THALES

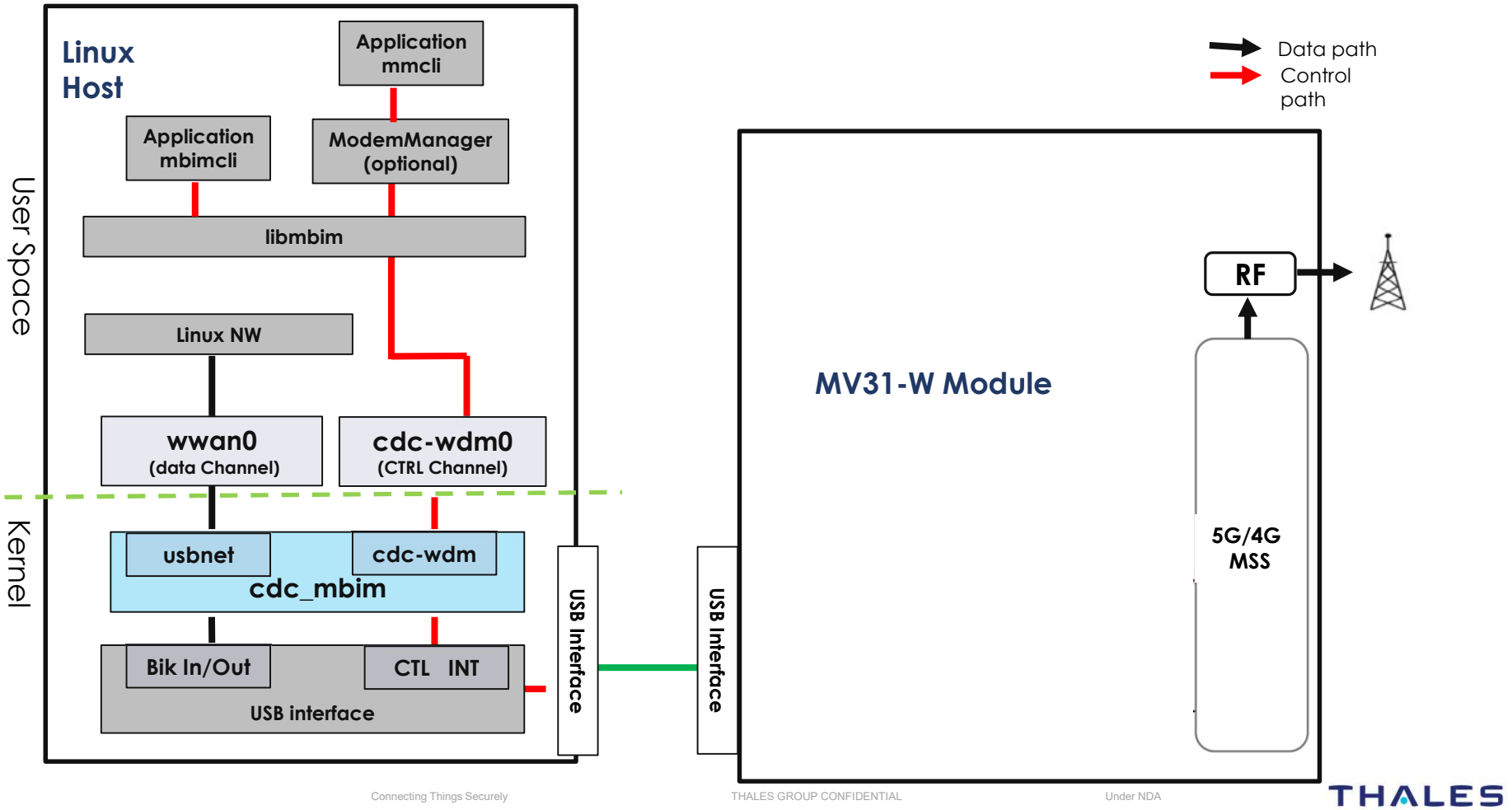
MBIM over USB

A Quick Guide of Setup Data Connection

November 19, 2020
Application Engineering

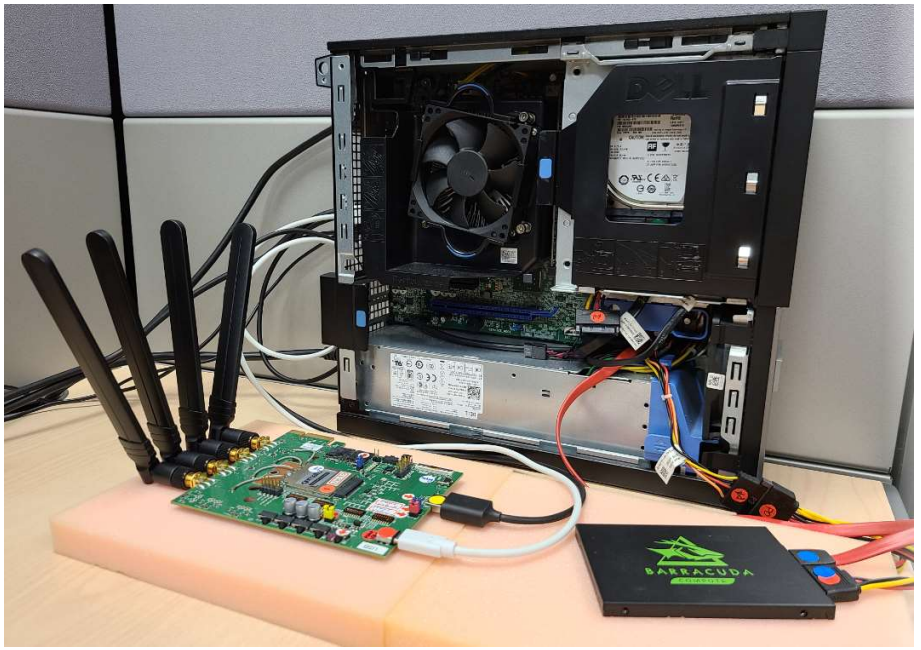
www.thalesgroup.com

Architecture of MBIM Over USB



Testing Environment

1. Dell Optiplex 9020
   - USB3.0
2. Linux Distribution
   - Ubuntu 18.04.5 (minimal)
3. 5G M.2 USB Module
   - MV31-W USB SUB6
   - FW_Version_F.0.0.0.5.7(AP076)
   - MBIM Mode (PID: 00B3)
4. 5G Modem Card Adapter Board
   - Variant: USB3



Disable Auto-naming of I/F on Ubuntu 18.04

In some Linux distributions, interface names generated by auto-naming can be long and inconvenient. There is one way to change interface names.

1. Edit the grub file
   - Look for "**GRUB_CMDLINE_LINUX**" and add the following"**net.ifnames=0 biosdevname=0**".
2. sudo update-grub
3. sudo reboot

```
$ sudo nano /etc/default/grub
