MultiPath TCP (MPTCP) Application Note

For a comprehensive list of changes to this document, see the Revision History.

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Introduction

With the increasing popularity and bandwidth of LTE technology, there is a lot of interest in using LTE as a WAN in Home Gateways. One of the use cases of interest is WAN Bonding (DSL+LTE) to increase the throughput. To handle the load balancing and effectively use both WAN links, GRE-based bonding solutions are in use but MPTCP is being proposed as a viable alternative.

MPTCP is designed primarily with the goal of utilizing multiple links for a single session/connection by creating multiple TCP sub-flows, and tries to leverage the flow and congestion control capabilities of TCP. The primary requirement of MPTCP is that both client and server should be MPTCP capable and the client must be aware of multiple WAN links. LAN clients connected to a Home-Gateway/CPE cannot get the benefit of MPTCP as they are not aware of multiple WAN interfaces. In addition, most of the servers on the Internet do not yet support MPTCP.

In order to address these issues, a proxy service is needed on CPE to convert a TCP session into an MPTCP session. Similarly, a proxy is needed on the WAN side to convert MPTCP to TCP. The Broadcom SDK adds support for MPTCP using the SOCKS protocol for handling the TCP proxy transparently.

Figure 1: Access Network Combining DSL and 3G/4G
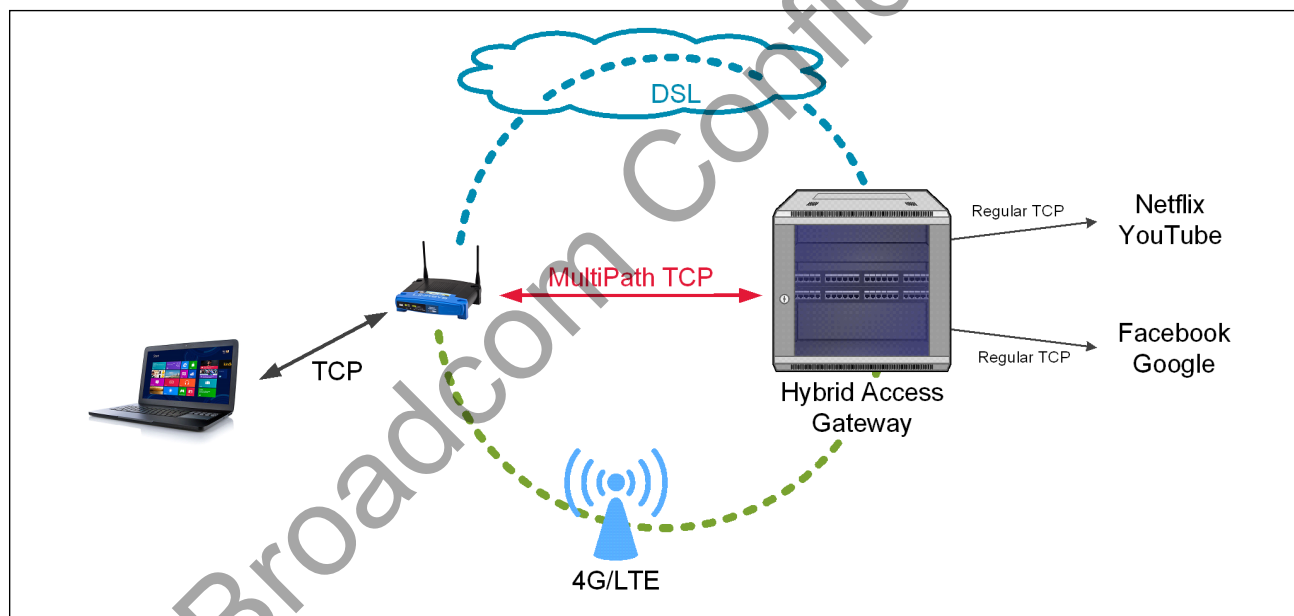
MPTCP on CPE

The Broadcom SDK integrates MPTCP v91 into the kernel and using the redsocks SOCKS proxy for converting TCP connections into MPTCP connections and vice versa. The main components for enabling MPTCP proxy on CPE include the following:

- MPTCP-enabled kernel
- Policy routing
- SOCKS proxy (redsocks)
- Iptables rules to redirect TCP connections from LAN to redsocks

Configuring CPE as MPTCP Proxy

1. Enable make menuconfig→Firewall, ALGs, and Networking Features→Enable MPTCP support.
   a. Compile and load the image onto CPE.

2. Start redsocks proxy.
   a. Create a config file (of critical importance is the address of the Hybrid Access Gateway [SOCKS] server).
   b. A sample script is added in CPE. Check /etc/redsocks.sh.

