An Innovative WAN optimization solution to bring out maximum network performance

October, 2013
Fujitsu Limited
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- Key technologies
- Supported network characteristics
- Example cases and performance benchmarks
- Technical architecture
- Deployment model
- Competitive advantage
- Product lineup
Overview

- WAN optimization solution overview
- FUJITSU Software for WAN optimization
- Key features
- Total WAN optimization solution
- Performance benchmark
WAN optimization solution overview

Challenges

- WAN’s characteristics
  - Low bandwidth
  - High latency
  - Packet Loss

Issues

- Slow application performance
- Poor user experience and low productivity
- Manage servers in branch offices

Solution

- Overcome both latency and packet loss problems in Wide Area Network
- Accelerate data transmission speed
- Deliver LAN-like performance to branch offices across the globe

Benefits

- Accelerate the performance of centrally hosted applications
- Improve user experience and boost productivity
- Avoid expensive WAN upgrades and reduce network costs
- Enable key IT initiatives using cloud

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FUJITSU Software for WAN optimization

FUJITSU Interstage Information Integrator V11

An Innovative WAN optimization solution to bring out maximum network performance

- Software-based WAN optimization solution
  - Key optimization method: protocol conversion
  - Convert TCP to Fujitsu patented proprietary high-performance protocol
    - Random Parity Stream (RPS)
    - Universal Network Acceleration Protocol (UNAP)
Key features

- **Innovative technologies**
  - **Random Parity Stream (RPS):** [patent-protected]
    - Patented technology for UDP to recover missing data when packets lost
  - **Universal Network Acceleration Protocol (UNAP):** [patent-pending]
    - UDP-based high-performance protocol with proprietary technologies that control unnecessary packet retransmission
  - **Reconfigurable-Transport (R-TSP):** [patent-pending]
    - Dynamic protocol selection technology

- **Support for a broad range of applications**
  - File sharing, Web, Collaboration, Backup, VDI, Unified communications, etc.

- **Complete network security**
  - Integrated AES encryption algorithm
  - No cached data on local storage

- **Quick and flexible deployment**
  - Can be connected anywhere in the LAN
  - Redundant configuration for mission-critical networks
Total WAN optimization solution

- Comprehensive platform support from mobile workers to large-scale datacenters
- Can be comfortably used on mobile devices such as smartphones and tablets

Headquarter / Datacenter
Web, Collaboration, VDI, ERP, CRM, SCM, File server, etc.

Branch Office
Interstage Information Integrator

Public Cloud
Backup, etc.
Interstage Information Integrator

WAN
High-speed network

Mobile environment
Smartphone, Tablet, Notebook
III Client

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Performance benchmark

Throughput comparison

- File transfer application

TCP: 90Mbps
UNAP: 3.3Gbps
(uses over 80% of bandwidth)

Latency comparison

- Virtual Desktop Infrastructure application

TCP: 3sec
UNAP: 0.5sec

> 30x improvement in throughput

Latency reduced to 1/6

With WAN optimization (UNAP, Fujitsu Interstage Information Integrator)

Without WAN optimization (Standard TCP)
Key technologies

- Issues with traditional TCP / UDP
- Fujitsu WAN optimization technologies
  - RPS (Random Parity Stream)
  - UNAP (Universal Network Acceleration Protocol)
  - R-TSP (Reconfigurable Transport)
  - Dynamic Bandwidth Control
Issues with traditional TCP

**Pros: good transfer quality**

**Cons: poor transfer speed**

- **Issue with bulk data transfer**

  - More volume of data sent, more acknowledgements returned. This process consumes significant time.
  - Longer RTT (Round Trip Time) takes more time spent for acknowledgements.

