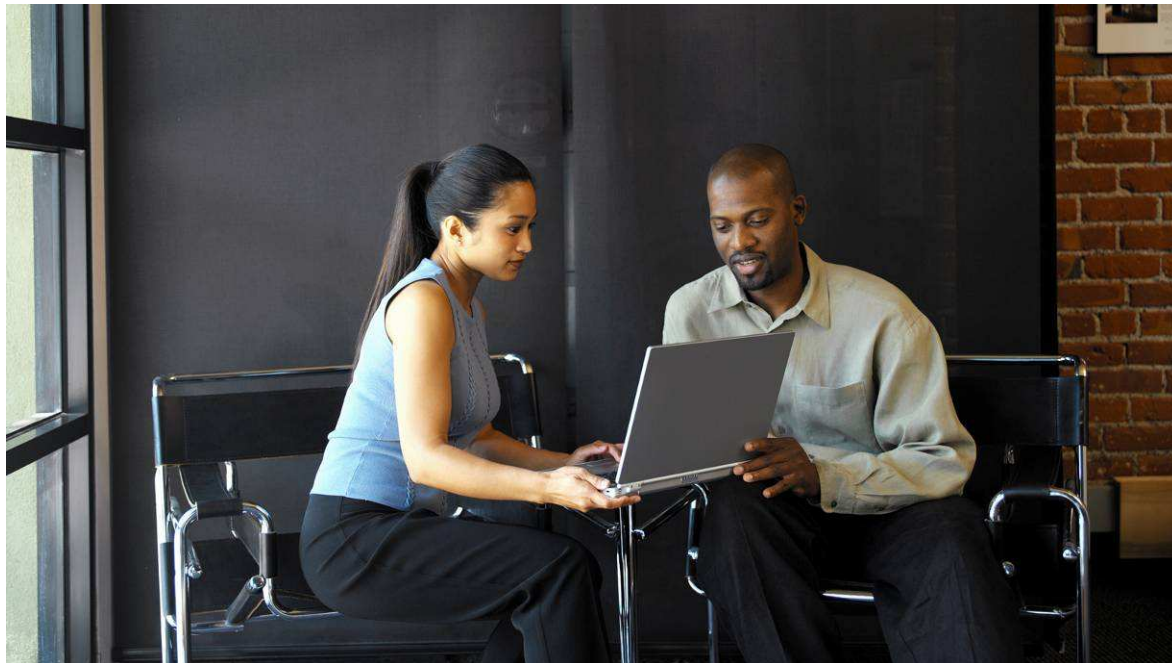
WAAS Virtual Blades

1. Leverages new Linux Kernel Virtual Machine technology
2. Utilizes 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

WAAS
Service

Win08
'Server Core'

Future Virtual Blades

Embedded Virtualization Component

Cisco OS
(Linux kernel)