```

Look for "**GRUB_CMDLINE_LINUX**" and add the following"**net.ifnames=0 biosdevname=0**".

From:

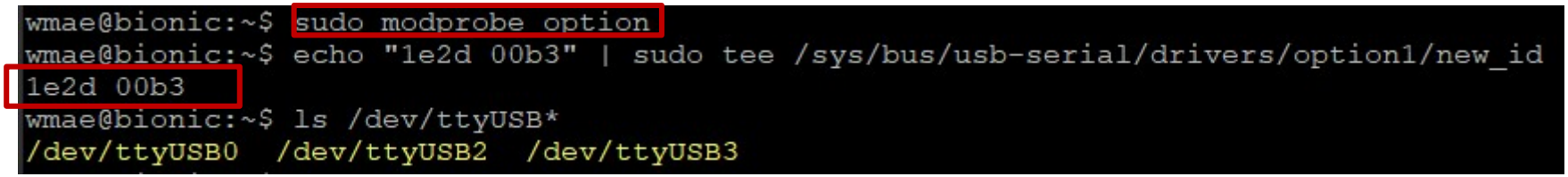
```
GRUB_CMDLINE_LINUX=""
```

To:

```
GRUB_CMDLINE_LINUX="net.ifnames=0 biosdevname=0"
```

Load option driver

#--- Load option driver
~$ sudo modprobe option
~$ echo "1e2d 00b3" | sudo tee /sys/bus/usb-serial/drivers/option1/new_id



Verify MV31 Network status

- sudo minicom -D /dev/ttyUSB0

```
Welcome to minicom 2.7.1

OPTIONS: I18n
Compiled on Aug 13 2017, 15:25:34.
Port /dev/ttyUSB0, 10:29:41

Press CTRL-A Z for help on special keys

ATI
Manufacturer: Thales
Model: T99W175
Revision: T99W175.F0.0.0.5.7.GC.004  1  [Oct 23 2020 14:00:00]
SVN: 01
IMEI: 351859110022880
+GCAP: +CGSM

OK
AT+USBSWITCH?
+USBSWITCH:00B3


OK
AT+CPIN?
+CPIN: READY

OK
AT+COPS?
+COPS: 0,0,"Chunghwa Telecom",7

OK
```

