

USB Cellular Modem

Feature Overview and Configuration Guide

Introduction

This guide describes the AlliedWare Plus USB Cellular Modem feature and how to configure it. This feature provides tools for identifying and solving problems with USB Cellular Modems that are connected to your AR-Series Firewall.

Products and software version that apply to this guide

This guide applies to AlliedWare Plus™ products that support USB Cellular Modems, running version **5.4.5-2.3** or later. Diagnostic tools are supported from version **5.4.6-1** or later.

To see whether your product supports USB Cellular Modem, see the following documents:

- The [product's Datasheet](#)
- The product's [Command Reference](#)

These documents are available from the above links on our website at alliedtelesis.com.

Feature support may change in later software versions. For the latest information, see the above documents.

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USB Cellular Modem Introduction

What does a USB Cellular Modem do?

A USB Cellular Modem is a wireless mobile USB device that plugs directly into an AR-Series Firewall to provide Internet access via a mobile broadband connection.

USB Cellular Modem features

The cellular interface configuration supports the following features:

- Setting an Access Point Name to use to connect to a cellular network
- Specifying a non-default chat-script to be executed when a USB Cellular Modem connects to a carrier network
- Displaying information about connected USB cellular devices
- Displaying information about inserted USB devices
- Manual mode-switching, to allow additional USB Cellular Modems to be put into the correct state when inserted

Supported modems and products

- For a list of cellular USB modems known to be compatible with AlliedWare Plus products see [USB Modem compatibility](#).

Unsupported modems

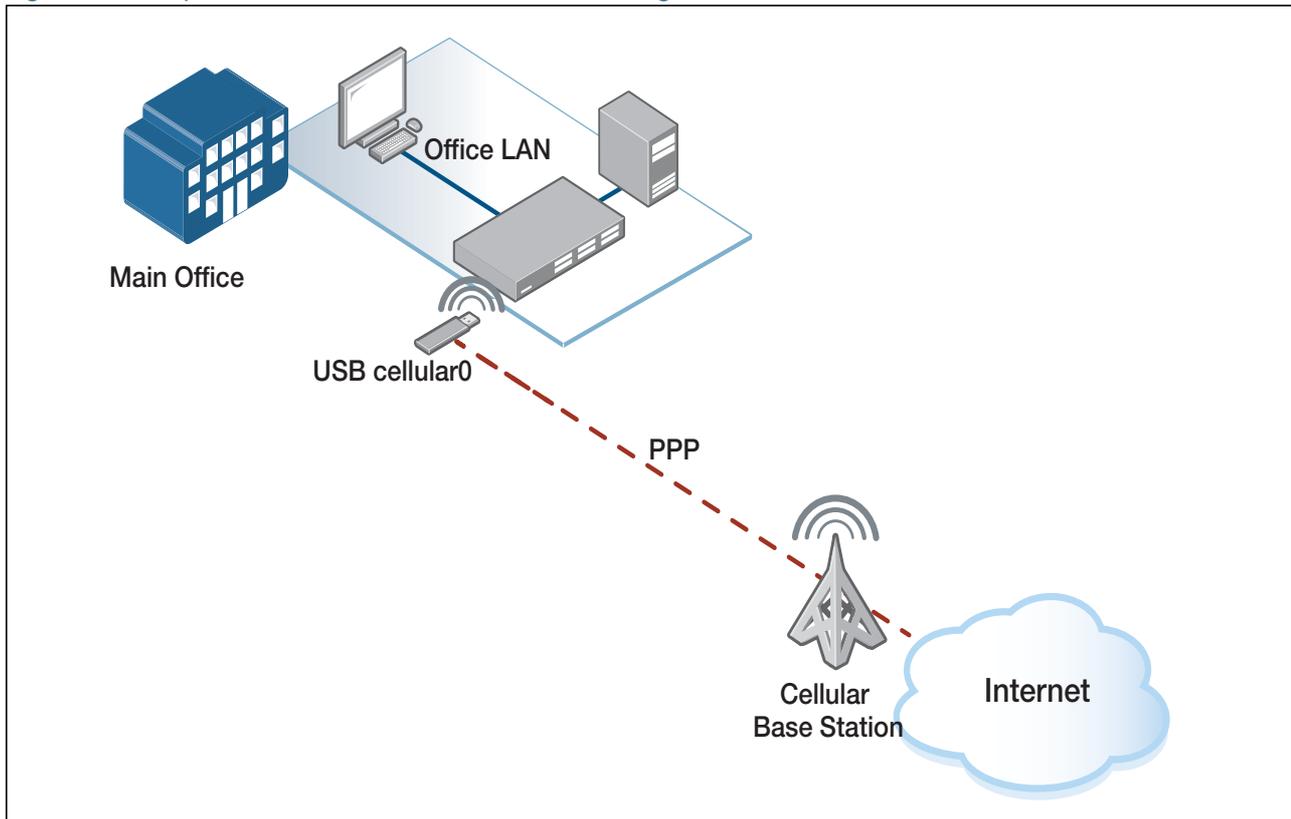
- Modems are unsupported if they do not support operation in **serial mode**. Some modems only support mode-switch to Wireless WAN (WWAN) **Ethernet mode**.
- Modems are unsupported if they have carrier-specific firmware loaded onto them to automatically pre-load settings specific to the network of the carrier. Such modems reject attempts to mode-switch the modem to serial mode. This can potentially be corrected by attempting to re-flash the modem with firmware supplied directly by the cellular USB device manufacturer (ZTE, Huawei, etc). Re-flashing the modem firmware is not possible from the AR-Series Firewall, but there are computer packages available that can do this.
- Modems are unsupported if they have been re-badged/re-branded and carrier-locked to a specific cellular carrier, so do not accept requests to be re-configured for use on other networks. This can potentially be corrected by using an external software tool to unlock the modem (for example a tool like DC-unlocker). Unlocking your modem is an operation performed at your own risk.

