



Technical Training



Training Goals

- How does the WarpTCP proxy work?
- When does the WarpTCP proxy provide benefit?
- Where should it be deployed for best benefit?
- How to configure a WarpTCP proxy
 - Bridge Mode
 - Bridge Gateway Mode
 - Gateway Mode
- How to verify the benefit?
- How to get help
- What are the different WarpTCP products?



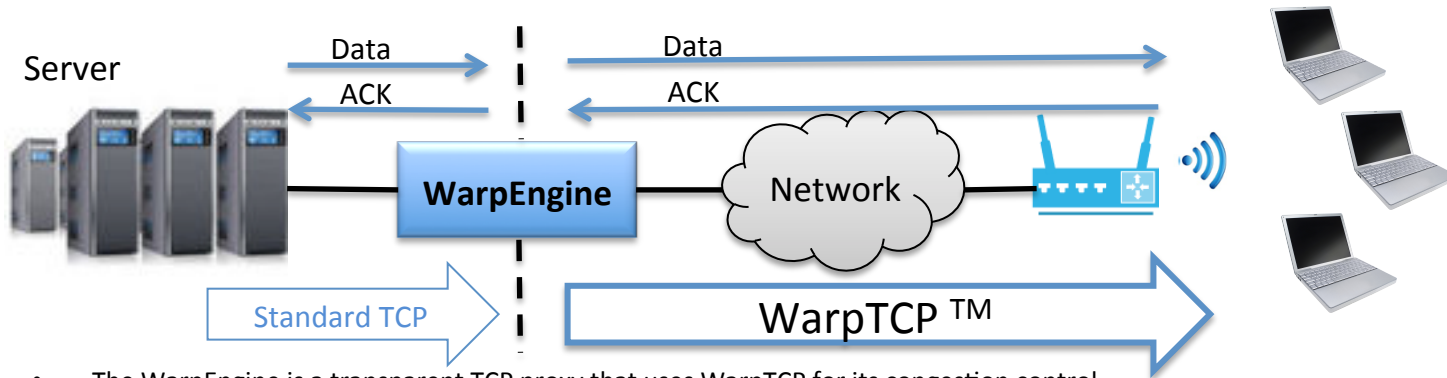
Assumed Knowledge

This tutorial assumes that the following is understood prior to the training:

- Ethernet networking
 - How an Ethernet packet gets from one adapter to another in a LAN
 - MAC addresses
 - Layer 2 switch operation (basics)
- IP Networking
 - How an IP packet gets from one host to another in a network
 - IPV4 addressing
 - Subnets
 - ARP
 - ICMP
- Routing
- The TCP protocol basics
 - 3-way Handshake
 - What is the congestion control window, and how does it work?
- Understanding how to use Wireshark will be helpful



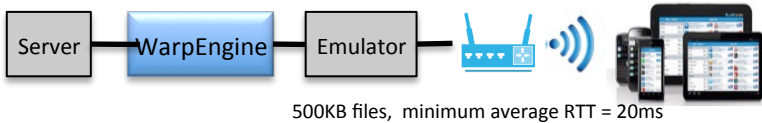
WarpEngine™: How does it work?



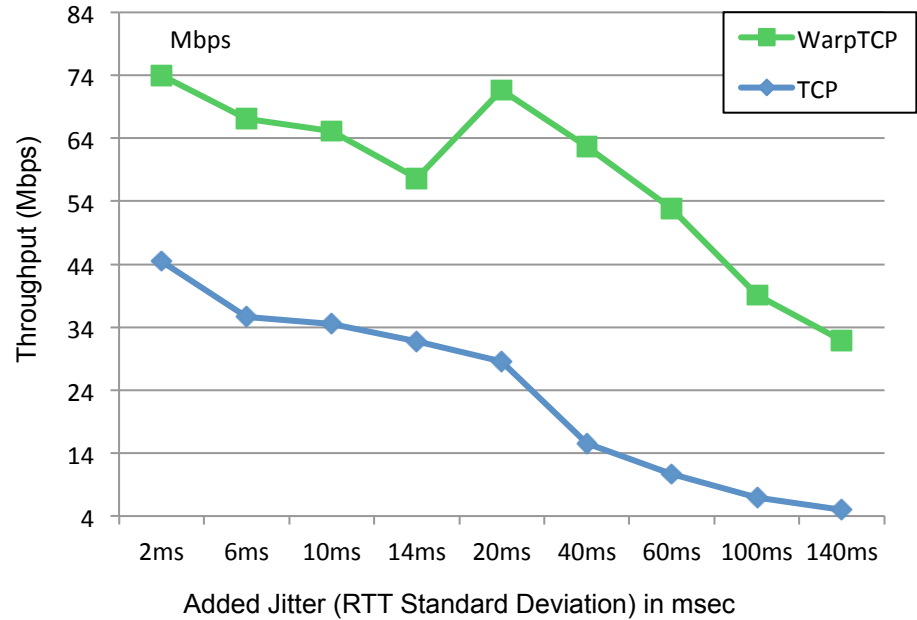
- The WarpEngine is a transparent TCP proxy that uses WarpTCP for its congestion control
 - The server thinks it is communicating directly with the client, and the client thinks it is communicating directly with the server.
 - TCP sessions are terminated, and buffered on the proxy
 - The payload of the TCP packets are buffered, but not touched. The proxy does not look at the contents.
- WarpEngine uses the source and destination IP + Ports to keep track of the sessions.
 - The TCP connection to the server will not have the same source port as the one from the client
 - The TCP sequence number will not be the same on either side of the proxy
 - The source MAC address on the WarpEngine will not necessarily be the same as the clients MAC address
- Connection process:
 - Client does 3 way handshake with WarpEngine
 - WarpEngine does 3 way handshake to the server
 - Client makes request for data
 - WarpEngine receives the request and passes it to the server.
 - WarpEngine receives the data from the server (as fast as possible)
 - As soon as WarpEngine receives data from the server, it sends it to the client

WarpTCP™ Outperforms TCP with Jitter

- As the jitter increases, WarpTCP is able to maintain throughput
- Benefit (%) gets very high under high jitter situations



WarpTCP –vs- Cubic TCP Performance with Jitter



WarpEngine™: When does it provide benefit?