- **Issue with distant communication**

  - Network performance drops due to time spent for ACK to reach to the sender.
  - Longer RTT takes, more speed drops.
Issues on traditional UDP

Pros: good transfer speed  Cons: unreliable, line gets occupied

- Issue with reliability of data-transfer

Issue (3)
Unlike TCP, UDP returns no acknowledgement. Therefore, the sender cannot notice any packet loss/mixed-up

Issue (4)
UDP traffic occupies whole network bandwidth. Other traffic has to wait for its data-transfer.
## Fujitsu WAN optimization technologies

<table>
<thead>
<tr>
<th>Type</th>
<th>Technology</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High-performance Protocol</strong></td>
<td>Random Parity Stream (RPS)</td>
<td>Patented technology for UDP to recover missing data when packets lost</td>
</tr>
<tr>
<td></td>
<td>[patent-protected]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Universal Network Acceleration Protocol (UNAP)</td>
<td>UDP-based high-performance protocol with proprietary technologies to control unnecessary packet retransmission</td>
</tr>
<tr>
<td></td>
<td>[patent-pending]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reconfigurable-Transport (R-TSP)</td>
<td>Dynamic protocol selection technology to measure and analyze network conditions in real time and dynamically select the most suitable communication method</td>
</tr>
<tr>
<td></td>
<td>[patent-pending]</td>
<td></td>
</tr>
<tr>
<td><strong>Quality Management</strong></td>
<td>Dynamic Bandwidth Control</td>
<td>Control consuming bandwidth dynamically</td>
</tr>
<tr>
<td></td>
<td>Transmission Speed Control</td>
<td>Control data transmission speed</td>
</tr>
<tr>
<td><strong>Security</strong></td>
<td>Data Encryption</td>
<td>Encrypt data on network (AES:128bit)</td>
</tr>
</tbody>
</table>
Patented technology for UDP

- Create redundant data when it is encoded
  - Redundant data size is less than 10% of data
- If the packet is lost, it can restore any data using redundant data
- Avoid packet retransmission
UNAP (Universal Network Acceleration Protocol)

- UDP-based high-performance protocol with proprietary technologies
  - Identify the reason why there may be a delay in delivery
    - packet loss, or temporary congestion on the network
  - If it determines the reason is packet loss, it will then retransmit the lost packet
  - Control unnecessary packet retransmission

Sender

Data 1

Data 2

Determine the necessity of packet retransmission

Receiver

Data 1

Resend request

Data 2
UNAP (Universal Network Acceleration Protocol)

**TCP**
- Manage transmission with data number only
- Unable to identify the reason of delay in delivery

**UNAP**
- Manage transmission with both data number and packet number
- Able to identify the reason of delay in delivery

### TCP Diagram
- Data Number:
  - 1
  - 2
  - 3
  - 4
- Data Number:
  - 1
  - 2
  - 4
- Unable to identify the reason
- Latency
- Timeout
- Retransmit request #1
- Retransmit request #2
- Packet loss
- Unnecessary retransmission
- Misjudge as packet loss
- Misjudge as congestion
- High latency

### UNAP Diagram
- Data Number:
  - 1
  - 2
  - 3
  - 4
  - 5
- Data Number:
  - 1
  - 2
  - 3
  - 4
  - 5
- Packet Number:
  - 1
  - 2
  - 3
  - 4
  - 5
- Packet Number:
  - 1
  - 2
  - 3
  - 4
  - 5
- Packet loss
- Retransmit request #1
- Retransmit request #2
- Latency
- Timeout
- Able to identify the reason
  - Packet No. is 5 (\(\geq 4\))
  - judge packet 3 is on network
- Judge as packet loss
- Judge as congestion
- Retransmit without latency
- No retransmission

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Fujitsu Develops New Data Transfer Protocol Enabling Improved Transmissions Speeds

Software-only approach enables over 30 times improvement in file transfer speeds between Japan and the US, reduces virtual desktop operating latency to less than 1/6 of previous levels

Kawasaki, Japan, January 29, 2013 — Fujitsu Laboratories Limited today announced the development of a new data transfer protocol that, by taking a software-only approach, can significantly improve the performance of file transfers, virtual desktops and other various communications applications.