How to use a USB Cellular Modem

Introduction

In this example the main office LAN is connecting to the Internet via a USB 3G cellular interface using PPP (Point to Point Protocol) to access the cellular network.

Figure 1: Example of a USB Cellular modem connecting over a cellular interface



In this example, the AR-Series Firewall at the Main Office has a USB Cellular Modem plugged in. An Access Point Name (APN) has been supplied by the carrier that the USB Cellular Modem (with its inserted SIM card) connects to. The APN has been configured on the AR-Series Firewall as part of the setup of the cellular interface. This information is used by the carrier to form a valid Internet connection via its cellular network and the public Internet. The APN allows the cellular carrier to ensure the correct WAN IP address is assigned to the serial PPP interface over the USB 3G Modem, and thereby enabling Internet connectivity via that cellular connection.

Different USB modems have different default states. Getting some modems from their default state into a state that works correctly with an AR-Series Firewall may require additional configuration or may require the modem to be unlocked.

Configuring a modem

Basic configuration

A minimum configuration required to use a supported modem to connect to a cellular network contains a configuration of the APN for the cellular network, and a static PPP configuration associated with the cellular interface.

Step 1. Configure the cellular interface

```
awplus#configure terminal
awplus(config)#interface cellular0
awplus(conf-if)#encapsulation ppp
awplus(conf-if)#apn www.example.com
```

The APN is the name of the gateway used to form a connection between a carrier's cellular network and the public Internet. The mobile carrier reads the APN settings and then determines the correct IP address to apply and connects to the appropriate secure gateway, etc. An APN must be set in order for the firewall to connect to the cellular network. APNs can usually be found by searching on-line, or by contacting the carrier directly. Some mobile network operators do not require a specific APN to be configured, in which case, any string can be used as the APN.

In the minimum configuration, an internal default chat-script is used to connect. The default chat-script uses the APN configured for a cellular interface. Note that setting/ changing the APN or any PPP settings will restart any currently running PPP session for that cellular interface. Unsetting the APN will stop the PPP session.

Step 2. Configure the static PPP interface

```
awplus#configure terminal
awplus(config)#interface ppp0
awplus(conf-if)#ppp ipcp dns request
awplus(conf-if)#keepalive
awplus(conf-if)#ip address negotiated
awplus(conf-if)#ip tcp adjust-mss pmtu
```

Step 3. Plug your modem into the firewall

When a supported modem (with an appropriate SIM card) is inserted into an AR-Series Firewall with a cellular interface configured, the following operations are performed:

- The USB device is identified as a cellular modem
- The modem is switched to USB serial mode, which internally creates a serial interface
- A PPP session is started, which uses the serial interface to communicate with the network
- The APN and modem vendor-specific settings are applied via a chat-script.

Advanced configuration

A number of internal parameters need to be applied to a modem in order to get it to connect. Often the default parameters applied by the AR-Series Firewall will not be appropriate for a given modem and it will fail to connect.

If your USB Cellular Modem does not work you can go through the processes below to determine its characteristics and to apply the right parameters to it.