- When there is available bandwidth
 - The data rate seen by the user is less than their connection
- When the traffic is TCP
 - Some applications run on UDP: Google QUIC, VOIP, VOLTE, RTP
- When TCP is limiting the connection rate
 - Jitter in the network causes Standard TCP to incorrectly interpret the jitter as real congestion, and it slows down as a result.
 - This type of jitter is caused by the following
 - Wireless networks (LTE, Wi-Fi)
 - Cable modems (DOCSIS)
 - VPN connections
 - Under-provisioned networks
- When the file size is greater than ~ 15KB
 - TCP initial window parameter causes data to be sent without congestion control (at line rate). As a result WarpTCP will not normally improve traffic under 15KB. Unless one of these 10 packets has an RTO.
- When a Web browser is accessing a web page
 - Web browsers only support establishment of 2 to 4 sessions simultaneously.
 - Web pages can easily have 100 to 200 objects which require individual TCP sessions.
 - The RTT to the proxy can be reduced significantly, and it will complete the TCP connections with the browser independently of the server connections, improving page load times.

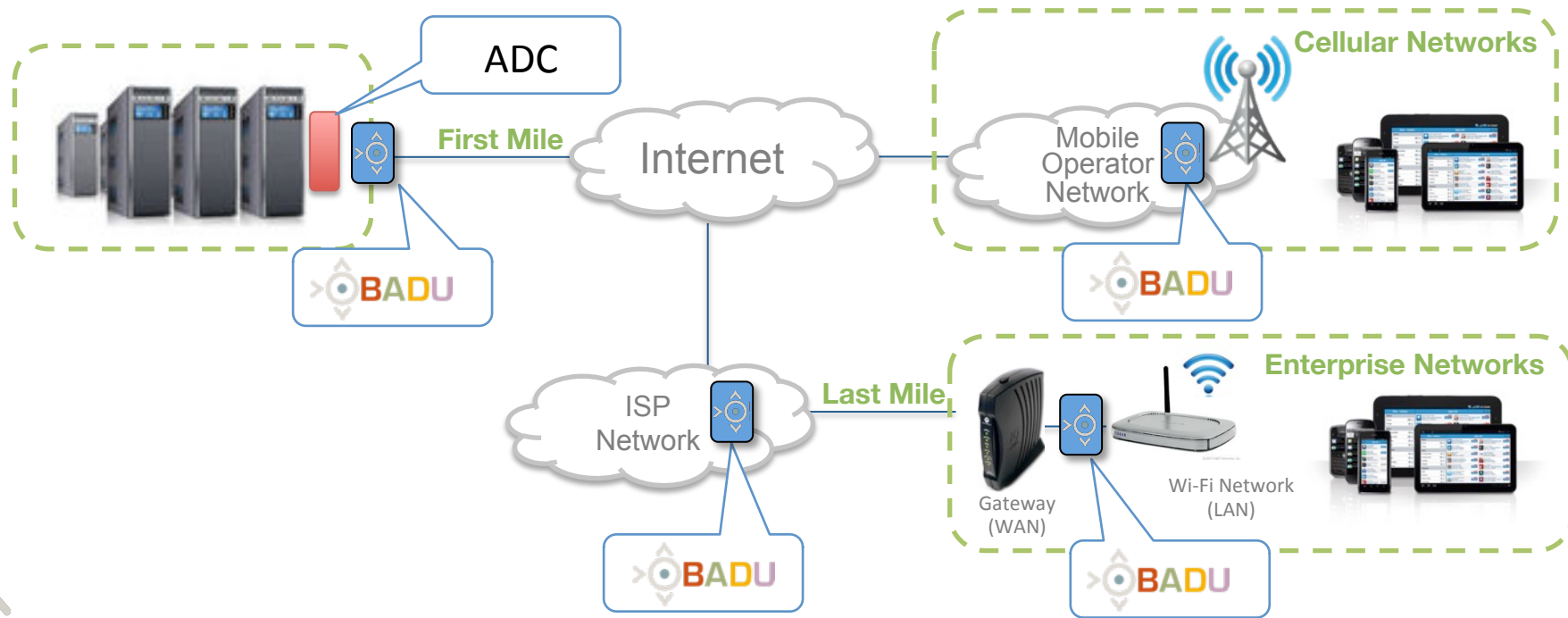


Where should the proxy be deployed for best benefit?

- In between the client and server
 - All packets from a particular session must pass through the proxy (no split horizon routing)
- Outside of VPN tunnels
 - VPN tunnels typically use UDP, and as a result are not accelerated
- Splitting the RTT + jitter between the server and client more evenly will improve the throughput as long as the proxy is not starved for data.
 - For downloads, if the server side connection is slower than the client side, the proxy will run out of data to send. As a result there will be limited bandwidth.
 - The same is true in the opposite direction, and so you should consider what traffic should be optimized.
- On the client side of ADCs (F5) or WAN optimization solutions
 - These boxes terminate the TCP sessions, and as a result terminate the WarpTCP session.
- In Enterprises, a good location is near the connection to the internet
- Carriers can locate the proxies at the cell towers or at the PGW



WarpTCP™ Flexible Deployment: Single Box Anywhere Between Server and Client



What Benefit Can be Expected?

These numbers are for ~ 1MB file sizes

- Long distance connections including highly congested Wi-Fi: ~10X
- VPN connections : ~4X
- Wi-Fi connections (limited congestion): ~2X
- Wi-Fi connections (limited congestion) to cloud servers: 3.5X
- LTE connections (limited congestion) ~ 30%
- LTE connections (Highly congested) ~ 2X

In general, benefit can change significantly as a result of rapidly changing network conditions



Proxy Configuration: What Mode to choose ?