Conventionally, when using transmission control protocol (TCP)(1)—the standard protocol employed in communications applications—in a low-quality communications environment, such as when connected to a wireless network or during times of line congestion, data loss (packet loss) can occur, leading to significant drops in transmission performance due to increased latency from having to retransmit data.
R-TSP (Reconfigurable Transport)

- Automatically selects the most suitable protocol (UNAP, UDP+RPS, TCP) based on the application and network properties (bandwidth, packet loss rate, latency, RTT, etc.)
- Guarantees the best access for each application flow and maximizes application performance
Dynamic Bandwidth Control

- Regularly checks the status of the network and actively controls the bandwidth
- Minimizes the impact on other important traffic and utilizes existing network bandwidth in the most efficient way

![Network Bandwidth Graph]

- Allocated bandwidth
- Other TCP traffic
- RPS / UNAP traffic
- Time
Dynamic Bandwidth Control

**Without bandwidth control**

Other traffic is interrupted

**Static bandwidth control**

Control bandwidth to minimize an impact on other important traffic

**Dynamic bandwidth control**

Automatically check bandwidth availability at defined interval

Dynamically control bandwidth to utilize maximum bandwidth while minimizing an impact on other important traffic
Supported network characteristics

- Network type and effectiveness
- Applicable protocol diagram
- Protocol performance comparison
Network type and effectiveness

Applicable network type and technology

- Broadband internet, Wireless networks, Satellite networks, Leased line, IPsec-VPN, MPLS-VPN
- SSL-VPN is not supported

<table>
<thead>
<tr>
<th></th>
<th>Factor</th>
<th>Effectiveness of III WAN optimization</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>1</td>
<td>Round Trip Time (RTT) (ms)</td>
<td>40</td>
</tr>
<tr>
<td>2</td>
<td>Packet loss rate (%)</td>
<td>0.01</td>
</tr>
<tr>
<td>3</td>
<td>Bandwidth (Mbps)</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Transfer data size (MB)</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Application type</td>
<td>Chatter application with frequent communication</td>
</tr>
</tbody>
</table>
Applicable protocol diagram

Interactive communication application

- TCP
- UNAP
- RPS
- Satellite

RTT (ms)

- High-quality WAN
- Low-quality WAN
- LAN
- Wireless LAN (WiFi)
- WiMAX
- LTE
- 3G
- Internet (Wired)
- LFN (Long Fat Network)

Packet loss rate (%)

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Protocol performance comparison

Throughput comparison
(File transfer application)

UNAP is better
RPS is better

Latency comparison
(Interactive communication application)

UNAP is better
RPS is better

Throughput comparison

Operating Latency (Operating Latency (ms))

Packet loss rate (%)

RTT (ms)

UNAP
RPS
TCP

UNAP
RPS
TCP
Example cases and performance benchmarks

- Applicable applications
- Backup
- Enterprise Content Management
- Secured Delivery System
- Virtual Desktop Infrastructure
- Mobile
## Applicable applications

<table>
<thead>
<tr>
<th>Type</th>
<th>Application (Protocol)</th>
</tr>
</thead>
<tbody>
<tr>
<td>File Sharing</td>
<td>Windows (CIFS), etc.</td>
</tr>
<tr>
<td>Web</td>
<td>Web-based applications (HTTP / HTTPS)</td>
</tr>
<tr>
<td>Collaboration</td>
<td>Microsoft SharePoint, etc.</td>
</tr>
<tr>
<td>Backup / Replication</td>
<td>Applications from leading vendors</td>
</tr>
<tr>
<td>VDI</td>
<td>Citrix XenDesktop (ICA), etc.</td>
</tr>
<tr>
<td>Unified communications</td>
<td>VoIP, Video conferencing, Video streaming, etc.</td>
</tr>
<tr>
<td>Other TCP/IP applications</td>
<td>ERP, CRM, ECM, etc.</td>
</tr>
</tbody>
</table>
Backup