3. Configure Policy routes.
   a. The MPTCP path manager module creates multiple TCP connections with different source IPs. We use source-based policy routing to send packets to the appropriate WAN interface.
   b. Check the sample script /etc/mptcp.sh.

4. Configure iptable rules to redirect the TCP connections that must be sent via MPTCP.
   a. Check sample script in /etc/mptcp.sh.

MPTCP Runtime Configuration

- The default path manager is set to fullmesh, so disable MPTCP on LAN interface to avoid trying to create a MPTCP connection with LAN-side-IP. A modified version of the "ip" command is used for this.

   Example: ip link set dev br0 multipath off

   – Check */proc/net/mptcp_fullmesh* to make sure you only have the desired WAN IP addresses.
- Congestion control. Use MPTCP-specific congestion control algorithms (lia or olia) to provide fairness for TCP connections.

   /proc/sys/net/ipv4/tcp_congestion_control
- It is better to use the default MPTCP scheduler, which is based on rtt:

   /proc/sys/net/mptcp/mptcp_scheduler
- */proc/sys/net/mptcp/mptcp_enabled* – enables /disables MPTCP at runtime.
- Enabler */proc/sys/net/mptcp/mptcp_debug* to check sub flow creation, etc.

Hybrid Access Gateway

Hybrid Access Gateway (HAG) is a new node in the service provider network (or in cloud) used to convert MPTCP→TCP for the traffic coming from CPE, and TCP→MPTCP for traffic going to CPE. The SOCKS proxy server resides in HAG. In the test setup described, the Ubuntu Linux machine and open source Dante SOCKS server are used.

Installing MPTCP Kernel

First, we need to have an MPTCP-enabled kernel on HAG. Currently, Ubuntu supports MPCTP in 14.04.

1. Install gpg-apt-key:

```
wget -q -O - https://multipath-tcp.org/mptcp.gpg.key | sudo apt-key add -
```

2. Then, add a new software repository in the new file /etc/apt/sources.list.d/mptcp.list with the following line:

```
deb http://multipath-tcp.org/repos/apt/debian/ trusty main
```

3. Now, install MPTCP with the following:

```
sudo apt-get update
sudo apt-get install linux-mptcp
```

You can check the latest version and alternatives here:

https://multipath-tcp.org/pmwiki.php/Users/HowToInstallMPTCP?

> **Note:** Ubuntu 14.04 uses MPTCP v.90

4. Reboot your machine and check if MPTCP is enabled

```
Sudo cat /proc/sys/net/mptcp/mptcp_enabled
```

Installing and Configuring Dante

A SOCKS server is needed to handle connections request from redsocks. Dante is an open source SOCKS server. There are two options described below.

- Sudo apt-get install Dante:
  - Modify the /etc/dante.conf.
  - Check man 5 dante.conf.
- Compile Dante from source:
  - Get source and instructions from https://www.inet.no/dante/.
  - When compiled, the executable is named sockd.

> **Note:** Some versions of Ubuntu's Dante have a problem with TCP window scaling. (The throughput of a single session will be low depending on link latency.)
>
> It is best to compile and install the latest stable version.

Other Configurations

- First, make sure you are able to ping the HAG from CPE; sometimes you may have policy routes on HAG (when multiple interfaces are present) that restrict this, so check policy routes (*Ip rule show)* and routing tables.

- Check if IP forwarding is enabled.

   cat /proc/sys/net/ipv4/ip_forward

- To avoid creating too many sub-flows, disable MPTCP on unwanted interfaces on HAG.

   https://multipath-tcp.org/pmwiki.php/Users/Tools

   Example: `ip link set dev eth0 multipath off`

- Install wire shark with MPTCP support.