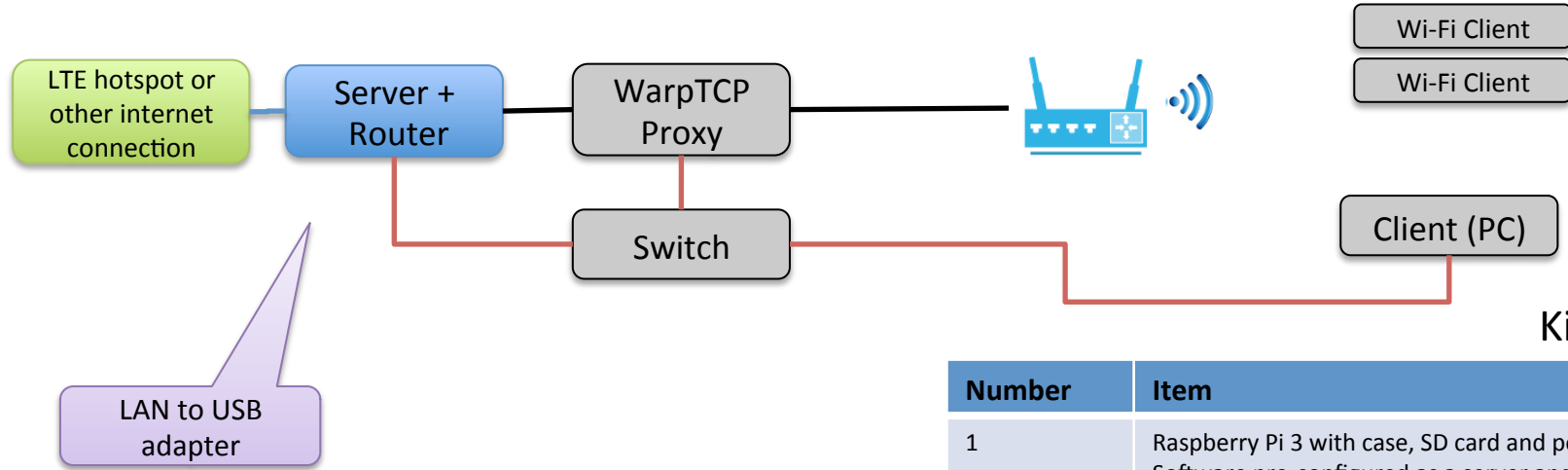
- If possible use Bridge Gateway mode, as it is the simplest to configure
- Each mode of operation has different features that affect the deployment but do not affect the benefit.

Item	Bridge Gateway	Bridge	Gateway
IP addresses required for the Proxy	0	1	2
DHCP support	No	Yes	Yes
Routing changes on Gateways	No	No	Yes
Route traffic only on the Proxy subnet	No	Yes	No
Management access over proxied interface	No	Yes	Yes
Source NAT	No	Yes	Yes
Selective Bypass Rules	Yes	Yes	Yes
SMB + IP Broadcast support (Windows® Share)	Yes	Yes	No
Forward Broadcast and Multi-cast traffic	Yes	Yes	No

All VLANs need to be configured by adding logical pairs in the interfaces tab



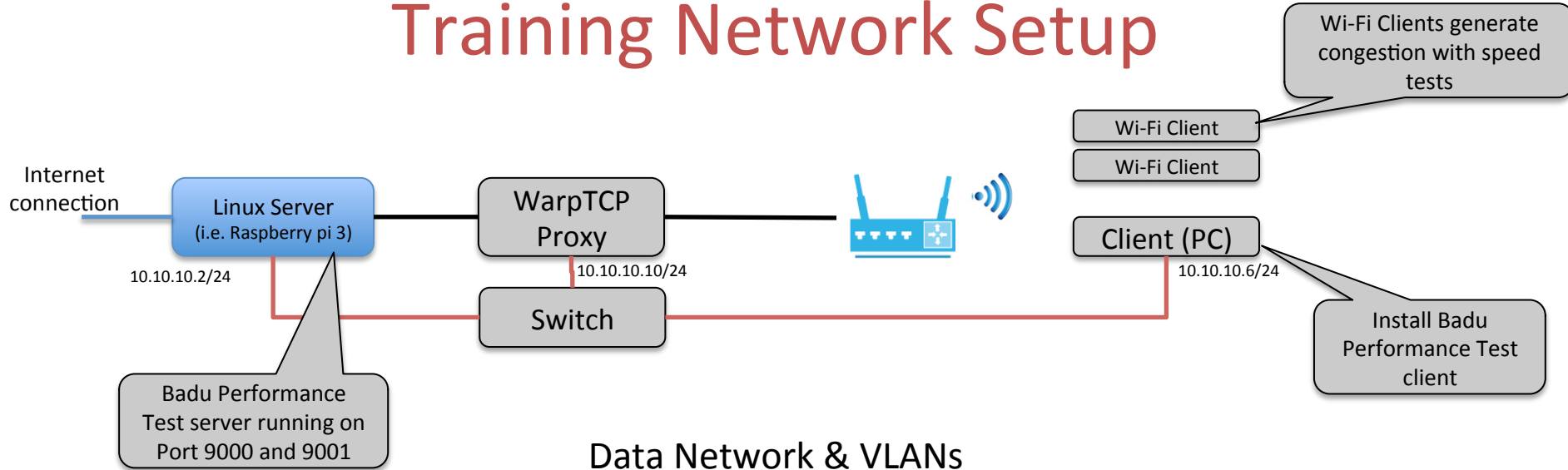
Training Materials: WarpTCP Training Kit



Kit contents

Number	Item
1	Raspberry Pi 3 with case, SD card and power supply. Software pre-configured as a server and router.
1	LTE hotspot with USB tether capability (optional)
1	USB to Ethernet converters
5	Ethernet cables
1	4 port switch
2	Wi-Fi Clients for generating network traffic

Training Network Setup

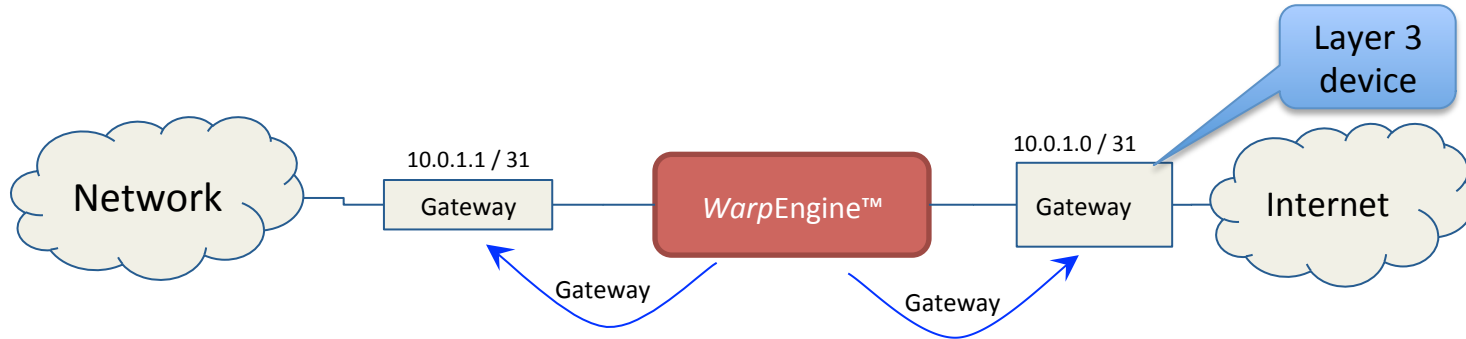


Data Network & VLANs

VLAN	Server	Proxy mode	Proxy Eth3	Proxy Eth2	WLAN WAN
1	10.10.1.2/24	Bridge Gateway	NA	NA	10.10.1.5/24
2	10.10.2.2/24	Bridge	10.10.2.3/24	NA	10.10.2.5/24
3	10.10.3.2/24	Gateway	DHCP	10.10.3.4/24	10.10.3.5/24