- Data backup from primary datacenter to secondary datacenter

**Benchmark Result**

- **International WAN** : Europe – Japan
  - Bandwidth: 100Mbps, Latency: 250ms, Loss rate: 0.1%

<table>
<thead>
<tr>
<th></th>
<th>File size</th>
<th>Without III</th>
<th>With III</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Backup</td>
<td>10 GB</td>
<td>7 hours 20 min</td>
<td>20 min</td>
<td>22x faster</td>
</tr>
</tbody>
</table>

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Data backup from primary datacenter to cloud storage

Regional WAN (2x Leased line) : Western Japan – Eastern Japan

- Bandwidth: 10Mbps, RTT: 25ms

Benchmark Result

Backup: 10x faster
Restore: 10x faster
**Example scenario**

**Enterprise Content Management**

- **Delivery of Technical information and documents**

![Diagram of network connections between Office, USA and Datacenter, Japan via WAN (Internet) with Interstage Information Integrators.](image)

**Benchmark Result**

- **International WAN: USA - Japan**
  - Bandwidth: 15Mbps, RTT: 250ms

**Table: Benchmark Results**

<table>
<thead>
<tr>
<th></th>
<th>File size</th>
<th>Without III</th>
<th>With III</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Upload</strong></td>
<td>1 MB</td>
<td>9 sec</td>
<td>1 sec</td>
<td>9x faster</td>
</tr>
<tr>
<td>(USA-Japan)</td>
<td>30 MB</td>
<td>180 sec</td>
<td>7 sec</td>
<td>26x faster</td>
</tr>
<tr>
<td><strong>Download</strong></td>
<td>1 MB</td>
<td>13 sec</td>
<td>1.5 sec</td>
<td>9x faster</td>
</tr>
<tr>
<td>(USA-Japan)</td>
<td>30 MB</td>
<td>350 sec</td>
<td>13 sec</td>
<td>27x faster</td>
</tr>
</tbody>
</table>
Example scenario
Secured Delivery System

- Delivery of high-volume data file through SSL network

### Benchmark Result

**International WAN : Europe/USA - Japan**
- Bandwidth: 10Mbps, RTT: 240ms, Loss rate: 1.0%

<table>
<thead>
<tr>
<th></th>
<th>File size</th>
<th>No. of clients</th>
<th>Without III</th>
<th>With III</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upload</td>
<td>10 MB</td>
<td>1 pcs</td>
<td>295 sec</td>
<td>11 sec</td>
<td>27x faster</td>
</tr>
<tr>
<td>(Europe-Japan)</td>
<td>10 MB</td>
<td>5 pcs</td>
<td>310 sec</td>
<td>14 sec</td>
<td>22x faster</td>
</tr>
<tr>
<td>Download</td>
<td>10 MB</td>
<td>1 pcs</td>
<td>205 sec</td>
<td>11 sec</td>
<td>19x faster</td>
</tr>
<tr>
<td>(USA-Japan)</td>
<td>10 MB</td>
<td>5 pcs</td>
<td>240 sec</td>
<td>17 sec</td>
<td>14x faster</td>
</tr>
</tbody>
</table>
Delivery of virtual desktop image hosted on datacenter to office

**Example scenario**

**Benchmark Result**

**International WAN : Europe – Japan**

- Bandwidth: 50Mbps, Latency: 250ms, Loss rate: 0.1%

<table>
<thead>
<tr>
<th></th>
<th>Without III</th>
<th>With III</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waiting time</td>
<td>2.3 sec</td>
<td>0.5 sec</td>
<td>4.6x faster</td>
</tr>
</tbody>
</table>
## Mobile

- **Access to web application from mobile devices**

![Diagram of Mobile Environment](image)