Step 1. Identify whether a modem has mode-switched correctly

Mode-switching USB devices

Most USB devices are detected as USB Mass Storage devices when they are first inserted, and will be subsequently **mode-switched** to the correct mode. Some devices may need to be manually configured to switch to the correct mode (e.g. in order to be recognized as modems). Currently, only USB modems that operate in **Serial mode** are supported. This excludes most 4G modems which operate in WWAN **Ethernet mode** by default.

Turn on logging at the terminal by using the command:

```
awplus#terminal monitor
```

Then plug in the modem and examine the messages. In success or failure you can expect to see the following messages:

```
18:49:03 awplus kernel: usb 1-1: new high-speed USB device number 2 using xhci-hcd
18:49:03 awplus kernel: usb 1-1: New USB device found, idVendor=19d2, idProduct=2000
18:49:03 awplus kernel: usb 1-1: New USB device strings: Mfr=2, Product=1, SerialNumber=3
18:49:03 awplus kernel: usb 1-1: Product: ZTE CDMA Technologies MSM
18:49:03 awplus kernel: usb 1-1: Manufacturer: ZTE, Incorporated
18:49:03 awplus kernel: usb 1-1: SerialNumber: P673A2VDF_MS
18:49:03 awplus kernel: usb-storage 1-1:1.0: USB Mass Storage device detected
18:49:03 awplus kernel: usb-storage 1-1:1.0: device ignored
18:49:05 awplus usb_modeswitch: switch device 19d2:2000 on 001/002
```

This output shows that the USB vendor and product IDs of the device prior to being mode-switched are 0x19d2 and 0x2000, respectively. The output also displays the USB Product, Manufacturer, and Serial Descriptors. This information can also be obtained in the following output of the **show system usb detail** command:

```

Bus 001 Device 002: ID 19d2:2000 ZTE WCDMA Technologies MSM MF627/MF628/MF628+/M
F636+ HSDPA/HSUPA
Device Descriptor:
  ...
  idVendor           0x19d2 ZTE WCDMA Technologies MSM
  idProduct          0x2000 MF627/MF628/MF628+/MF636+ HSDPA/HSUPA
  iManufacturer      2 ZTE, Incorporated
  iProduct           1 ZTE CDMA Technologies MSM
  iSerial            3 P673A2VDF_MS
Configuration Descriptor:
  ...
  Interface Descriptor:
    ...
    bInterfaceClass   8 Mass Storage
    bInterfaceSubClass 6 SCSI
    bInterfaceProtocol 80 Bulk-Only
    iInterface        0
  ...

```

Note: The output also shows the **Interface Class** of the device as **Mass Storage**.

The following is an example of a successful mode-switched device:

```

19:31:43 awplus usb_modeswitch: switch device 19d2:2000 on 001/003
19:31:45 awplus kernel: usb 1-1: USB disconnect, device number 3
19:31:51 awplus kernel: usb 1-1: new high-speed USB device number 4 using xhci-hcd
19:31:51 awplus kernel: usb 1-1: New USB device found, idVendor=19d2, idProduct=0063
19:31:51 awplus kernel: usb 1-1: New USB device strings: Mfr=2, Product=1, SerialNumber=0
19:31:51 awplus kernel: usb 1-1: Product: ZTE CDMA Technologies MSM
19:31:51 awplus kernel: usb 1-1: Manufacturer: ZTE, Incorporated
19:31:51 awplus kernel: option 1-1:1.0: GSM modem (1-port) converter detected
19:31:51 awplus kernel: usb 1-1: GSM modem (1-port) converter now attached to ttyUSB0
19:31:51 awplus kernel: option 1-1:1.1: GSM modem (1-port) converter detected
19:31:51 awplus kernel: usb 1-1: GSM modem (1-port) converter now attached to ttyUSB1
19:31:51 awplus kernel: option 1-1:1.2: GSM modem (1-port) converter detected
19:31:51 awplus kernel: usb 1-1: GSM modem (1-port) converter now attached to ttyUSB2
19:31:51 awplus kernel: option 1-1:1.3: GSM modem (1-port) converter detected
19:31:51 awplus kernel: usb 1-1: GSM modem (1-port) converter now attached to ttyUSB3
19:31:51 awplus kernel: qmi_wwan 1-1:1.4: cdc-wdm0: USB WDM device
19:31:51 awplus kernel: qmi_wwan 1-1:1.4 wwan0: register 'qmi_wwan' at usb-xhci-
hcd.0.auto-1, WWAN/QMI device, a6:c6:58:7c:25:3e
19:31:51 awplus kernel: usb-storage 1-1:1.5: USB Mass Storage device detected
19:31:51 awplus kernel: scsi host2: usb-storage 1-1:1.5
19:31:51 awplus root: usb_modeswitch: switched to 19d2:0063 on 001/004

```

If the mode-switch output is logged, then the device has successfully mode-switched. You can then go to [Step 4 Check carrier network connection](#) to check your modem's configuration.