Setup a data connection

Usage steps - Connection via command

1. Required to stop ModemManager
   - ~$ sudo systemctl stop ModemManager.service
   - ~$ sudo systemctl status ModemManager.service

2. Check mbim package
   - ~$ mbimcli –V

3. Create mbim connection profile
   - ~$ sudo vim /etc/mbim-network.conf

```
----------------------
APN=INTERNET
APN_USER=
APN_PASS=
PROXY=yes
----------------------
```

Usage steps(cont)

4. Start the mbim data connection with commands bellow
   1) sudo ip link set wwan0 down
   2) sudo mbim-network /dev/cdc-wdm0 start
   3) sudo mbimcli -d /dev/cdc-wdm0 --device-open-proxy --query-ip-configuration
   4) sudo ip addr add <ipv4 address> dev wwan0
   5) sudo ip link set wwan0 up
   6) sudo ip rout add default dev wwan0

5. Checking IP connection
   - ping 8.8.8.8

6. Stop data connection
   - sudo mbim-network /dev/cdc-wdm0 stop
   - sudo ifconfig wwan0 down

Live Demo
Using mbimcli command

Stop ModemManager

~$ sudo systemctl stop ModemManager.service
~$ sudo systemctl status ModemManager.service

```
wmae@bionic:~$ sudo systemctl stop ModemManager.service
wmae@bionic:~$ sudo systemctl status ModemManager.service
● ModemManager.service - Modem Manager
   Loaded: loaded (/lib/systemd/system/ModemManager.service; enabled; vendor preset: enabled)
   Active: inactive (dead) since Mon 2020-11-16 10:16:36 CST; 1min 35s ago
  Process: 801 ExecStart=/usr/sbin/ModemManager --filter-policy=strict (code=exited, status=0/
 Main PID: 801 (code=exited, status=0/SUCCESS)

Nov 16 10:16:17 bionic ModemManager[801]: <warn>  couldn't load UE mode of operation for EPS:
Nov 16 10:16:17 bionic ModemManager[801]: [/dev/cdc-wdm0] sending message as MBIM...
Nov 16 10:16:17 bionic ModemManager[801]: [/dev/cdc-wdm0] Received MBIM message
Nov 16 10:16:17 bionic ModemManager[801]: [/dev/cdc-wdm0] sending message as MBIM...
Nov 16 10:16:17 bionic ModemManager[801]: [/dev/cdc-wdm0] Received MBIM message
Nov 16 10:16:17 bionic ModemManager[801]: <warn>  Couldn't open ports during Modem SIM hot swa
Nov 16 10:16:17 bionic ModemManager[801]: <info>  Modem: state changed (unknown -> disabled)
Nov 16 10:16:36 bionic ModemManager[801]: <warn>  Disabling modems took too long, shutting dow
Nov 16 10:16:36 bionic ModemManager[801]: <info>  ModemManager is shut down
Nov 16 10:16:36 bionic systemd[1]: Stopped Modem Manager.
```