WAE Hardware Appliance

WAAS Virtual Blades – How it Works
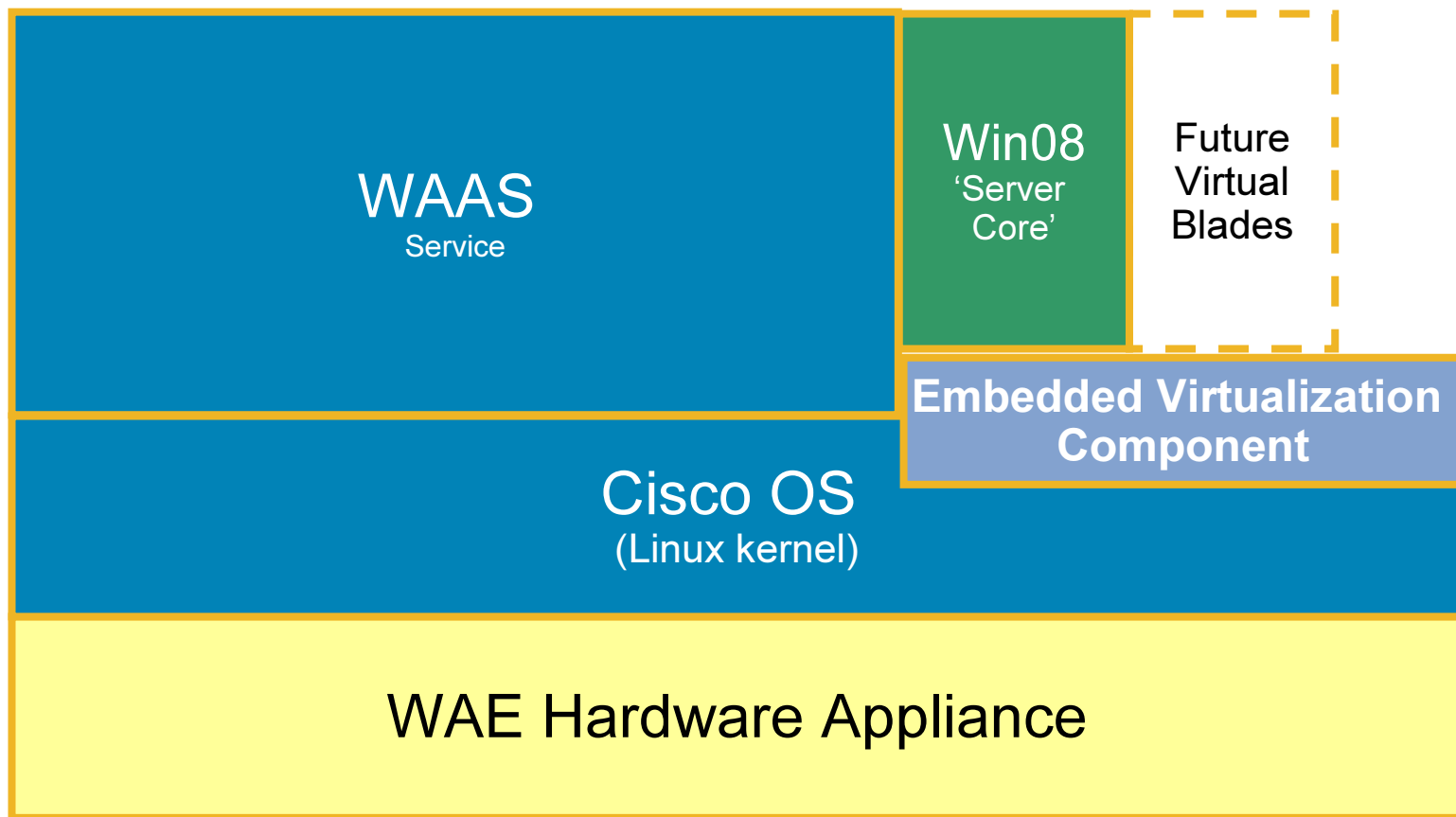
1. ## WAAS provides virtualized platform for local services

   Windows Server 2008 Server Core pre-packaged with WAAS

2. ## Key Benefits:

   Simple, Low Cost Branch Office

   Time to Service/Flexibility

   Fast Branch Applications

Application Rollout Using WAAS Virtual Blades

1. Activate virtual blade centrally

2. Manage Windows services centrally

Remote Office

WindowsServer2008

VB

WAAS Appliance

Remote Office

WindowsServer2008

VB

WAAS Appliance

WAN

Data Center

WAAS Appliance

Microsoft® System Center
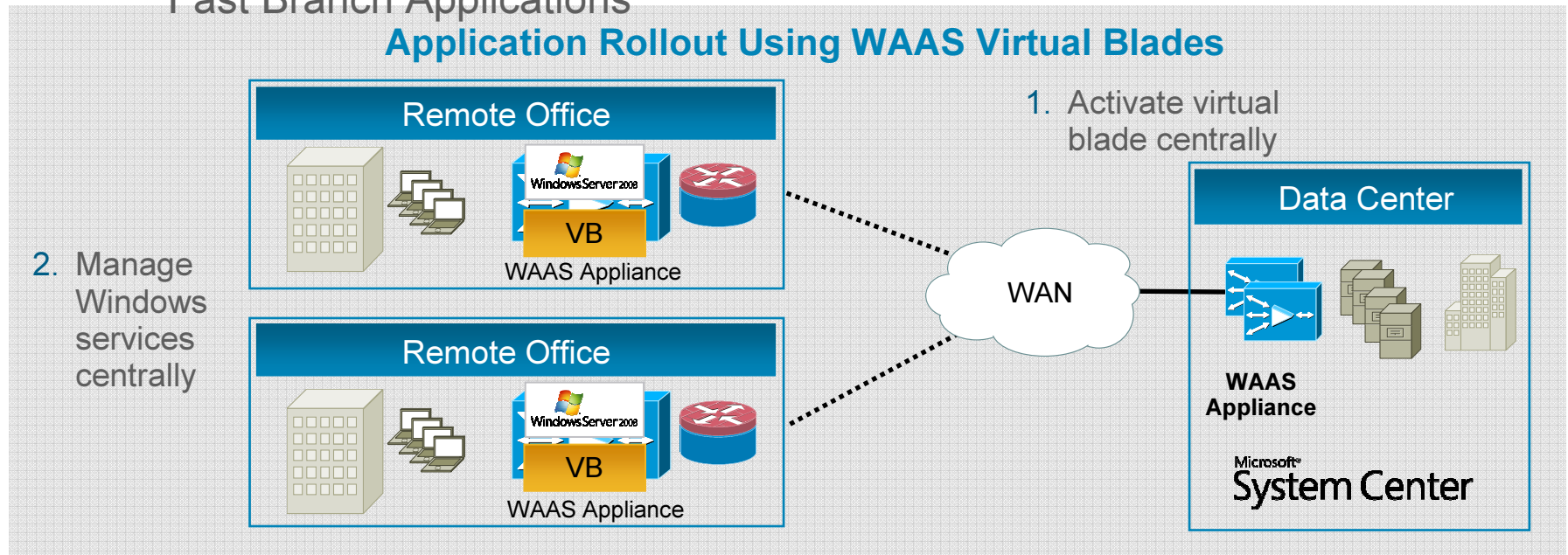
Virtual Blade – Sample Flow
Allocate Resources and Deploy Image

1. Allocate resources and start Virtual-Blade instance

    Easy & Simple - from WAAS CM or from CLI

2. Centrally deploy server image over to WAE

    From CLI or WAAS CM, using FTP or HTTP
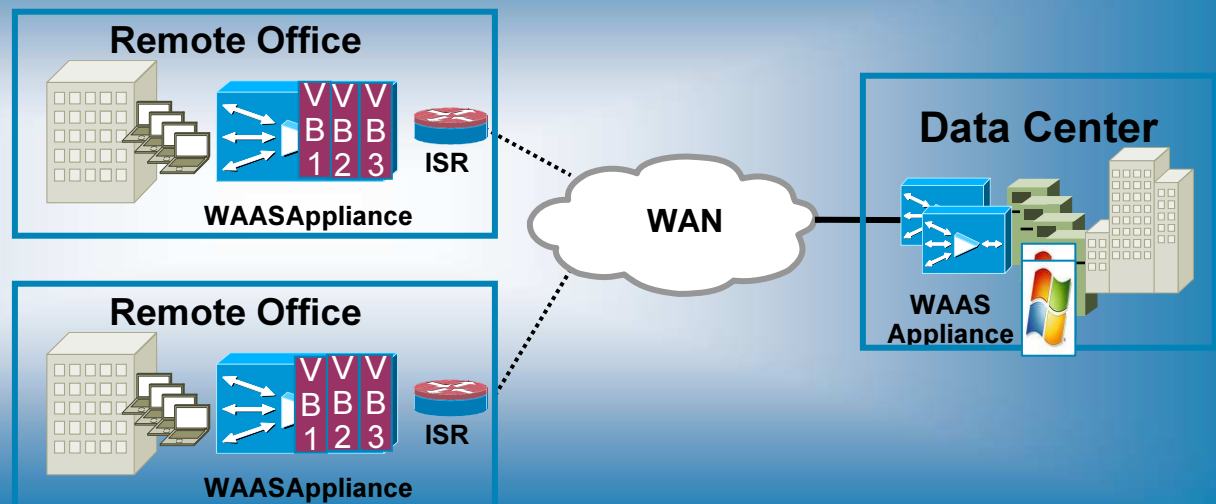
Virtual Blade – Sample Flow
Boot Server and Configure