### Benchmark Result

- **Mobile WAN**
  - Bandwidth: 20Mbps, Latency: 150ms, Loss rate: 0.1%

<table>
<thead>
<tr>
<th></th>
<th>Without III</th>
<th>With III</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waiting time</td>
<td>5 sec</td>
<td>1 sec</td>
<td>5x faster</td>
</tr>
</tbody>
</table>
Technical architecture

- Technical architecture
- Communication flow
- Environment setting overview
- Setting screen sample (Windows / Android)
Technical architecture

- **Protocol Conversion**
  - Convert TCP/IP protocol to high-performance protocol (UNAP, UDP+RPS) at lower layer
  - No need to modify applications

1. **TCP/IP**
   - Proxy address

2. **High-performance protocol (UNAP, UDP+RPS)**

3. **TCP/IP**
(1) Client Application transmits data to client-side III

(2) Client-side III converts the data from Client application into UNAP or UDP+RPS

(3) Client-side III transmits data to server-side III

(4) Server-side III converts the data from client-side III into TCP

(5) Server-side III transmits data to Server Application
Environment setting overview

[C-1] / [S-1] Service
Service ID: Interstage 01

[C-2] Receiving Information
Machine’s own IP: 192.168.2.161
TCP port Number: 80

[C-3] Sending Information
IP (host name): 192.168.2.162
TCP Port Number (for control): 7100
Protocol Type: R-TSP
UDP Port Number (for data): 5100

[S-2] Receiving Information
Machine’s own IP: 192.168.2.162
TCP Port Number: 7100
Protocol Type: R-TSP
UDP Port Number (for data): 5100
TCP Port Number (for Rapid TCP): 5100

[S-3] Sending Information
Application Server IP (Domain): 192.168.2.170
TCP Port Number: 80

[A-1] Destination
IP: 192.168.2.161
Port: 80

Waiting port: 80

TCP port number that is necessary to consider the firewall settings
UDP port number that is necessary to consider the firewall settings
Setting screen sample (Windows)

Basic Setting (client-side)

Basic Setting (server-side)
Setting screen sample (Windows)

Line Setting (Client / Server)
Setting screen sample (Android)
Deployment model

- Deployment topologies
- Proxy environment
- Load balancing environment
- NAPT environment
- SSL-VPN environment
Deployment topologies

Out-of-path / Virtual in-path deployment

- The traffic is redirected to client-side III
  
  A) at client applications by configuring client-side III as proxy server
  
  B) at client-side switches using routing technologies

(A) Out-of-path
Configure client-side III as proxy

(B) Virtual-in-path
Redirect traffic to III at switch
Proxy environment

- Traffic using III needs to detour the proxy server
- Client and server have to communicate without going through proxy

Select network path
Configuration requiring load balancing

- Deploy server-side III in front of a load-balancer

Load balancing environment

Client-side

- Client PC recognizes several servers as 'only one server'

Server-side

- Flexibly balance workload according to the congestion status (round robin, etc.)
For successful NAPT configuration in III environment

- Change the above configuration by having one extra server for exclusive use of III
- All the client PCs are aggregated to client-side III (one IP created)
SSL-VPN environment

Reference example - Reason for no sufficient result on SSL-VPN

- III converts TCP to high-performance protocol (UNAP, UDP+RPS)
- However, SSL-VPN encapsulates UDP protocol into HTTPS protocol (TCP)
- HTTPS protocol (TCP) causes extra waiting time affecting its RTT
- For this reason, sufficient acceleration cannot be performed
Competitive advantage