If nothing else is logged after **usb_modeswitch** says that it is switching the device, the device most likely wasn't found in the database of devices with default mode-switch configurations. In this case, more diagnostic work is required. Continue to [Step 2 Get USB identification information](#), below.

Step 2. Get USB identification information

As mentioned above, the **show system usb detail** command outputs detail of the Modem ID, Manufacturer etc. This information can also be obtained in more compact form from the command:

```
awplus#show system usb
```

The **show system usb** command is used to obtain identification information about a connected USB device. This information can be used to find out the USB mode-switch parameters required to switch the modem into **Serial mode**. The following example is output from the **show system usb** command:

```
awplus#show system usb
Bus 001 Device 002: ID 12d1:1001 Huawei Technologies Co., Ltd. E169/E620/E800 HS DPA Modem
```

The following information is displayed:

Table 1: **show system usb** command output descriptions

| PARAMETER | DESCRIPTION |
|---------------------------|--|
| Bus | USB bus number (e.g. 001) |
| Device | Device number (e.g. 002) |
| ID | |
| Vendor | Vendor ID (e.g. 12d1) |
| Product | Product ID (e.g. :1001) |
| Vendor string descriptor | ID of the vendor (e.g. Huawei Technologies Co., Ltd) |
| Product string descriptor | ID of the Product (e.g. E169/E620/E800 HS DPA Modem) |

The **show system usb detail** command can be used to obtain more identification information about the modem, for example, Serial ID, Device Type, and other USB related configuration information.

```
awplus#show system usb detail
```

The following example shows output from the **show system usb detail** command:

```
awplus#show system usb detail
Bus 001 Device 002: ID 12d1:1001 Huawei Technologies Co., Ltd. E169/E620/E800 HS
DPA Modem
Device Descriptor:
  bLength                18
  bDescriptorType        1
  bcdUSB                  2.00
  bDeviceClass            0 (Defined at Interface level)
  bDeviceSubClass         0
  bDeviceProtocol         0
  bMaxPacketSize0        64
  idVendor                0x12d1 Huawei Technologies Co., Ltd.
  idProduct               0x1001 E169/E620/E800 HSDPA Modem
  bcdDevice               0.00
  iManufacturer           3 HUAWEI Technology
  iProduct                2 HUAWEI Mobile
  iSerial                 0
  bNumConfigurations     1
```

```

Configuration Descriptor:
  bLength          9
  bDescriptorType  2
  wTotalLength     85
  bNumInterfaces   3
  bConfigurationValue  1
  iConfiguration   1 Huawei Configuration
  bmAttributes     0xe0
    Self Powered
    Remote Wakeup
  MaxPower        500mA
Interface Descriptor:
  bLength          9
  bDescriptorType  4
  bInterfaceNumber 0
  bAlternateSetting 0
  bNumEndpoints   3
  bInterfaceClass  255 Vendor Specific Class
  bInterfaceSubClass 255 Vendor Specific Subclass
  bInterfaceProtocol 255 Vendor Specific Protocol
  iInterface       0
Endpoint Descriptor:
  bLength          7
  bDescriptorType  5
  bEndpointAddress 0x81 EP 1 IN
  bmAttributes     3
    Transfer Type  Interrupt
    Synch Type     None
    Usage Type     Data
  wMaxPacketSize  0x0040 1x 64 bytes
  bInterval       5
Endpoint Descriptor:
  bLength          7
  bDescriptorType  5
  bEndpointAddress 0x82 EP 2 IN
  bmAttributes     2
    Transfer Type  Bulk
    Synch Type     None
    Usage Type     Data
  wMaxPacketSize  0x0200 1x 512 bytes
  bInterval       32
Endpoint Descriptor:
  bLength          7
  bDescriptorType  5
  bEndpointAddress 0x01 EP 1 OUT
  bmAttributes     2
    Transfer Type  Bulk
    Synch Type     None
    Usage Type     Data
  wMaxPacketSize  0x0200 1x 512 bytes
  bInterval       32
Interface Descriptor:
  bLength          9
  bDescriptorType  4
  bInterfaceNumber 1
  bAlternateSetting 0
  bNumEndpoints   2
  bInterfaceClass  255 Vendor Specific Class
  bInterfaceSubClass 255 Vendor Specific Subclass
  bInterfaceProtocol 255 Vendor Specific Protocol
  iInterface       0
Endpoint Descriptor:
  bLength          7
  bDescriptorType  5
  bEndpointAddress 0x83 EP 3 IN
  bmAttributes     2
    Transfer Type  Bulk
    Synch Type     None
    Usage Type     Data
  wMaxPacketSize  0x0200 1x 512 bytes
  bInterval       32