libmbim Linux library

~$ mbimcli -V
~$ sudo apt install libmbim-utils

```
wmae@bionic:~$ mbimcli -V

Command 'mbimcli' not found, but can be installed with:

sudo apt install libmbim-utils

wmae@bionic:~$ sudo apt install libmbim-utils
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following packages were automatically installed and are no longer required:
  fonts-liberation2 fonts-opensymbol gir1.2-gst-plugins-base-1.0 gir1.2-gstreamer-1.0 gir1.2-gudev-1.0 gir1.2-udisks-2.0
  grilo-plugins-0.3-base gstreamer1.0-gtk3 libboost-date-time1.65.1 libboost-filesystem1.65.1 libboost-iostreams1.65.1
  libboost-locale1.65.1 libcdr-0.1-1 libclucene-contribs1v5 libclucene-core1v5 libcmis-0.5-5v5 libcolamd2 libdazzle-1.0-0
  libe-book-0.1-1 libedataserverui-1.2-2 libeot0 libepubgen-0.1-1 libetonyek-0.1-1 libexiv2-14 libfreerdp-client2-2
  libfreerdp2-2 libgc1c2 libgee-0.8-2 libgexiv2-2 libgom-1.0-0 libgpgmepp6 libgpod-common libgpod4 liblangtag-common
  liblangtag1 liblirc-client0 liblua5.3-0 libmediaart-2.0-0 libmspub-0.1-1 libodfgen-0.1-1 libqqwing2v5 libraw16
  librevenge-0.0-0 libsgutils2-2 libssh-4 libsuitesparseconfig5 libvncclient1 libwinpr2-2 libxapian30 libxmlsec1 libxmlsec1-nss
  lp-solve media-player-info python3-mako python3-markupsafe syslinux syslinux-common syslinux-legacy usb-creator-common
Use 'sudo apt autoremove' to remove them.
The following NEW packages will be installed:
  libmbim-utils
0 upgraded, 1 newly installed, 0 to remove and 0 not upgraded.
Need to get 32.5 kB of archives.
After this operation, 120 kB of additional disk space will be used.
Get:1 http://tw.archive.ubuntu.com/ubuntu bionic-updates/universe amd64 libmbim-utils amd64 1.18.0-1~ubuntu18.04.1 [32.5 kB]
Fetched 32.5 kB in 1s (60.8 kB/s)
Selecting previously unselected package libmbim-utils.
(Reading database ... 186940 files and directories currently installed.)
Preparing to unpack .../libmbim-utils_1.18.0-1~ubuntu18.04.1_amd64.deb ...
Unpacking libmbim-utils (1.18.0-1~ubuntu18.04.1) ...
Setting up libmbim-utils (1.18.0-1~ubuntu18.04.1) ...
Processing triggers for man-db (2.8.3-2ubuntu0.1) ...
wmae@bionic:~$
wmae@bionic:~$ mbimcli -V

mbimcli 1.18.0
Copyright (C) 2013-2019 Aleksander Morgado
License GPLv2+: GNU GPL version 2 or later <http://gnu.org/licenses/gpl-2.0.html>
This is free software: you are free to change and redistribute it.
There is NO WARRANTY, to the extent permitted by law.
```

Start the mbim data connection

- if successful it will print "Network started successfully"

Setup Network I/F and Verify data connection

- Setup the mbim_mhi0 network I/F

```
wmae@bionic:~$ sudo mbimcli -d /dev/cdc-wdm0 --device-open-proxy --query-ip-configuration

[/dev/cdc-wdm0] IPv4 configuration available: 'address, gateway, dns, mtu'
     IP [0]: '10.201.182.94/30'
    Gateway: '10.201.182.93'
    DNS [0]: '168.95.1.1'
    DNS [1]: '168.95.192.1'
        MTU: '1500'

[/dev/cdc-wdm0] IPv6 configuration available: 'address, gateway, dns, mtu'
     IP [0]: '2001:b400:e2ac:1f9f:9ce5:4054:9c40:1517/64'
    Gateway: '2001:b400:e2ac:1f9f:31dd:e1dd:19bf:ea0e'
    DNS [0]: '2001:b000:168::1'
    DNS [1]: '2001:b000:168::2'
        MTU: '1500'
wmae@bionic:~$ sudo ip addr add 10.201.182.94/30 dev wwan0
wmae@bionic:~$ sudo ip link set wwan0 up
wmae@bionic:~$ sudo ip rout add default dev wwan0
wmae@bionic:~$
wmae@bionic:~$ ping 8.8.8.8
PING 8.8.8.8 (8.8.8.8) 56(84) bytes of data.
64 bytes from 8.8.8.8: icmp_seq=1 ttl=56 time=40.9 ms
64 bytes from 8.8.8.8: icmp_seq=2 ttl=56 time=26.7 ms
64 bytes from 8.8.8.8: icmp_seq=3 ttl=56 time=27.8 ms
64 bytes from 8.8.8.8: icmp_seq=4 ttl=56 time=26.5 ms
64 bytes from 8.8.8.8: icmp_seq=5 ttl=56 time=24.8 ms
```

Using MBIM utility

Download the mbim network and set-ip script

1) https://chromium.googlesource.com/chromiumos/third_party/libmbim/+/master/utils/

2) https://github.com/elementzonline/GSMModem/tree/master/SIM7600/mbim-set-ip

Installation and usage steps

- Verify that the module is exposing the MBIM interface and Check Network status
  1. sudo minicom -D /dev/ttyUSB0
  2. sudo vim /etc/mbim-network.conf
  3. mbimcli -V
  4. sudo systemctl stop ModemManager.service