Lab Test Setup

Below are sample lab test setups. Here, HAG is also used to terminate DSL and LTE (to reduce the number of devices), so 4.4.4.4 will be used as HAG IP address in the redsocks Configuration on CPE. As the MPTCP scheduler is based on RTT when using Ethernet WAN (instead of LTE), configure speeds to 10 /100 Mbps. In addition, adjust latency depending on DSL line latencies to make the setup realistic.
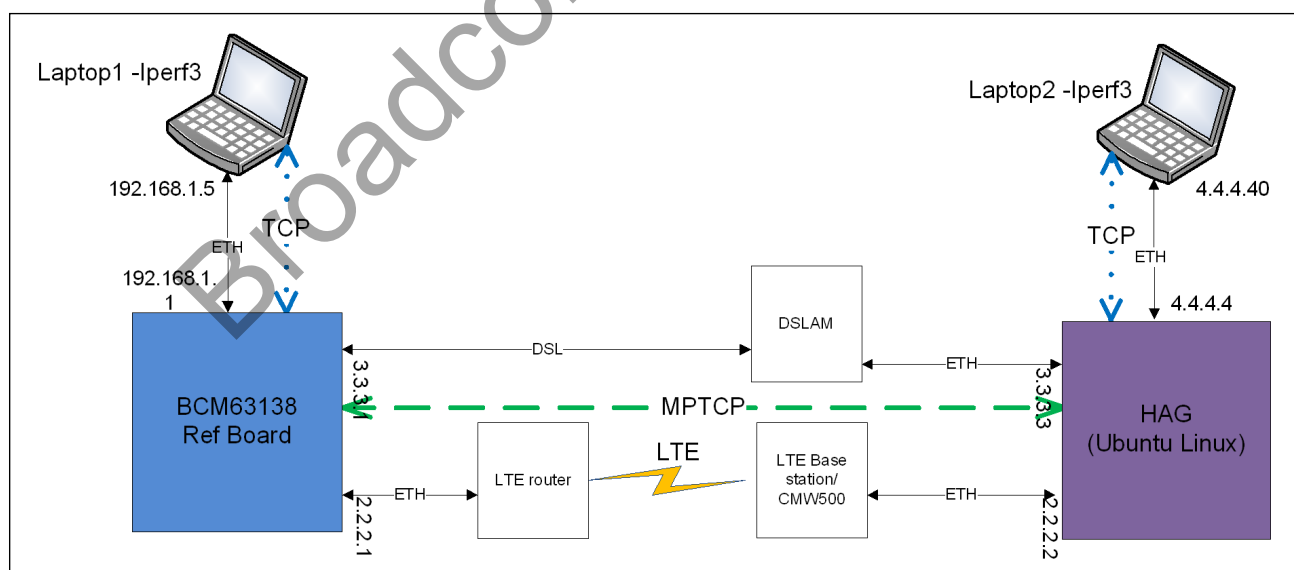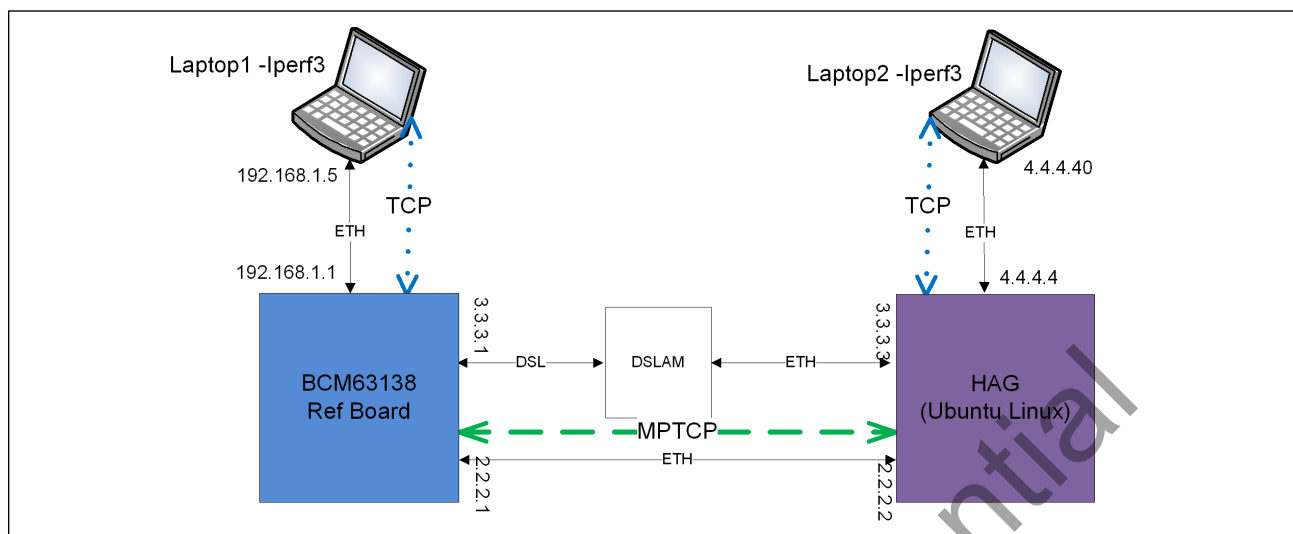
Figure 2: Lab Test Setup (1)

Figure 3: Lab Test Setup (2)

Miscellaneous Notes

• Sending UDP traffic via TCP will have latency issues, so UDP traffic will use the default WAN interface.

• Because the MPTCP proxy is very memory intensive, it is better to have 1 GB or more DDR on CPE. This depends on the number of simultaneous connections needed.

• Currently, there is no Acceleration support for MPTCP.

• MPTCP configuration is not integrated into CMS.

• Redsocks proxy currently supports only IPV4.

Revision History

Revision	Date	Change Description
MPTCP-AN100-R	May 19, 2017	Initial release

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