```

```

Endpoint Descriptor:
  bLength                7
  bDescriptorType        5
  bEndpointAddress      0x02  EP 2 OUT
  bmAttributes           2
    Transfer Type        Bulk
    Synch Type           None
    Usage Type           Data
  wMaxPacketSize        0x0200  1x 512 bytes
  bInterval              32
Interface Descriptor:
  bLength                9
  bDescriptorType        4
  bInterfaceNumber       2
  bAlternateSetting      0
  bNumEndpoints          2
  bInterfaceClass        255  Vendor Specific Class
  bInterfaceSubClass     255  Vendor Specific Subclass
  bInterfaceProtocol     255  Vendor Specific Protocol
  iInterface              0
Endpoint Descriptor:
  bDescriptorType        5
  bEndpointAddress      0x84  EP 4 IN
  bmAttributes           2
    Transfer Type        Bulk
    Synch Type           None
    Usage Type           Data
  wMaxPacketSize        0x0200  1x 512 bytes
  bInterval              32
Endpoint Descriptor:
  bLength                7
  bDescriptorType        5
  bEndpointAddress      0x03  EP 3 OUT
  bmAttributes           2
    Transfer Type        Bulk
    Synch Type           None
    Usage Type           Data
  wMaxPacketSize        0x0200  1x 512 bytes
  bInterval              32
Device Qualifier (for other device speed):
  bLength                10
  bDescriptorType        6
  bcdUSB                 2.00
  bDeviceClass            0 (Defined at Interface level)
  bDeviceSubClass        0
  bDeviceProtocol         0
  bMaxPacketSize0        64
  bNumConfigurations     1
Device Status:          0x0001
  Self Powered
  
```

The following information is useful to troubleshoot the mode status:

Table 2: **show system usb detail** output descriptions for mode

| PARAMETER | DESCRIPTION |
|-----------|--|
| Mode | 255 indicates device type/mode. In the case of a failed mode-switch, this will be: 8 Mass Storage . After a successful mode-switch, most devices will display: 255 Vendor Specific Class . |

IMPORTANT NOTE: When finding out the identity of your modem, ensure that the product and vendor IDs are captured when the modem is in the state before any mode-switch happens. This is important because a device may be switched to an incompatible mode, and the ID numbers are changed after the switch has been performed.

Having found the vendor information for the modem, it should now be possible to configure a custom mode-switch configuration for the modem. A mode-switch configuration file contains the information that must be written to a modem to put it into **Serial mode**. Different models of modem require different information to be written to them. The key is to find the right configuration file for your modem.

Mode-switch configurations files for various models of modem are usually shared by the community on the USB mode-switch forum. For more information, see ['ModeSwitchForum'](#).

The following is an example of the contents of a mode-switch configuration file:

```
# ZTE devices, some Onda devices
TargetVendor= 0x19d2
TargetProductList="0001,0002,0015,0016,0017,0019,0024,0031,0033,0037,0042,0052,0055,0
061,0063,0064,0066,0091,0108,0
117,0128,0151,0157,0177,1402,2002,2003"
StandardEject=1
MessageContent="5553424312345670200000080000c85010101180101010101000000000000"
```

Step 3. Map USB mode-switch configuration file to a USB Cellular Modem

Having found the right file, save it somewhere and then configure the AR-Series Firewall to associate the file with the right type of modem. The command to configure this is:

```
awplus#configure terminal
awplus(config)#usb mode-switch id <1-16> vendor-id <vendor-id>
product-id <product-id> [manufacturer <manufacturer>|product
<product>|serial <serial>|vendor <vendor>|model <model>|revision
<revision>]|file <file-name>
```

A mode-switch configuration must specify an **ID Number**, the USB **Product-ID** and **Vendor ID** of the target device, and a mode-switch configuration file which must have the **.conf** extension. Additional parameters can be specified, including USB descriptors (manufacturer, product, serial), and SCSI descriptors (vendor, model, revision). These are useful if there are multiple devices with the same vendor or product IDs but requiring different mode-switch config files.