If VLANs are not supported, each network can be configured one at a time

Example Network: Bridged-Gateway Mode



- When to use:
 - Between Two Gateways
 - Simple configuration
 - Cannot modify Router configurations

GUI: Interfaces tab

Required Fields

- Interface Gateways
- VLAN (if needed)

Optional fields

- MSS : Often used with VPNs
- MAC address
- VLAN fields
- All fields in grey

Verify configuration

This is used to verify that the configuration is correct. It uses the fields in grey in order to determine if the configuration is correct. The “?” lists all of the verified conditions, and those it could not test.

The screenshot shows the configuration page for a WarpEngine Proxy. At the top, there is a header bar with a status indicator (green dot), the name 'Ip_0 (Physical)', and two Gateway IP addresses: 192.168.1.7 and 192.168.1.8. A dropdown menu is set to 'Bridged Gateway' and a 'Bypass' button is visible.

The main configuration area is divided into three sections: 'Downstream Gateway', 'WarpEngine Proxy', and 'Upstream Gateway'. Each section has a greyed-out 'IP' field and other fields for IP Address, MAC Address, Netmask, and VLAN ID.

The 'WarpEngine Proxy' section is highlighted in blue and contains two interface configurations: 'Interface: eth2' and 'Interface: eth3'. Each interface has fields for Gateway, MSS, MAC Address, Pair Name, VLAN Name, VLAN ID, and VLAN Priority. There are also checkboxes for 'Enable GTP' and 'GTP Seq Num', and an 'Assign MAC Addresses' button.

At the bottom, there is a 'Verify Configuration' button and a 'Notes' field. The footer shows '+ Selective Bypass Configuration' and 'Active Selective Bypass Rules: 0'.



Conditions for operation : Bridge GW

These conditions need to be met for proxy operation, and are mostly checked using the Verify configuration button .

	Description
	The gateway IP address for WarpEngine do not use Network or Broadcast IP address (top and bottom of subnet range)
	Gateways must respond to ARP
	WarpEngine must be physically connected on both ports
	Management Network must not be on the same subnet as routed traffic
	The upstream and downstream Gateway VLANs must be the same as the VLAN on the proxy
	If there is a Firewall, it should allow the TCP traffic to flow through WarpEngine
	The network must not use “split Horizon” routing.
	The network must be routable prior to installing WarpEngine
	Proxy must be licensed
	WarpEngine must be able to reach the upstream gateway
	WarpEngine must be able to reach (ping) the downstream device

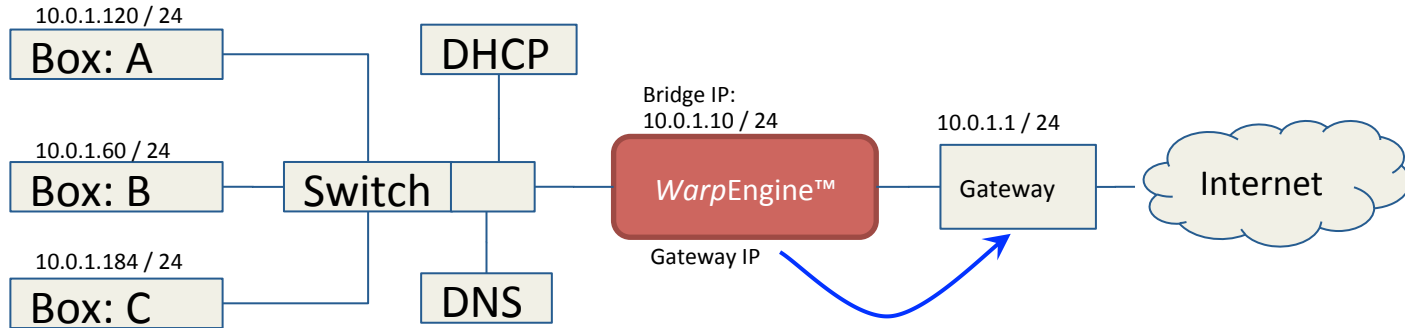


Bridge Gateway Training Exercises

- License your proxy through License.badunetworks.com
- Update the software through License.badunetworks.com
- Configure the proxy in Bridge Gateway mode (VLAN 1)
 - Remember to configure selective bypass for destination port 9001
 - Configure MAC addresses for Hardware bypass (MAC Spoofing)
 - You can use ARPprobe to determine the MAC addresses of the gateways
- Launch the performance test tool on the client
 - MAC or Windows PC
- Verify proxy operation with sessions graph while the test tool runs traffic
 - Run speed test with multiple clients, and see how the benefit changes.
 - Run speed test while one of the clients is doing a large (1GB) upload to Google or some similar site.



Example Network: Bridge mode



- All devices need to be in the WarpEngine Bridge subnet to be routed
- Supported:
 - SNAT
 - Management over proxied interface
 - DHCP for bridge IP address

GUI: Interfaces tab

Required Fields

- Interface Gateway
- Bridge IP / netmask
 - Or DHCP
- VLAN (if needed)

Optional fields

- MSS : Often used with VPNs
- MAC address
- VLAN fields
- All fields in grey

Verify configuration

This is used to verify that the configuration is correct. It uses the fields in grey in order to determine if the configuration is correct. The “?” lists all of the verified conditions, and those it could not test.

The screenshot displays the configuration interface for a WarpEngine Proxy. At the top, there are two gateway IP addresses: 192.168.1.7 and 192.168.1.8. The interface is divided into three main sections: Downstream Client, WarpEngine Proxy, and Upstream Gateway. The Downstream Client and Upstream Gateway sections contain greyed-out fields for IP, Netmask, and VLAN ID. The WarpEngine Proxy section is highlighted in blue and contains fields for Pair Name (Ip_0), VLAN Name, VLAN ID, VLAN Priority, Source NAT, and MGMT Port. It also features two interface-specific sections: Interface: eth2 and Interface: eth3. The eth3 section includes fields for IP Address, Netmask, Gateway (192.168.1.8), MSS, MAC Address (08:00:27:6b:5e:7b), and checkboxes for DHCP, MGMT, and SSH. A 'Verify Configuration' button is located at the bottom left, and a 'Notes' field is at the bottom. A 'Bypass' button is visible in the top right corner.



