Information Infrastructure for a Customer-Focused, Always-On World
WAN OPTIMIZATION

Srinivasan Padmanabhan (Padhu)
Network Architect
Texas Instruments, Inc.
Disclaimer

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Agenda

• Wan optimization overview

• Criteria for evaluating wan optimization products

• Production readiness/methodology for deployment

• Case studies

• Questions
COMPANY OVERVIEW

Global Semi-Conductor Design and Manufacturing

Business problem: Time to Market
- Global work-flow and global teams
- Collaborative design (Data and Thin Client)
- Regionally distributed compute resources / data

Users want: “local” experience from the “remote” office
- Administrative / Knowledge worker, Designer

Network solution
- Enable use of global compute resource
- Significantly reduce bulk data transfer times
  Example: 48hr transfer reduced to 4hr = 18 day reduction in time to market
TECHNOLOGY ENVIRONMENT

• Wide range of networking solutions with redundant diverse WAN architecture

• Product Suite for WAN Optimization
  - Silverpeak NX Appliances
  - Cisco 6500 with SUP720,7200 with NPE-G2,3845

• Enable strategic network architecture that reduces data on our Wide Area Network

(Best way to save bandwidth on the WAN is not to send data in the first place)
WAN OPTIMIZATION TECHNOLOGY OVERVIEW
Key Technical Drivers

• Growing pressure on WAN Bandwidth
  – Data Center/Server Consolidation
  – Remote System Backups across WAN
  – Data replication and Disaster Recovery requirements

• Obstacles
  – Latency (Throughput inversely proportional)
  – Inefficient Bandwidth usage
  – TCP/IP Protocol inefficiencies
    • Packet Loss/Re-transmissions
WAN Optimization

A suite of tools to mitigate network latency and improve network throughput and efficient use of WAN bandwidth

Normally involves one or many of the following components

- TCP Acceleration (TCP Proxy – Local acks)
- Deduplication/Cacheing -- Network/Application
- Header/Payload Compression
- Network Integrity
- Application proxy
- UDP Optimization
- Transport – Tunnels / Auto-Discovery
- Custom plug-in for SSL/CIFS
Impact of latency and loss on TCP

- Performance impacted due to connection oriented mechanism.
- TCP throughput is inversely proportional to network latency regardless of the bandwidth available.
- Layer-7 application chattiness.

Maximum theoretical TCP throughput

- Dependent on transmission window sizes and latency.

\[
\text{Throughput (bps)} = \frac{\text{TCP Window size (bytes)}}{\text{Latency (seconds)}}
\]

<table>
<thead>
<tr>
<th>RTT (ms)</th>
<th>Throughput in Kbps</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>8038</td>
</tr>
<tr>
<td>50</td>
<td>4982</td>
</tr>
<tr>
<td>100</td>
<td>3377</td>
</tr>
<tr>
<td>200</td>
<td>2054</td>
</tr>
<tr>
<td>300</td>
<td>1476</td>
</tr>
<tr>
<td>400</td>
<td>1152</td>
</tr>
<tr>
<td>500</td>
<td>944</td>
</tr>
</tbody>
</table>
• Impact of latency and loss on TCP

![Graph showing the impact of latency and loss on TCP throughput.]
Network based caching

When similar information is recognized it is conveyed via a reference to the remote network memory.

Data Center

A single instance of information is populated in each appliance based on normal network usage.

Office A

All appliances know the state of each other’s memory.

Branch Office A

Information is delivered locally when possible.
Network De-duplication at work

- File modified and sent
- Only delta traverses WAN
- Local Instance Updated
- Complete file sent to server

Branch Office A
Data Center
WAN
Office A
Data Center
Local Instance Updated
Network De-duplication at work
# Network vs Content Caching