- Competitive advantage
## Competitive advantage

<table>
<thead>
<tr>
<th>Package</th>
<th>FUJITSU Interstage Information Integrator</th>
<th>Traditional WAN optimization solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimization Technics</td>
<td>Protocol Conversion</td>
<td>Compression, Caching, De-duplication</td>
</tr>
<tr>
<td>Protocol</td>
<td>UDP-based proprietary protocol</td>
<td>TCP</td>
</tr>
<tr>
<td></td>
<td>• UNAP, UDP+RPS</td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td>Small</td>
<td>Bulky</td>
</tr>
<tr>
<td></td>
<td>• No HDD/SSD for data cache</td>
<td>• many HDD/SSD for data cache</td>
</tr>
<tr>
<td>Scalability</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>• No bottleneck in HDD/SSD capacity</td>
<td>• HDD/SSD can become bottleneck</td>
</tr>
<tr>
<td>Security</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>• No local storage for data cache</td>
<td>• Important data is stored on local cache</td>
</tr>
<tr>
<td></td>
<td>• AES encryption</td>
<td></td>
</tr>
<tr>
<td>Price</td>
<td>Cost-effective</td>
<td>Expensive</td>
</tr>
<tr>
<td>Mobile device</td>
<td>Supported</td>
<td>Not supported</td>
</tr>
<tr>
<td></td>
<td>(Android smartphone, tablet)</td>
<td></td>
</tr>
</tbody>
</table>
Product lineup

- License scheme
- License model example
- System requirements
## License scheme

<table>
<thead>
<tr>
<th>Product</th>
<th>License scheme</th>
<th>Appropriate for</th>
</tr>
</thead>
</table>
| Interstage Information Integrator Standard Edition | **Needs to be purchased per processor on server**  
**Single-core processors**  
- One processor license is required per processor  
**Multi-core processors**  
- Licenses equal to the total number of cores multiplied by the relevant coefficient must be purchased (decimals rounded up) | Datacenter Branch office |
| Interstage Information Integrator Client License | **Needs to be purchased in line with the number of client devices**  
(Smartphone, Tablet, Notebook) | Mobile users |

<table>
<thead>
<tr>
<th>Processor type</th>
<th>Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intel (excl. Itanium)</td>
<td>0.5</td>
</tr>
<tr>
<td>AMD</td>
<td>0.5</td>
</tr>
</tbody>
</table>
License model example

Required Licenses

- Datacenter: 1x PRIMERGY RX100 (4 cores, Xeon) + 2x III Standard Edition Licenses
- Office A: 1x PRIMERGY TX120 (2 cores, Pentium) + 1x III Standard Edition License
- Office B: 1x PRIMERGY TX120 (2 cores, Pentium) + 1x III Standard Edition License
- Mobile: 10x Tablet/Smartphone/Notebook + 10x III Client Licenses
## System requirements

### Hardware

<table>
<thead>
<tr>
<th></th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Server</td>
<td>Memory: more than 2GB, Disk: more than 1GB free space</td>
</tr>
<tr>
<td>Client</td>
<td>Memory: more than 1GB, Disk: more than 50MB free space</td>
</tr>
<tr>
<td>Smart device</td>
<td>Memory: more than 1GB, Disk: more than 30MB free space</td>
</tr>
</tbody>
</table>

### Operating System

<table>
<thead>
<tr>
<th></th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Windows</strong></td>
<td>FUJITSU PC, PRIMERGY, PRIMEQUEST, FUJITSU Cloud IaaS Trusted Public S5, AT compatible machine</td>
</tr>
<tr>
<td></td>
<td>Microsoft Windows Vista, 7, 8</td>
</tr>
<tr>
<td><strong>Linux</strong></td>
<td>PRIMERGY, PRIMEQUEST, FUJITSU Cloud IaaS Trusted Public S5</td>
</tr>
<tr>
<td></td>
<td>Red Hat Enterprise Linux 6</td>
</tr>
<tr>
<td><strong>Solaris</strong></td>
<td>SPARC M10, SPARC Enterprise, PRIMEPOWER, S Series</td>
</tr>
<tr>
<td></td>
<td>Oracle Solaris 10, 11</td>
</tr>
<tr>
<td><strong>Android</strong></td>
<td>Smart device equipped with Android</td>
</tr>
<tr>
<td></td>
<td>Android OS 4.0, 4.1, 4.2</td>
</tr>
</tbody>
</table>