Conditions for operation : Bridge

These conditions need to be met for proxy operation, and are mostly checked using the Verify configuration button . (New fields only)

	Description
	IP address and subnet mask for the bridge interface must be defined
	The Bridge IP address must not be a network IP address or a broadcast address
	Management Network must not be on the same subnet and VLAN as routed traffic as the Bridge network
	If DHCP is enabled there must be only one DHCP server on each side.
	If DHCP is enabled It must be in the same VLAN and subnet as the bridge
	All downstream devices must be in the same subnet as the bridge

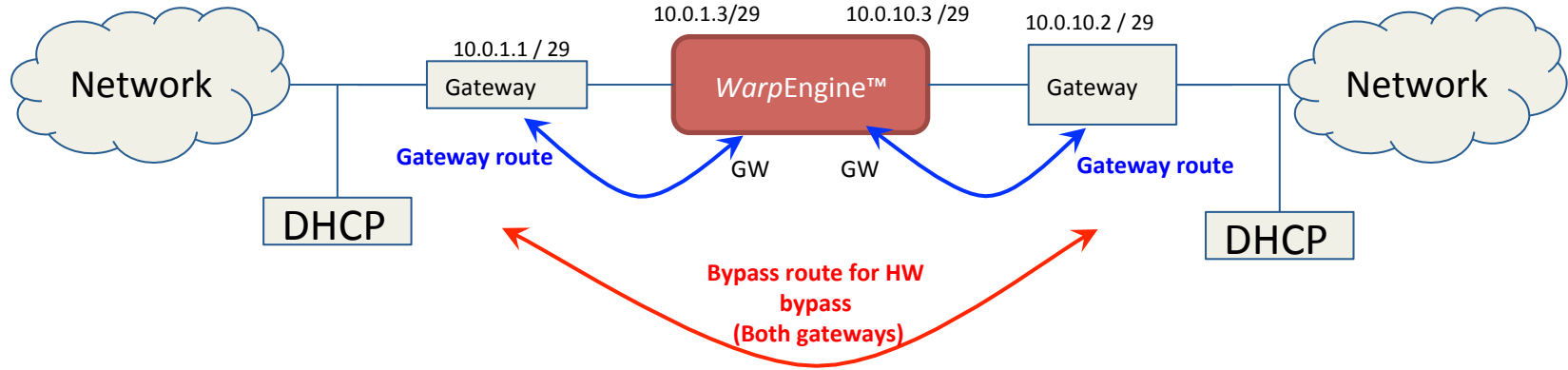


Bridge Mode Training Exercises

- Configure the proxy VLAN 2 in Bridge Mode
 - Remember to configure selective bypass for destination port 9001
- Launch the performance test tool on the client
 - MAC or Windows PC
- Verify proxy operation with sessions graph while the performance test tool runs traffic
- Download the performance test tool results to CSV file
- Select Bypass for the bridge interface, to verify the benefit difference.



Example Network: Gateway Mode



- When to use:
 - Between Two Gateways
 - Spanning between subnets
 - When you need all the features, and can make modifications to the gateways

GUI: Interfaces tab

Required Fields

- 2 Interface Gateways
- 2 IP / netmask
 - Or DHCP
- VLAN (if needed)

Optional fields

- MSS : Often used with VPNs
- MAC address
- VLAN fields
- All fields in grey

Verify configuration

This is used to verify that the configuration is correct. It uses the fields in grey in order to determine if the configuration is correct. The “?” lists all of the verified conditions, and those it could not test.

The screenshot shows the GUI for configuring interfaces on a device. The top bar indicates the device name is 'Ip_0 (Physical)' and the current Gateway IP is '192.168.1.7'. A 'Gateway' dropdown menu is set to 'Gateway', and the resulting Gateway IP is '192.168.1.8'. A 'Bypass' button is visible in the top right corner.

The main configuration area is titled 'WarpEngine Proxy' and is divided into three sections:

- Downstream Gateway:** Contains fields for IP, Bypass Route, IP Address, MAC Address, Netmask, and VLAN ID. These fields are currently greyed out.
- WarpEngine Proxy:** Contains configuration for two interfaces: 'Interface: eth2' and 'Interface: eth3'. Each interface has fields for IP Address, Netmask, Gateway, MSS, MAC Address, and Address. There are also checkboxes for DHCP, MGMT, and SSH, and a dropdown for MGMT Port. A central button labeled 'Assign MAC Addresses' is present.
- Upstream Gateway:** Contains fields for IP, Bypass Route, IP Address, MAC Address, Netmask, and VLAN ID. These fields are currently greyed out.

At the bottom of the interface, there is a 'Verify Configuration' button and a 'Notes' field.



Conditions for operation : Gateway mode

These conditions need to be met for proxy operation, and are mostly checked using the Verify configuration button .

	Description
	IP address and subnet mask for the subnets on each side of WarpEngine - Do not use Network or Broadcast IP
	Gateway IP addresses on each side of WarpEngine (Eth2, Eth3) are present
	Management Network must not be on the same VLAN and subnet as routed traffic if the MGMT checkbox is not checked.
	If DHCP is enabled on either data port, they must be in the same VLAN and subnet as the Proxy on that side.
	The LAN + VLAN on each side of WarpEngine must not be the same.
	Routes on the devices on either side of WarpEngine must be added to include WarpEngine in the path.
	Bypass Routes on the devices on either side of WarpEngine must be added to ensure HW bypass functions correctly
	The upstream and downstream networks must be on different subnets.

Gateway Mode Training Exercises

- Configure the proxy VLAN 3 in Gateway Mode
 - Remember to configure selective bypass for destination port 9001
 - Configure Eth3 as DHCP operation
- Launch the performance test tool on the client
 - MAC or Windows PC
- Verify proxy operation with sessions graph while the performance test tool runs traffic
- Modify the performance test tool to point to port 9000 for both TCP and WarpTCP, and run one hundred 100K file downloads
 - Select Benefits button and observe the difference in throughput on the throughput graph between proxied and bypassed sessions.