1. Boot Virtual Blade

2. Access Virtual Display to finalize service settings

   Using VNC, pointing to WAE IP with Virtual Blade display#

Microsoft and Cisco Solution

Microsoft Windows Server 2008 Server Core

1. Branch optimized IT services

   Read-only Domain Controller

   Print services

   DNS/DHCP services

Cisco WAAS with Virtualization

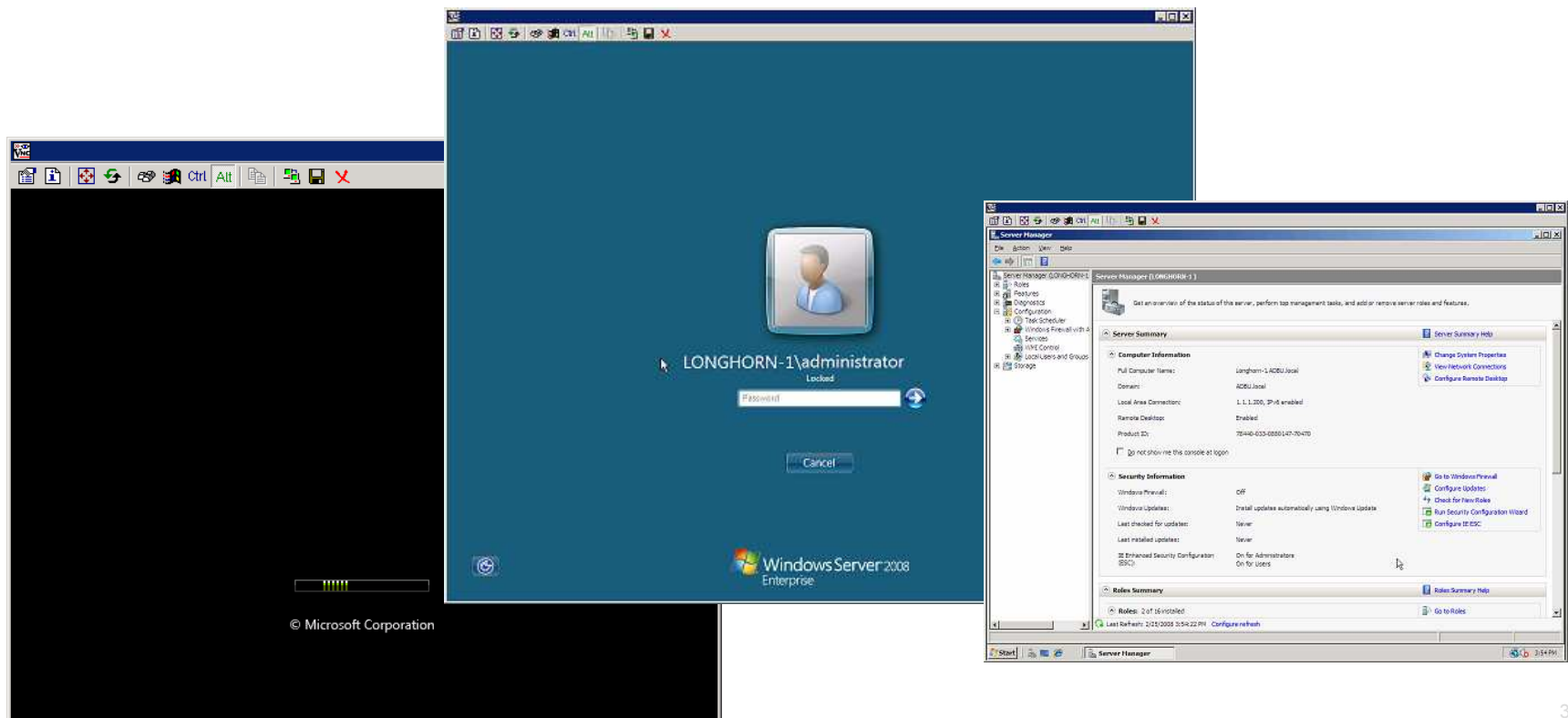1. Complete WAN optimization + application acceleration

2. Ability to host Windows services locally

Cisco WAAS with pre-packaged Windows Server 2008 services

Windows Server 2008

✓ **Jointly developed architecture**

✓ **Joint customer support**

WAAS Mobile

Cisco WAAS Mobile Overview

Available Now !