<table>
<thead>
<tr>
<th><strong>Web/File Cache</strong></th>
<th><strong>Network Caching</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Caches a single data type</td>
<td>Works with all applications</td>
</tr>
<tr>
<td>– Benefits limited to a single application</td>
<td>– Benefits broad range of applications</td>
</tr>
<tr>
<td>Identifies content by URL/filename</td>
<td>Examines content itself</td>
</tr>
<tr>
<td>– Changing name defeats cache</td>
<td>– Renaming does not affect operation</td>
</tr>
<tr>
<td>Recognizes pages/objects</td>
<td>Recognizes content at byte level</td>
</tr>
<tr>
<td>– Whole object must be identical</td>
<td>– Detects similar/modified content</td>
</tr>
<tr>
<td>– All or none cache result</td>
<td>– Can send byte granular deltas</td>
</tr>
<tr>
<td>Limited coherency guarantees</td>
<td>100% coherent</td>
</tr>
<tr>
<td>– Freshness vs efficacy tradeoff</td>
<td>– No chance of stale data</td>
</tr>
<tr>
<td>– Local authentication and locking</td>
<td>– Native application handles locking etc</td>
</tr>
</tbody>
</table>
CRITERIA FOR EVALUATING WAN OPTIMIZATION PRODUCTS
Criteria for site selection for deployment of WAN Accelerators

- Latency sensitive applications impacting performance (> 40ms)
- Limited Bandwidth impacting performance (< 10 Mbps)
- Need for faster bulk data transfer
- Need for WAN encryption
- Data Center Consolidation
- Cost avoidance opportunities by leveraging data reduction
- Cost savings opportunity to scale down bandwidth
Phase-I Testing

Applications performance test criteria
- FTP (100MB file /40ms delay/first pass/second pass)
- FTP (100MB file /500ms delay/first pass)
- CIFS (100MB file /40ms delay/first pass/second pass)
- CIFS (100MB file /500ms delay/first pass/second pass)
- CIFS (21MB file /32ms delay /20mb bw /first pass)
- FTP (100MB file /32ms delay/20mb bw / first pass)
- SSL Applications – with and without CERTs
  Thin Client at both low and high latency – What tweaks are required?

Performance Comparison
- Low latency throughput
- High latency throughput
- Utilization with drops
- Utilization when circuit is 50% loaded
Phase-II Testing

Advanced Functions:
• Configure and test out of band via WCCP (wccp throughput check)
• Configure and test out of band via PBR
• Asymmetrical routing support
• Test appliance behavior when flows or appliance max throughput are exceeded
• Exclusion/Inclusion of ports, IP address from acceleration
• Enterprise network topology feasibility
• Physical Topology awareness (subnet/network configuration)
• Support for multi hop transport
• Can it rate limit?
• Scalability (Bandwidth and Flows) - Cost per flow
• Encryption of accelerated data
• Protocols accelerated (TCP/UDP)
• Support for virtualization
• Support for Dot1q trunks
• Centralized management/Reports / Troubleshooting / Support
Throughput anomalies ..

• How is the improvement for bulk data applications at low latencies?
• What about throughput improvement at high latencies?
• With errors introduced in the path what is the net effect on throughput at both high and low latencies.
• Is there any difference in performance based on inline vs out of path?
PRODUCTION READINESS & DEPLOYMENT METHODOLOGY
Deployment Models

a) Out of path
   - WCCP (L3 or L2)
   - PBR Policy Based Routing

b) Inline (Sites with single Data VLAN)

c) Physical Inline with Dot1q
   (Sites with multiple VLANs trunked to WAN Router)
PBR/WCCP Model

WCCP Group 51 and 52 (TCP and UDP), include both routers
Router ACL Config: permit LAN-A to LAN-B

WCCP Group 51 and 52 (TCP and UDP), include both routers
Router ACL Config: permit LAN-B to LAN-A
Inline / Virtual Inline Model

- **Inline** – Wire in / Wire out – Relay bypass
- **Virtual Inline** - Uses VLAN xx as a Transit VLAN to get LAN traffic passed through the appliance.
- Ability to bypass the WAC by short circuiting VLAN xx with default data vlan.
CASE STUDIES

- Improving application throughput on the WAN
- Reducing cycle time for DR/ Bulk data transfers
- Optimizing thin client applications over high latency WAN circuits
Use case with (SnapVault)

1.68 GB Snapvault Data sent to accelerator from NetApp Filer. Accelerator sent 126 MB of data over WAN after data reduction. Data Reduction ratio is 13.278x or 93%.