How to Measure WarpTCP Benefit

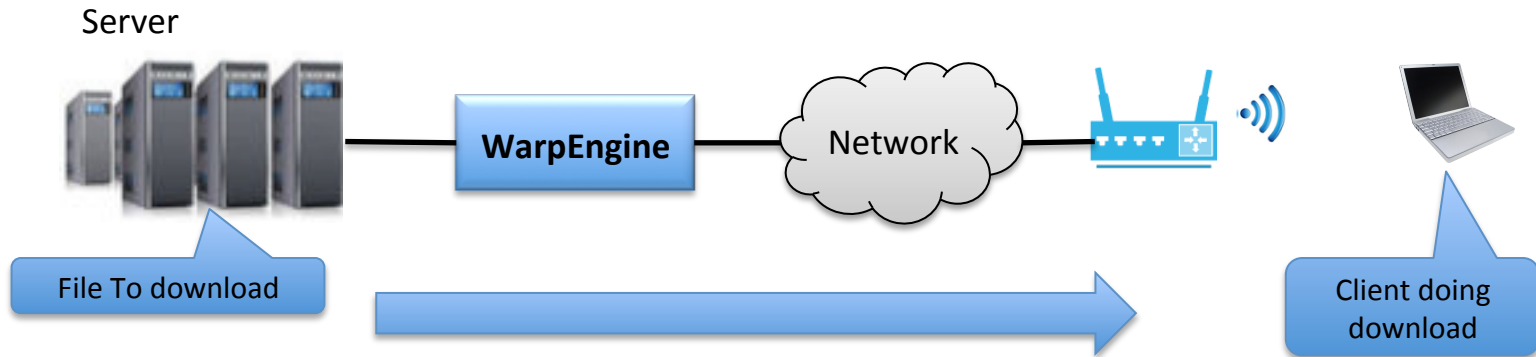


Measuring WarpTCP Benefit

- The benefit needs to be measured while it is congested with real traffic
- Rapidly changing network conditions require averaging multiple measurements to get accurate results
- Measurements must be made by alternating acceleration and bypass while using the same network path.
- Badu Networks Performance test tool automates this measurement
- The **Benefits** button next to the throughput graph can be used to estimate the benefit in a network with a significant amount of traffic
 - The **Benefit** button implements a mode where every other TCP session is bypassed.
 - By comparing the average throughput of the bypassed traffic to the proxied traffic can give a good estimate of the benefit.



Typical Test Setup



Measure throughput using similar file sizes as the application is using

- 100K: Web page elements
- 1M -> 2M: Video chunk size
- 5M: Pictures

Badu Networks Performance Test tool

- Badu Networks has created a tool that makes this measurement easy
- Download from [License.badunetworks.com](https://license.badunetworks.com)
 - Support materials -> Download Test Software
- See the user guide in the downloaded archive



Performance Test Tool Configuration

Server



WarpEngine


Network





Install Performance test tool server software, and run on port 9000, and port 9001:
`nohup ./BaduTestServer 9000 &`
`nohup ./BaduTestServer 9001 &`

Install Performance test tool server on client (MAC or PC)

Performance Test Tool GUI

Control Help

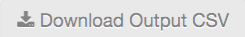
Test Control

  Test: 0/0
Estimated time left:



Server	IP:Port or URL
WarpTCP	10.10.1.2 : 9000
TCP	10.10.1.2 : 9001




Test Statistics

Number of Tests (Upload + Download):	0
Total Transmit Bytes:	0 B
Total Receive Bytes:	0 B
Average WarpTCP Upload:	0.0 bps
Average WarpTCP Download:	0.0 bps
Average TCP Upload:	0.0 bps
Average TCP Download:	0.0 bps



TCP should match the bypassed port in the proxy.

Size in Bytes (M, k)	Iterations	Mode	Upload	Download	Average Download WarpTCP/TCP (Mbps)			Average Upload WarpTCP/TCP (Mbps)			
					WarpTCP	TCP	Benefit	WarpTCP	TCP	Benefit	
100K	50	Alternating	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	0.0000	0.0000	%	0.0000	0.0000	%	
1M	30	Alternating	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	0.0000	0.0000	%	0.0000	0.0000	%	

How to get help:

- User Manual
- Troubleshooting guide
- Questions and positioning for sales:
 - Support@badunetworks.com