A mode-switch configuration cannot be added if it has the same ID or all the same parameters as another configuration. The value of the Vendor-ID, Product-ID, and USB Descriptors are included in the output of the **show system usb detail** command. When specifying the descriptors, spaces must be substituted with underscores ("_") due to the design of the underlying **usb_modeswitch** utility. We recommend to only use the optional parameters if absolutely necessary because entering them incorrectly will result in the device not being matched. The SCSI options in particular are unsuitable for matching on USB modem devices because they will generally only appear after the device has successfully mode-switched.

The following are examples of commands that associate a mode-switch file with a model of modem:

```
awplus#configure terminal
awplus(config)#usb mode-switch id 1 vendor-id 12d1 product-id 140c
manufacturer HUAWEI file switch.conf

awplus#usb mode-switch id 1 vendor-id 19d2 product-id 2000
manufacturer ZTE file flash:/zte_modem.conf
```

If, in the command, no path is specified in front of the name of the file, the file is assumed to be located in the root directory of Flash.

If a message similar to the following appears when a device is inserted:

```
usb_modeswitch: use overriding config file /etc/usb_modeswitch.d/<vendor>:<product>;
make sure this is intended
```

where **<vendor>** and **<product>** are substituted with the vendor and product IDs of the device, respectively, it means that the device was successfully mapped to the specified configuration file. Subsequently, if messages like the following appear, it is an indication that the device was successfully mode-switched to serial modem mode:

```
19:31:43 awplus usb_modeswitch: switch device 19d2:2000 on 001/003
19:31:45 awplus kernel: usb 1-1: USB disconnect, device number 3
19:31:51 awplus kernel: usb 1-1: new high-speed USB device number 4 using xhci-hcd
19:31:51 awplus kernel: usb 1-1: New USB device found, idVendor=19d2, idProduct=0063
19:31:51 awplus kernel: usb 1-1: New USB device strings: Mfr=2, Product=1, SerialNumber=0
19:31:51 awplus kernel: usb 1-1: Product: ZTE CDMA Technologies MSM
19:31:51 awplus kernel: usb 1-1: Manufacturer: ZTE, Incorporated
19:31:51 awplus kernel: option 1-1:1.0: GSM modem (1-port) converter detected
19:31:51 awplus kernel: usb 1-1: GSM modem (1-port) converter now attached to ttyUSB0
19:31:51 awplus kernel: option 1-1:1.1: GSM modem (1-port) converter detected
19:31:51 awplus kernel: usb 1-1: GSM modem (1-port) converter now attached to ttyUSB1
19:31:51 awplus kernel: option 1-1:1.2: GSM modem (1-port) converter detected
19:31:51 awplus kernel: usb 1-1: GSM modem (1-port) converter now attached to ttyUSB2
19:31:51 awplus kernel: option 1-1:1.3: GSM modem (1-port) converter detected
19:31:51 awplus kernel: usb 1-1: GSM modem (1-port) converter now attached to ttyUSB3
19:31:51 awplus kernel: qmi_wwan 1-1:1.4: cdc-wdm0: USB WDM device
19:31:51 awplus kernel: qmi_wwan 1-1:1.4 wwan0: register 'qmi_wwan' at usb-xhci-
hcd.0.auto-1, WWAN/QMI device, a6:c6:58:7c:25:3e
19:31:51 awplus kernel: usb-storage 1-1:1.5: USB Mass Storage device detected
19:31:51 awplus kernel: scsi host2: usb-storage 1-1:1.5
19:31:51 awplus root: usb_modeswitch: switched to 19d2:0063 on 001/004
```

Note: The product ID is now different to before the mode-switch.

IMPORTANT: Some devices ignore mode-switch configurations. These devices will usually be switched to a compatible mode. Examples of modems that ignore mode-switch configurations are the Huawei e220 modems (vendor ID 0x12d1 and the product IDs 0x1001, 0x1003-4, 0x1401-3F).

The **usb_modeswitch** utility logs execution output to **debug:/usb-modeswitch-<bus>-<port>**, where **<bus>** and **<port>** are the USB bus and port that the device is on (this is usually bus 1, port 1). If a mode-switch does not appear to work, it may be helpful to view the contents of the log by running the command **show file debug:/usb-modeswitch-1-1**.