<table>
<thead>
<tr>
<th>Application</th>
<th>LAN Traffic (%)</th>
<th>WAN Traffic (%)</th>
<th>LAN Rx Bytes</th>
<th>WAN Tx Bytes</th>
<th>Ratio (X)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SnapVault</td>
<td>52.045</td>
<td>13.238</td>
<td>1,678,242,753</td>
<td>125,304,642</td>
<td>13.278</td>
</tr>
</tbody>
</table>
# SSL Optimization with WAN Accelerators

<table>
<thead>
<tr>
<th>Test#</th>
<th>Test Description</th>
<th>File Type</th>
<th>File Size</th>
<th>Latency</th>
<th>Bandwidth</th>
<th>Time Elapsed (In Seconds) without WAN optimization</th>
<th>Time Elapsed (In Seconds) with WAN optimization</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Load Sharepoint url</td>
<td>https</td>
<td>0.2MB</td>
<td>300ms</td>
<td>10 Mbps</td>
<td>11</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>Upload</td>
<td>Word</td>
<td>7MB</td>
<td>300ms</td>
<td>10 Mbps</td>
<td>97</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>Download</td>
<td>Word</td>
<td>7MB</td>
<td>300ms</td>
<td>10 Mbps</td>
<td>82</td>
<td>30</td>
</tr>
<tr>
<td>4</td>
<td>Download</td>
<td>Excel</td>
<td>27MB</td>
<td>300ms</td>
<td>10 Mbps</td>
<td>284</td>
<td>93</td>
</tr>
<tr>
<td>5</td>
<td>Download</td>
<td>PowerPoint</td>
<td>47MB</td>
<td>300ms</td>
<td>10 Mbps</td>
<td>496</td>
<td>191</td>
</tr>
<tr>
<td>6</td>
<td>Download</td>
<td>Excel</td>
<td>55MB</td>
<td>300ms</td>
<td>10 Mbps</td>
<td>559</td>
<td>87</td>
</tr>
<tr>
<td>7</td>
<td>Download</td>
<td>Word</td>
<td>87MB</td>
<td>300ms</td>
<td>10 Mbps</td>
<td>900</td>
<td>78</td>
</tr>
</tbody>
</table>
## Application Performance with WAN Accelerators

<table>
<thead>
<tr>
<th>Test Cases</th>
<th>Accelerated</th>
<th>Baseline</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>FTP (100MB file /500ms delay)</td>
<td>47 secs</td>
<td>18mins 50 secs</td>
<td>23X BW increase</td>
</tr>
<tr>
<td>CIFS (20MB file /500ms delay)</td>
<td>11 secs</td>
<td>4 mins</td>
<td>22X BW increase</td>
</tr>
<tr>
<td>CDDS/HTTP (80MB file /300ms delay)</td>
<td>53 secs</td>
<td>11 min</td>
<td>12X BW increase</td>
</tr>
<tr>
<td>Rsync with ssh (100MB file /500ms delay)</td>
<td>11min 8 secs</td>
<td>18 mins</td>
<td>No IPSEC</td>
</tr>
<tr>
<td>Rsync with rsh (100MB file /500ms delay)</td>
<td>56 secs</td>
<td>18 mins</td>
<td>With IPSEC</td>
</tr>
<tr>
<td>SFTP (680MB file /320ms delay)</td>
<td>1 hr 30 min</td>
<td>1 hr 36 min</td>
<td></td>
</tr>
<tr>
<td>FTP (680 MB file /320ms delay)</td>
<td>4 min 10 sec</td>
<td>1 hr 36 min</td>
<td>23X BW increase</td>
</tr>
<tr>
<td>Mobilize (4GB file /320 ms delay)</td>
<td>14 min</td>
<td>4 hr 34 min</td>
<td></td>
</tr>
</tbody>
</table>
Leveraging WAN Acceleration for Thin client

- **TCP acceleration - Latency mitigation**
  - Performance improve significant **when latency is above 100ms**
  - Higher the latency better the performance
  - Improves predictability in keystrokes and mouse moves

- **Network Integrity corrections optimizes dirty links**

- **Local ‘ack’ addresses chatty applications**

- **Compression effectively reduces initial transfer**

- **Network Cacheing**
  - Cumulative benefit as more users access same thin client farm
  - Saves wan bandwidth that potentially could be made available for other bulk data applications
Few good use cases....

For achieving best performance using WAN Acceleration:

- Disable application compression
- Leverage SSL optimization where possible
- Actively manage thin client environment to leverage WAN optimization
- Disable encryption (ssh/sftp) * Exceptions from Security may be required

- Files to be in native format (no zip/compressed files)
- Works best for bulk data transfers
- No ssh/secure wrappers
WAN Optimization

Questions ??
WAN Optimization

Thank you!!