1. Where It Sits

VPN Concentrator

Public
Internet

WAAS
Mobile Client

ORACLE Microsoft
SAP WebSphere bea

Web, File &
App Servers

WAAS
Mobile Server
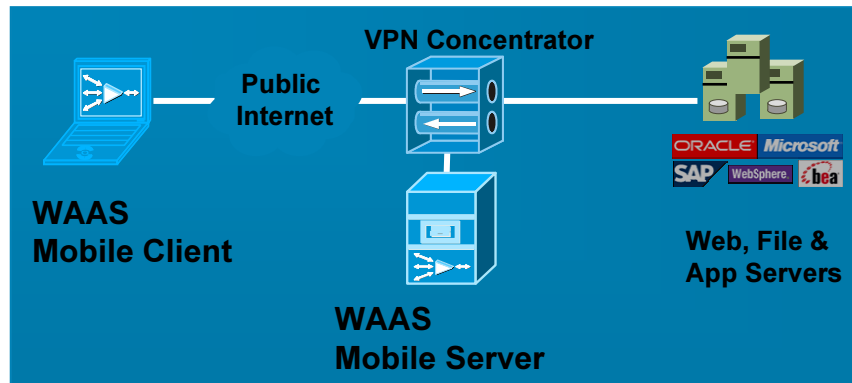
2. What It Does

Installs on Windows Desktop

Accelerates Mobile VPN connections over the Internet

3. Why It's Better

Purpose Built for the Windows PC/Laptop	1. Not an appliance software ported to Windows OS
	2. Similar to Cisco's approach with VPN client
	3. Results in reliability & stability on the Windows PC
Industry-leading Performance	1. Significantly higher throughput
	2. Better application performance
	3. Tested under a wide range of links
Lowest TCO	1. Best reliability, stability and troubleshooting tools reduce cost of support
	2. Centralized policy based management reduces deployment and support cost
	3. Integration with software distribution tools reduces deployment costs

WAAS Mobile Features

1. Unparalleled performance over low quality/high latency/high congestion/intermittent networks

   Intelligent Data Transport (ITP) outperforms TCP and optimized TCP in challenging network environments

   Persistent sessions feature maintains acceleration through network connection interruptions

2. Unparalleled "cold" up/download performance

   Advanced compression encoders optimize first time up/download

3. Industry-leading "warm" up/download performance

   Bi-directional acceleration achieved for up/down and down/up transfers

4. Accelerates any size file

   Protocol independent accelerator built on a scalable single-instance store

5. Optimizes chatty application protocols

   HTTP/S, CIFS, MAPI, FTP, SMTP, POP

6. Dynamic bandwidth reservation for softphone VoIP

Unique Secure Acceleration

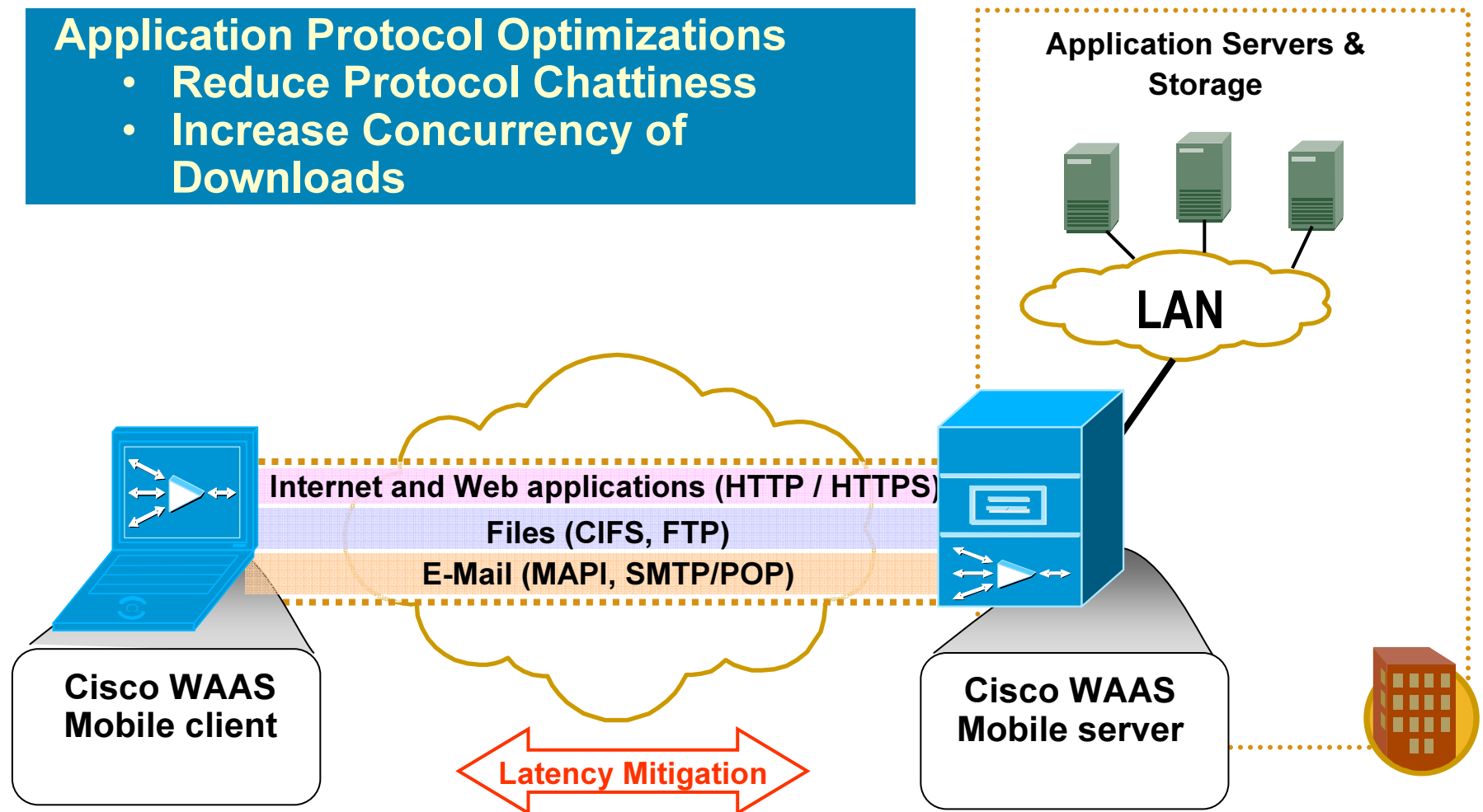1. First and only client-based accelerator to provide:

   ✓ **HTTPS acceleration (patent pending)**

   - Ensures private keys never leave the data center

   ✓ **SMB traffic protected from man-in-the-middle attack**

   - Signed SMB traffic is accelerated

   ✓ **IPSEC & SSL VPN Support**

   - Cisco   - Sonic

   - Nortel   - F5

   - Juniper   - CheckPoint

   ✓ **Data encrypted at rest (AES-256)**

Application Accelerators

Application Protocol Optimizations
- **Reduce Protocol Chattiness**
- **Increase Concurrency of Downloads**
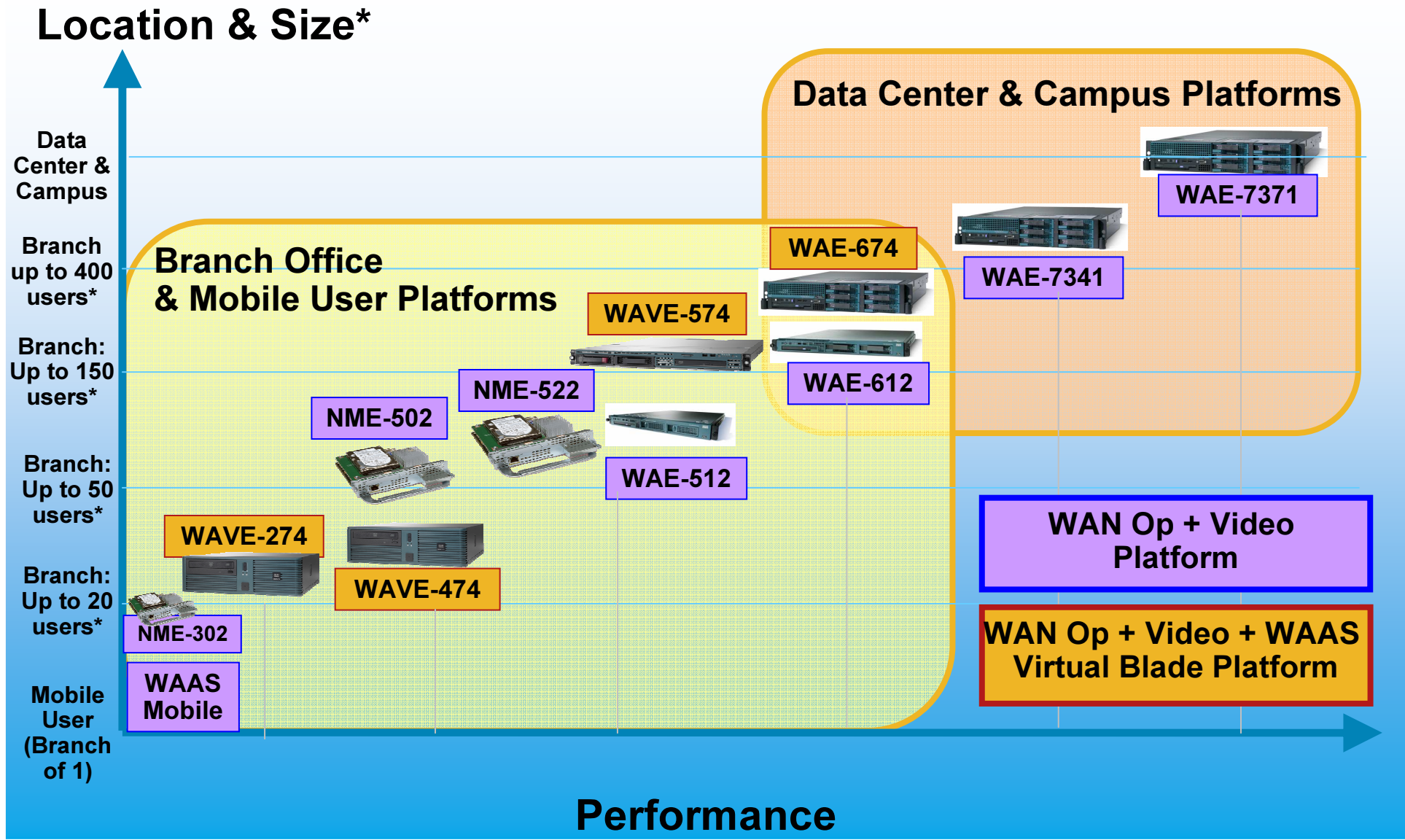
Application Servers & Storage