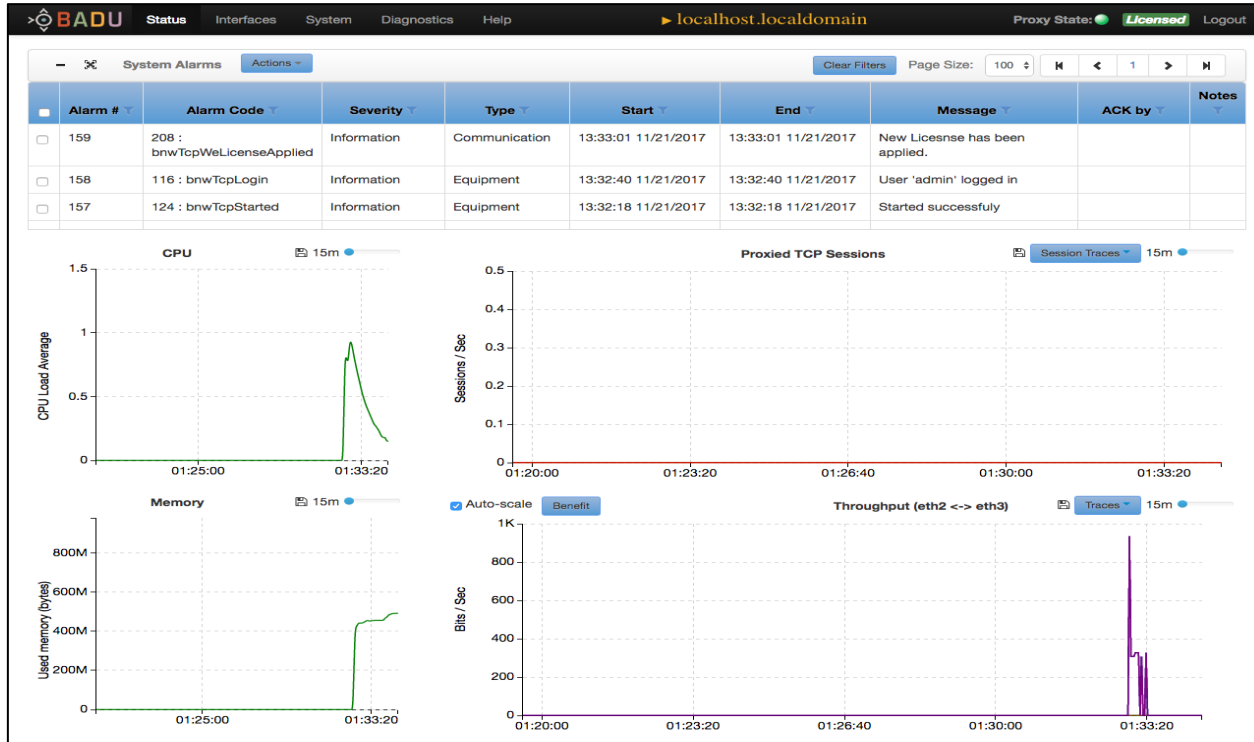


WarpEngine™

GUI INTERFACE



Status Page



Activities

- Monitor status of the proxy
- Monitor traffic
- Monitor proxy load
- View and update messages



Interfaces: Management Page

The screenshot displays the BADU network management interface. At the top, there is a navigation bar with 'BADU' logo, 'Status', 'Interfaces', 'System', 'Diagnostics', and 'Help'. The current page is 'localhost.localdomain' and the proxy state is 'Licensed'. Below the navigation bar, there is a 'System Alarms' section with a table of recent alarms.

Alarm #	Alarm Code	Severity	Type	Start	End	Message	ACK by	Notes
159	208 : brwTcpWELicenseApplied	Information	Communication	13:33:01 11/21/2017	13:33:01 11/21/2017	New License has been applied.		
158	116 : brwTcpLogin	Information	Equipment	13:32:40 11/21/2017	13:32:40 11/21/2017	User 'admin' logged in		
157	124 : brwTcpStarted	Information	Equipment	13:32:18 11/21/2017	13:32:18 11/21/2017	Started successfully		

Below the alarms, there is a 'MGMT' section with a dropdown menu showing 'eth2 <-> eth3'. A 'Warp Management Interface' section shows details for the 'Physical Interface' eth0:

Physical Interface	
Name	eth0
Link Status	
MAC Address	08:00:27:8d:9c:63
Speed (Mbps)	1000
MTU	1500

The 'WarpEngine Proxy MGMT' section contains a 'WarpEngine Fixed MGMT' table and a 'WarpEngine MGMT On Proxy Interfaces' table. The 'WarpEngine Fixed MGMT' table has columns for DHCP, IP address, Netmask, Gateway, VLAN ID, VLAN Name, Physical port, and Delete. The 'WarpEngine MGMT On Proxy Interfaces' table has columns for IP address, Netmask, Gateway, Port, VLAN ID, VLAN Name, and Physical port. A 'Management Server' section is also visible with fields for IP, Netmask, and VLAN ID. At the bottom, there are 'Cancel' and 'Save' buttons.

Activities

- Configure alternate Management address
- View configured management ports associated with proxied interfaces
- Log traffic on the MGMT interface

Interfaces: Configuration Page

The screenshot displays the BADU network management interface. At the top, there is a navigation bar with 'BADU' logo, 'Status', 'Interfaces', 'System', 'Diagnosics', and 'Help'. The current page is titled 'localhost.localdomain' and shows 'Proxy Status: Licensed' and a 'Logout' button.

Below the navigation bar is a table of system alarms:

Alarm #	Alarm Code	Severity	Type	Start	End	Message	ACK by	Notes
159	208 : brwTcpWlicenseApplied	Information	Communication	13:33:01 11/21/2017	13:33:01 11/21/2017	New License has been applied.		
158	116 : brwTcpLogin	Information	Equipment	13:32:40 11/21/2017	13:32:40 11/21/2017	User 'admin' logged in		
157	124 : brwTcpStarted	Information	Equipment	13:32:18 11/21/2017	13:32:18 11/21/2017	Started successfully		

Below the table is a 'MGMT' section showing 'eth2 <-> eth3' and a 'WarpTCP' button.

The main configuration area is titled 'WarpEngine Hardware Interface' and is divided into 'Client Side' and 'Server Side' sections:

Client Side		Server Side	
Name	eth2	Name	eth3
Link Status	<input checked="" type="checkbox"/>	Link Status	<input checked="" type="checkbox"/>
MAC Address	08:00:27:65:35:0e	MAC Address	08:00:27:1b:fb:0d
Speed (Mbps)	1000	Speed (Mbps)	1000
MTU	1500	MTU	1500

Below this is a 'WarpEngine Proxy' configuration section. It includes a 'Downstream Gateway' and an 'Upstream Gateway' section. The 'WarpEngine Proxy' section has two columns for 'Interface: eth2' and 'Interface: eth3'. Each column contains fields for IP Address, Netmask, Gateway, MSS, DHCP, MGMT, and SSH. The 'Verify Configuration' button is visible below the proxy configuration.

At the bottom, there are sections for 'Selective Bypass Configuration' and 'Redirect Configuration (Beta)', along with 'Add', 'Cancel', and 'Save' buttons.

Activities

- Configure logical proxies
- Select Proxy mode
- One proxy per VLAN
- Selective bypass
- Redirect
- MAC Spoofing
- Management over interface

Other:

- Support for multiple HW NIC
- Support for software bypass
- Support for HW bypass



System -> Administration

The screenshot displays the BADU System Administration web interface. At the top, the navigation bar includes 'BADU', 'Status', 'Interfaces', 'System', 'Diagnostics', and 'Help'. The current page is 'System Alarms', with a 'Proxy State: Licensed' indicator and a 'Logout' link. Below the navigation is a table of system alarms with columns for Alarm #, Alarm Code, Severity, Type, Start, End, Message, ACK by, and Notes. Three alarms are listed, all with a severity of 'Information'. Below the table, there are tabs for 'Proxy Information', 'Utilities', 'Database', 'Administration', 'SNMP', 'Manager', 'Alarm Modifications', and 'Accounts'. The 'Administration' tab is active, showing sections for 'Access Control' (with buttons for 'WarpAdmin Admin Password', 'Generate New SSH Key', and 'Revoke SSH Key'), 'Current Key Expiration' (with a text input field), 'Badu Networks Website' (with buttons for 'License Request', 'Apply License', and 'Upload Firmware'), and 'Report Problems:' (with a text input field for 'support@badunetworks.com' and buttons for 'Generate SOS File' and 'Remote Support'). A copyright notice at the bottom reads '© Copyright BADU Networks Inc; 2014-2017; All rights reserved'.