The following is an example of the log output after a failed mode-switch:

```
awplus#show file debug:usb_modeswitch_1-1
USB_ModeSwitch log from Mon Jun 20 20:29:46 UTC 2016
Use global config file: /etc/usb_modeswitch.conf
Use top device dir /sys/bus/usb/devices/1-1
Check class of first interface ...
Interface 0 class is 08.
-----
USB values from sysfs:
  manufacturer  ZTE, Incorporated
  product       ZTE CDMA Technologies MSM
  serial        P673A2VDF_MS
-----
bNumConfigurations is 1 - don't check for active configuration
ConfigList: /etc/usb_modeswitch.d/19d2:2000 /usr/share/usb_modeswitch/19d2:2000
/usr/share/usb_modeswitch/19d2:#linux
SCSI attributes not needed, move on
Check config: /etc/usb_modeswitch.d/19d2:2000
! matched. Read config data
Use config file from override folder /etc/usb_modeswitch.d
Logger is /usr/bin/logger
Driver module is "option", ID path is /sys/bus/usb-serial/drivers/option1
Command to be run:
usb_modeswitch -W -D -u -l -b 1 -g 5 -v 19d2 -p 2000 -f $flags(config)
Verbose debug output of usb_modeswitch and libusb follows
(Note that some USB errors are to be expected in the process)
-----
Read long config from command line
* usb_modeswitch: handle USB devices with multiple modes
* Version 2.3.0 (C) Josua Dietze 2015
* Based on libusb1/libusbx
! PLEASE REPORT NEW CONFIGURATIONS !
DefaultVendor= 0x19d3
DefaultProduct= 0x2000
TargetVendor= 0x19d2
TargetProductList="0001,0002,0015,0016,0017,0019,0031,0033,0037,0052,0055,0061,0
063,0064,0066,0091,0108,0117,0128,0157,0177,1402,2002,2003"
StandardEject=1
MessageContent="55534243123456702000000080000c85010101180101010101000000000000"
System integration mode enabled
Use given bus/device number: 001/005 ...
Look for default devices ...
  bus/device number matched
  found USB ID 19d2:2000
No devices in default mode found. Nothing to do. Bye!
-----
(end of usb_modeswitch output)
Core program reported switching failure. Exit
```

The log reports that **No devices in default mode found**. The value for **DefaultVendor** in the mode-switch configuration file is set to 0x19d3, but the program reports finding a USB device with a vendor ID of 19d2, which means that the configuration file is wrong. **DefaultVendor** should be set to 0x19d2.

For more information about how to write mode-switch configuration files, see [the man page for 'usb_modeswitch'](#).

Step 4. Check carrier network connection

If the mode-switch is successful, but the modem still has not connected, then more information is required.

```
awplus#show cellular <cellular-interface-name>
```

The **show cellular** command displays status information about USB modems currently plugged into the network. If a cellular interface name is entered, the command only shows information about the USB modem associated with that specified interface.

Different vendors and models of modems often provide different sets of information. Vendor-specific information will not be displayed if the information is unable to be obtained from the network. For information that is common to most USB modems, the text **(unknown)** will be displayed if the information was not obtained successfully.

This command can be used to find out why a modem might not be connecting to a carrier network. Once you find the problem, you can write a chat-script to put the device into the desired configuration.

An example of the output of the **show cellular** command when a Huawei E1762 modem is plugged in:

```
awplus#show cellular
Interface cellular0
  Manufacturer: huawei
  Model ID: E1762
  Revision ID: 11.126.10.00.74
  Serial ID: 351553036840711
  IMSI: 530011104647258
  Signal Quality:
    RSSI: -71 dBm
    Bit Error Rate: (unknown)
  Active Service Class: Data mode
  Phone Activity Status: Ready
  Service Center Address:
    Phone Number: +6421600600
    Number Type: International
  GPRS Mobile Station Class: Class A
  Serial Port Configuration:
    Baud rate: 115200
    Character Format: 8-N-1
    Parity: Space
  Terminal Equipment Character Set: IRA
  Cable interface DTE-DCE local flow control:
    To DTE: RTS
    To DCE: CTS
  System Time: 1980/01/06,03:37:39
  GPRS Network Registration Status: Registered, home network
  PIN Request Status: READY
  Functionality Level: Full functionality (power-saving disabled)  Facility Lock
Status:
  SIM card lock: Not active
  SIM fixed dialling memory feature: Not active
  Network personalization: Not active
  Network subset personalization: Not active
  Service provider personalization: Not active
  Corporate personalization: Not active
  Lock phone to first SIM card: Not active
  Call Mode: Single mode
  Wireless Data Service: 3GPP systems (GERAN, UTRAN and E-UTRAN)
  GPRS Service Status: Mobile station is attached to a GPRS service
  Dialling Number Type: National
```

