Ethernet Bridging over WANPIPE Frame Relay

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Introduction

Ethernet bridging over WANs all ows the Wide Area Network to operate as an exact analog of an ordinary Ethernet LAN. Traffic is not limited to IP, but any network protocol supported by Ethernet can be run transparently over a bridged WAN. These include IPX/SPX, AppleTalk and VINES. DHCP services can be used for IP management.

Bridging has particular application over one-to-many networks such as Frame Relay. ADSL networks often use a Frame Relay connection from the DSLAM to an ISP, with each DLCI supporting traffic from one DSL line. A Linux machine running bridged Ethernet over Frame Relay can provide a very attractive concentrator for such a system at the ISP end.

This implementation is based on work done by Mark Wells <mark@pc-intouch.com>, who did much of the original work on bridging for WANPIPE.

Bridging over Frame Relay

The Linux kernel contains the Ethernet bridging module that will be used to bridge the Frame Relay link to the Ethernet network. However, the Linux Bridge only supports Ethernet network interfaces, not Frame Relay: bridging is based on Ethernet MAC addresses.

To interface WANPIPE Frame Relay network interfaces to the kernel bridge, it first must be reconfigured as an Ethernet network interface that will convert the Frame Relay header into the Ethernet header during data transmission. Thus, from the kernel point of view, WANPIPE Frame Relay links would behave like standard Ethernet connections.

Since the bridge works with MAC addresses, layer two of the OSI model, not IP, all interfaces that are directly connected to the bridge must not be configured for IP. This step has been automated using the wancfg configuration utility, by selecting the BRIDGE option in network interface setup.   Thus, the Frame Relay network interface, configured for bridging would look as following, in the wanpipe#.conf configuration file.

> Ex: [interfaces]
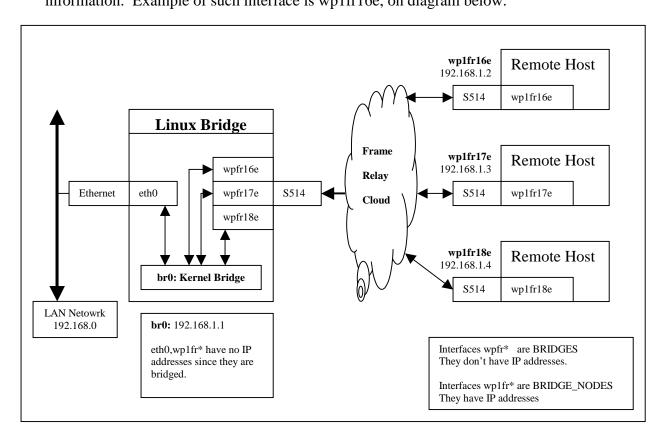>   wp1_fr16 = wanpipe1, 16, BRIDGE, comment

On the remote side of the Frame Relay link, WANPIPE network interfaces should be configured as BRIDGE_NODE(s).   Since these interfaces will not be directly connected to the kernel bridge, they must be configured with IP addresses. The wancfg configuration utility will require the user to input IP addresses for each BRIDGE_NODE.

Note: if a DHCP server is used, set the BRIDGE_NODE IP address to a arbitrary value, since a DHCP client will override it when the interface activates.

Configuring WANPIPE for bridging

To make the WANPIPE Frame Relay bridging easier to configure and install, WANPIPE configuration utility `wancfg`, and the `wanrouter` startup script will setup the virtual Ethernet interfaces according to the following options:

- If the WANPIPE network interfaces reside in the server where the kernel bridge is going to be implemented, then such interfaces should be configured as a BRIDGE. In this case, WANPIPE virtual Ethernet interface will be configured without IP information. Once the interface is started, the user must add the virtual interface (wp1fr16e) to the kernel bridge using the bridge configuration utility. Example of a BRIDGE interface is wpfr16e, in diagram below.

- If the WANPIPE network interface is located at the remote end of the bridge, meaning that the other side of the link is connected to a bridge, such interfaces should be configured as a BRIDGE_NODE.
  In this case, WANPIPE virtual Ethernet interface will be configured with IP information. Example of such interface is wp1fr16e, on diagram below.

The BRIDGE Network Interface

The WANPIPE virtual Ethernet network interfaces configured for BRIDGE operation mode are interfaces that directly connect to the Linux kernel bridge. Example of such interface is wpfr16e, in diagram above.

The WANPIPE configuration utility, `wancfg`, will setup the wanpipe#.conf configuration file for bridging. During startup, the `wanrouter` startup stcript will load the appropriate kernel modules and configure the virtual Ethernet network interfaces without IP information.

The BRIDGE NODE Network Interface

The WANPIPE virtual Ethernet network interfaces configured as BRIDGE NODES are interfaces that are remotely connected to the Linux kernel bridge. Example of such interface is wp1fr16, in diagram above.