Alarm #	Alarm Code	Severity	Type	Start	End	Message	ACK by	Notes
159	208 : bnwTcpWeLicenseApplied	Information	Communication	13:33:01 11/21/2017	13:33:01 11/21/2017	New License has been applied.		
158	116 : bnwTcpLogin	Information	Equipment	13:32:40 11/21/2017	13:32:40 11/21/2017	User 'admin' logged in		
157	124 : bnwTcpStarted	Information	Equipment	13:32:18 11/21/2017	13:32:18 11/21/2017	Started successfully		

Activities

- Download a license request from the proxy
- Upload a license to the proxy
- Upload new firmware
- Create SOS file:
 - Log and proxy status to help Badu Networks debugging
- Change admin password
- Generate/Revoke SSH keys
- Enable Remote Support



Product Lineup



WarpTCP Product Family

	WarpEngine-X	WarpEngine-CT	WarpEngine	WarpVM-AWS	WarpGateway-B	WarpGateway
Segment	Enterprise	Mobile Carriers	Enterprise	Enterprise	Commercial	Small Business
Interface	10Gbps	1Gbps	1Gbps	-	1Gbps	1Gbps- Copper
Max Optimized Throughput	10 Gbps 5 Gbps 2.5 Gbps	1 Gbps 500 Mbps 250 Mbps 100 Mbps	1 Gbps 500 Mbps 250 Mbps	2 Gbps	100Mbps	100Mbps
Simultaneous Sessions (MAX)	5,000,000	500,000	500,000	300,000	40,000	5,000
Form Factor	1U	2U, Short	1U	AWS C4-2XL	1U, Half Depth	Table-top
Expansion slots for NICs	3	2	2	-	1	0
Power Supplies	Redundant AC	-48 VDC input	Redundant AC	-	AC	Wall Adapter
HW Bypass	✓	✓	✓	-	✓	
High Availability	Active-Standby	N/A	Active-Standby	✓	Active-Standby	
RAID 1 SSD	✓	✓	✓	EBS		
Environmental	NEBS3	NEBS 3	NEBS3	-		
Availability	Now	Q4 2017	Now	Now	Now	Now

Bypass NIC Variants: Copper, Multi-mode fiber(LC), Single mode fiber(LC)

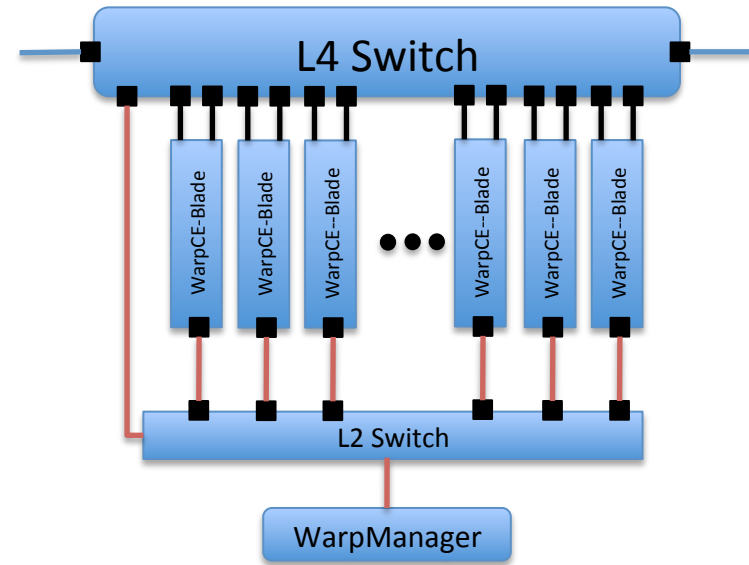
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WarpCE™ TCP Optimization System

- Support up to 400Gbps WarpTCP Optimization
- Up to 200M simultaneous flows
- Modular flexible design with 10Gbps Blades
- Robust L4 hardware bypass: Niagara Networks
- Fault tolerant distributed processing
 - Proxying continues if management disconnects
- Integrated management and control system
 - WarpManager Management system

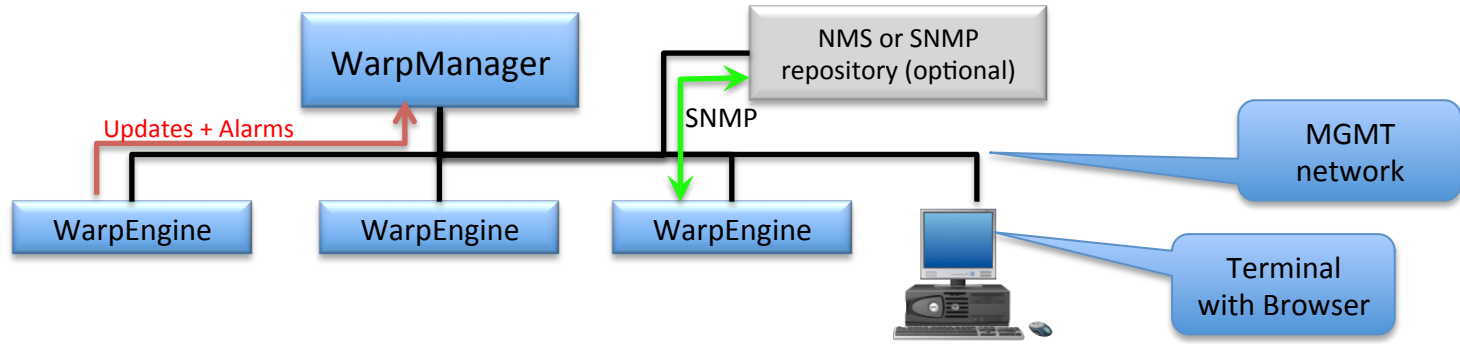


WarpManager™

- Manage all of your WarpTCP proxies from a single application
- Initiate batch commands for multiple WarpTCP™ proxies
 - License
 - Firmware update
 - Configuration backup
 - SNMP Notification Management
 - Set software or hardware bypass
- Monitor Alarms and Proxy Status
- Robust hardware and database solution
- High Availability with NoSQL database and multi-node support



Deployment example



- A terminal with a browser is used to access both the Warp Manager and WarpEngine
- WarpEngine devices connect to WarpManager
- Status updates are periodically sent from WarpEngine to WarpManager (1/sec)
- SNMP Notifications are sent to WarpManager and optional NMS