- Usage
  1. ./mbim-network.in <MBIM-INTERFACE> start
  2. ./mbim-set-ip <MBIM-INTERFACE> <NETWORK-INTERFACE>

- Examples:
  1. sudo ./mbim-network.in /dev/cdc-wdm0 start
  2. sudo ./mbim-set-ip /dev/cdc-wdm0 wwan0

Debugging and Troubleshooting

Check ModemManager on stop status

~$ sudo systemctl status ModemManager.service

```
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wmae@bionic:~$ sudo systemctl status ModemManager.service
● ModemManager.service - Modem Manager
   Loaded: loaded (/lib/systemd/system/ModemManager.service; enabled; vendor preset: enabled)
   Active: inactive (dead) since Mon 2020-11-16 10:16:36 CST; 1min 35s ago
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```

Verify MV31 Network status

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```
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Port /dev/ttyUSB0, 10:29:41

Press CTRL-A Z for help on special keys

ATI
Manufacturer: Thales
Model: T99W175
Revision: T99W175.F0.0.0.5.7.GC.004  1  [Oct 23 2020 14:00:00]
SVN: 01
IMEI: 351859110022880
+GCAP: +CGSM

OK
AT+USBSWITCH?
+USBSWITCH:00B3


OK
AT+CPIN?
+CPIN: READY

OK
AT+COPS?
+COPS: 0,0,"Chunghwa Telecom",7

OK
```

Verify MV31-W USB is enumerated "00B3"

- ~$ lsusb

```
wmae@bionic:~$ lsusb
Bus 002 Device 002: ID 8087:8000 Intel Corp.
Bus 002 Device 001: ID 1d6b:0002 Linux Foundation 2.0 root hub
Bus 001 Device 002: ID 8087:8008 Intel Corp.
Bus 001 Device 001: ID 1d6b:0002 Linux Foundation 2.0 root hub
Bus 004 Device 004: ID 1e2d:00b3
Bus 004 Device 002: ID 0bda:0409 Realtek Semiconductor Corp.
Bus 004 Device 001: ID 1d6b:0003 Linux Foundation 3.0 root hub
Bus 003 Device 004: ID 046d:c05a Logitech, Inc. M90/M100 Optical Mouse
Bus 003 Device 003: ID 413c:2106 Dell Computer Corp. Dell QuietKey Keyboard
Bus 003 Device 002: ID 0bda:5409 Realtek Semiconductor Corp.
Bus 003 Device 001: ID 1d6b:0002 Linux Foundation 2.0 root hub
```