The WANPIPE configuration utility, `wancfg`, will setup the wanpipe#.conf configuration file for bridging. During startup, the `wanrouter` startup script will load the appropriate kernel modules and configure the virtual Ethernet network interfaces with IP information.

Since the bridge is on the remote end, no further configuration is needed. Assuming that the remote side has been successfully configured, the Remote Host would be able to ping the LAN.

Example WANPIPE Bridge Configuration

In this example we'll assume configuration as in diagram above. The configuration will be split into three parts: configuring the WANPIPE on the bridge, Linux Kernel Bridge and the WANPIPE remotely connected to the bridge. This example assumes that WANPIPE drivers and utilities were installed properly on each system.

Setting up Linux for Wanpipe and Bridging

- For WANPIPE installation instructions please refer to the WanpipeForLinux.pdf document.

- The WANPIPE setup utility will patch the new kernel with the latest WANPIPE drivers that include the WANPIPE bridging support. However, before recompiling the kernel, the Linux kernel must also be update with the latest bridging code.

- The latest bridging patches and utilities can be downloaded from http://projects.openrock.net/bridge/.

- The bridge patch should be applied to the kernel using the patch command
    - copy the patch into the linux source directory /usr/src/linux
    - patch the kernel : `patch -p1 < patch_name.diff`

- Once both the WANPIPE drivers and the kernel bridge have been updated proceed with WanpipdForLinux.pdf instructions on how to recompile the kernel.

WANPIPE on the bridge server

- Create the WANPIPE configuration file using the `/usr/local/wanrouter/wacfg` utility. The wancfg utility contains all the help files necessary to lead you through the protocol and hardware configuration. However, for each Frame Relay interface setup, the operation mode must be set to BRIDGE. Note: There will be no option for IP setup.

- Once the configuration file (wanpipe1.conf) is complete, start the WANPIPE device using the `wanrouter start` command. This command will load all necessary WANPIPE modules and setup all network interfaces. In this case all WANPIPE interfaces are configured without IP information.
    ```
    wanrouter start
    ```

- Run ifconfig and confirm the encapsulation type of each Frame relay link configured.
    ```
    Ifconfig
    ```

- Using the ifconfig command, set the eth0 IP address to 0.0.0.0 if not already done so.
    ```
    ifconfig eth 0.0.0.0
    ```

Linux Kernel Bridge

The Linux kernel bridge must be compiled, usually as a module, in the kernel. The bridging option can be selected from the Networking Option menu of the kernel configurator.
- Assuming the bridge support has been compiled as modules, proceed to load the kernel bridge as follows:
    ```
    modprobe -v bridge
    ```

    Note: If the bridge has been compiled directly into the kernel, this step is not necessary. However, if the module load fails, then the kernel has not been configured properly, please refer to the http://projects.openrock.net/bridge/ for more information or check the kernel compilation.

- Use the brctrl utility to create a bridge and add network interfaces to it.
    Ex:
        Create the Bridge called "br0"
        ```
        brctl addbr br0
        ```

Add an interface into the bridge "br0"
```
brctl addif br0 eth0
brctl addif br0 wpfr16e
brctl addif br0 wpfr17e
brctl addif br0 wpfr18e
```

- Once all interfaces are added, make sure that eth0 interface is not setup with IP addresses. If so, zero the eth0 IP addresses.
  ```
  ifconfig eth0 0.0.0.0
  ```

- To add IP support to the bridge server, configure the bridge network interface br0 with appropriate IP addresses.
  ```
  ifconfig br0 192.168.1.1 netmask 255.255.255.0 up
  ```

  Since we cannot configure IP addresses to any network interfaces that are directly connected to the bridge, currently there is no way of accessing the bridge server itself using IP. Therefore, an IP address must be defined for the bridge itself. The kernel bridge has a special network interface that can be configured with IP. This network interface has the same name as the bridge; In the case above the interface name would be **br0**. Using the `ifconfig()` command an IP address must be manually applied to the bride network interface.

WANPIPE Bridge Node

- Create the WANPIPE configuration file using the `/usr/local/wanrouter/wacfg` utility. The wancfg utility contains all the help files necessary to lead you through the protocol and hardware configuration. However, for each Frame Relay interface setup, the operation mode must be set to BRIDGE_NODE and IP information must be setup.

  Note: When setting IP information, make sure that the IP network address is the same as the LAN network address. Bridge cannot connect two different networks.

- Once the configuration file (wanpipe1.conf) is complete, start the WANPIPE device using the `wanrouter start` command. This command will load all necessary WANPIPE modules and setup all network interfaces. In this case all WANPIPE interfaces are configured without IP information.
  ```
  wanrouter start
  ```

Note: if a DHCP server is used, set the BRIDGE_NODE IP address to a arbitrary value, since a DHCP client will override it when the interface activates.

Assuming that the other end has been configured, one should be able to ping the remote LAN.