LAN

Internet and Web applications (HTTP / HTTPS)
Files (CIFS, FTP)
E-Mail (MAPI, SMTP/POP)

Cisco WAAS Mobile client

Cisco WAAS Mobile server

Latency Mitigation

WAAS Mobile Acceleration Matrix

Application	Acceleration Features					Support Details
	Predictive Request Pipelining	Intelligent Transport Protocol (ITP)	Delta Compression	Persistent Sessions	Signed SMB	
Web Browsing (HTTP)	●	●	●	●		Supported browsers: Internet Explorer, Mozilla Firefox, Opera, Netscape
Secure Web Browsing (HTTPS)		●	●	●		Supported browsers: Internet Explorer
Windows File Shares (CIFS/SMB)	●	●	●		●	Supported file servers: Windows 2003/XP/2000, Samba, EMC, Novell
Outlook/Exchange (MAPI)	●	●	●	●		All Outlook/Exchange versions, including 2007
E-mail (POP3/SMTP)		●	●	●		Most e-mail clients, including Outlook, Outlook Express, Mozilla Thunderbird
FTP		●	●	●		Wwide range of FTP clients, including Windows Explorer FTP Client
Other Networked Applications		●	●	●		Any TCP traffic, including Lotus Notes, Windows Remote Desktop, Citrix

Feature	Description
Intelligent Transport Protocol	Outperforms TCP and optimized TCP in high latency, low bandwidth, high packet loss, and/or congested networks.
Delta Compression	Compression is bi-directional, protocol agnostic, and accelerates any size file or data object by eliminating redundant data transmission.
Persistent Sessions	Maintains acceleration sessions through network outages.

Product update

WAAS Product Line Overview

Location & Size*

Data Center & Campus Platforms

Branch Office & Mobile User Platforms

WAE-7371

WAE-7341

WAE-674

WAVE-574

WAE-612

NME-522

NME-502

WAE-512

WAN Op + Video Platform

WAVE-274

WAVE-474

WAN Op + Video + WAAS Virtual Blade Platform

NME-302

WAAS Mobile

- Data Center & Campus
- Branch up to 400 users*
- Branch: Up to 150 users*
- Branch: Up to 50 users*
- Branch: Up to 20 users*
- Mobile User (Branch of 1)

Performance

* Indicative sizing only. Please refer to WAAS sizing guidelines to size specific to customer requirements.
* NME-302 - offers TCP Optimization & Compression only. It does not support Enterprise License Features.

48

Cisco Networkers Barcelona
26 – 29. January 2009.

http://www.cisco.com/web/europe/cisco-networkers/2009/index.html