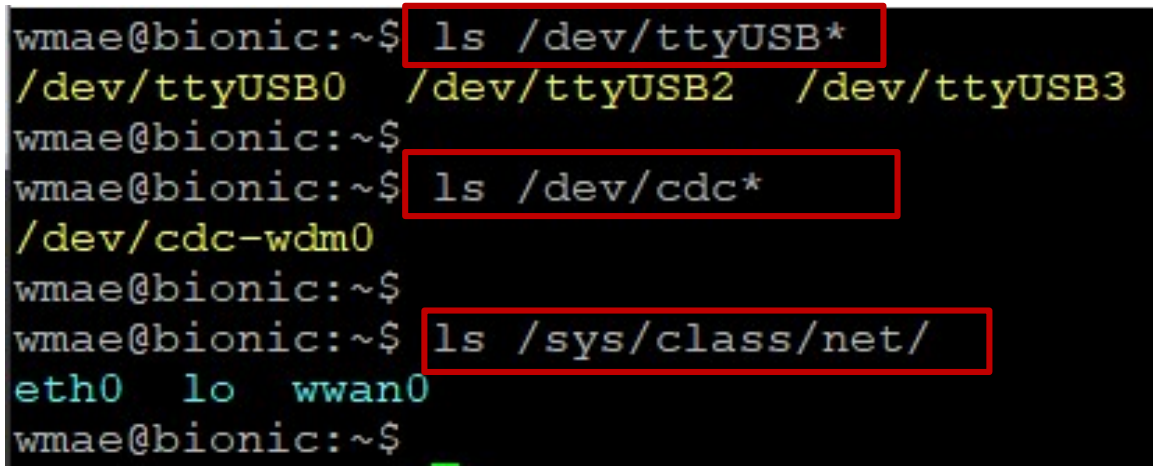
Verify USB interface

~$ lsusb -t

```
wmae@bionic:~$ lsusb -t
/:  Bus 04.Port 1: Dev 1, Class=root_hub, Driver=xhci_hcd/6p, 5000M
    |__ Port 1: Dev 3, If 0, Class=Communications, Driver=cdc_mbim, 5000M
    |__ Port 1: Dev 3, If 1, Class=CDC Data, Driver=cdc_mbim, 5000M
    |__ Port 1: Dev 3, If 2, Class=Vendor Specific Class, Driver=, 5000M
    |__ Port 1: Dev 3, If 3, Class=Vendor Specific Class, Driver=, 5000M
    |__ Port 1: Dev 3, If 4, Class=Vendor Specific Class, Driver=, 5000M
    |__ Port 1: Dev 3, If 5, Class=Vendor Specific Class, Driver=, 5000M
    |__ Port 6: Dev 2, If 0, Class=Hub, Driver=hub/2p, 5000M
/:  Bus 03.Port 1: Dev 1, Class=root_hub, Driver=xhci_hcd/15p, 480M
    |__ Port 4: Dev 2, If 0, Class=Hub, Driver=hub/4p, 480M
    |__ Port 5: Dev 3, If 0, Class=Human Interface Device, Driver=usbhid, 1.5M
    |__ Port 6: Dev 4, If 0, Class=Human Interface Device, Driver=usbhid, 1.5M
/:  Bus 02.Port 1: Dev 1, Class=root_hub, Driver=ehci-pci/3p, 480M
    |__ Port 1: Dev 2, If 0, Class=Hub, Driver=hub/8p, 480M
/:  Bus 01.Port 1: Dev 1, Class=root_hub, Driver=ehci-pci/3p, 480M
    |__ Port 1: Dev 2, If 0, Class=Hub, Driver=hub/6p, 480M
```

Check MV31 USB device nodes

- ~$ ls /dev/ttyUSB*
- ~$ ls /dev/cdc*
- ~$ ls /sys/class/net/



Verify by mbimcli command

- ~$ sudo mbimcli -V
- ~$ sudo mbimcli -d /dev/cdc-wdm0 -p --query-device-caps
- ~$ sudo mbimcli -d /dev/cdc-wdm0 -p --query-home-provider

```
wmae@bionic:~$ sudo mbimcli -V

mbimcli 1.18.0
Copyright (C) 2013-2019 Aleksander Morgado
License GPLv2+: GNU GPL version 2 or later <http://gnu.org/licenses/gpl-2.0.html>
This is free software: you are free to change and redistribute it.
There is NO WARRANTY, to the extent permitted by law.

wmae@bionic:~$ sudo mbimcli -d /dev/cdc-wdm0 -p --query-device-caps
[/dev/cdc-wdm0] Device capabilities retrieved:
              Device type: 'embedded'
          Cellular class: 'gsm'
             Voice class: 'no-voice'
               SIM class: 'removable'
              Data class: 'umts, hsdpa, hsupa, lte, custom'
                SMS caps: 'pdu-receive, pdu-send'
               Ctrl caps: 'reg-manual'
            Max sessions: '15'
       Custom data class: ' '
               Device ID: '351859110022744'
           Firmware info: 'T99W175.F0.0.0.5.7.GC.004
076'
           Hardware info: 'Thales Snapdragon X55'
wmae@bionic:~$ sudo mbimcli -d /dev/cdc-wdm0 -p --query-home-provider
[/dev/cdc-wdm0] Home provider:
         Provider ID: '46692'
       Provider name: 'Chunghwa Telecom'
               State: 'home'
       Cellular class: 'gsm'
                RSSI: '99'
          Error rate: '99'
```

Check loaded module status after MV31 after attached

~$ lsmod

```
wmae@bionic:~$ lsmod
Module                  Size  Used by
cdc_mbim               20480  0
cdc_wdm                24576  2 cdc_mbim
cdc_ncm                36864  1 cdc_mbim
usbnet                 45056  2 cdc_mbim,cdc_ncm
mii                    16384  1 usbnet
cfg80211              712704  0
intel_rapl_msr         20480  0
mei_hdcp               24576  0
intel_rapl_common      24576  1 intel_rapl_msr
x86_pkg_temp_thermal   20480  0
intel_powerclamp       20480  0
coretemp               20480  0
kvm_intel             253952  0
kvm                   655360  1 kvm_intel
crct10dif_pclmul       16384  1
crc32_pclmul           16384  0
snd_hda_codec_hdmi     61440  1
ghash_clmulni_intel    16384  0
aesni_intel           372736  0
```

End