Bearer Service Type:
Autobauding: Enabled
Service: Data circuit asynchronous (UDI or 3.1 kHz modem)
Connection Element: Non-transparent
Automatic time and time zone update via NITS: Not enabled
PPP support between TE and MT: Supported
Last Error Report: No cause information available
PLMN selection method: User controlled PLMN selected from Access Technology
PDP Contexts:
Context ID: 1
Type: IP
APN: www.vodafone.com
Address: 0.0.0.0
Header Compression: Off
Status: Not active
Primary DNS: 0.0.0.0
Secondary DNS: 0.0.0.0
Diagnostic mode baud rate: 115200
TE-DCE baud rate: 115200
Tolerance to long delays in PDP call setup: Enabled
Hardware Version: CD25TCPV
System Info:
System Service State: Valid service
System Service Domain: CS and PS service
Roaming Status: Not roaming
System Mode: WCDMA mode
SIM card state: Valid USIM card state
System Sub-mode: WCDMA mode
System Config:
Supported System Mode: Auto-select
Network Acquisition Order: WCDMA, then GSM
Service Domain Support: CS and PS
Card-Lock:
Lock Status: Unlock code does not need to be provided
Remaining Unlock Attempts: 10
PLMN ID of the operator who has locked this device: None
Signal Strength:
RSSI (dBm): -64
ECIO (dBm): -5
RSCP (dBm): -69
ICCID: 984610411061462785F5
Software Version: E1762 11.126.10.00.74,CD25TCPV,Ver.B
HSUPA status: Enabled
HSDPA status: Enabled
Card Mode: USIM
Device Mode:
Mode ID: 20
Port Modes:
Port 0: MDM
Port 1: NDIS
Port 2: DIAG
Port 3: PCUI
Port 4: CDROM
Data Service Traffic:
Last Connection Time (s): 5134
Last Bytes Transmitted: 0
Last Bytes Received: 168
Total Connection Time (s): 64354
Total Bytes Transmitted: 910
Total Bytes Received: 3168
PIN Status:
Status: READY
Remaining input attempts:
PUK: 10
PIN: 3
PUK2: 10
PIN2: 3

The following information is useful for troubleshooting:

Table 3: **show cellular** command output descriptions

| OUTPUT | DESCRIPTION |
|--|---|
| Interface cellular0 Manufacturer: Model ID: Revision ID: Serial ID: IMSI: | This information is good for searching for solutions online or providing to support staff. |
| Signal Quality: | If this is exceptionally low (e.g. less than -113dbm), the signal strength may be insufficient to establish a reliable link with the network. |
| Last Error Report: | If an AT command failed, this field 'Last Error Report:' may provide additional information about the cause. |
| PDP Contexts: Context ID: APN: Address: Header Compression: Status: | This should be the APN configured in the cellular interface. |
| Card-Lock: Lock Status: | If the value is "Unlock code needs to be provided", it means that the modem is 'locked' and rejects changes to its settings. Unlocking your device is performed at your own risk. |
| Data Service Traffic: Last Connection Time (s): Last Bytes Transmitted: Total Connection Time (s): Total Bytes Transmitted: Total Bytes Received: | Useful to check whether traffic is being sent/received by the USB modem. |

Some fields may be displayed in different formats for different devices, for example **System Time** is a text string printed exactly as given by the modem.

Some fields such as the **Status** field under **PIN Status** are displayed in an abbreviated format. Consult the [AT \(Hayes\) command reference](#) for the device for the exact meanings of the output.

Querying the modem for information is slow. Currently the **show cellular** command takes about 10 seconds to display for a single cellular interface.

Some of the meanings of the abbreviated outputs are given in the following tables:

Table 4: PIN Request Status

| ABBREVIATION | DESCRIPTION |
|---------------|--|
| CS | circuit-switched |
| PS | packet-switched |
| READY | Not waiting for any password |
| SIM PIN | Waiting for SIM PIN to be given |
| SIM PUK | Waiting for SIM PUK to be given |
| PH-SIM PIN | Waiting for phone-to-SIM PIN to be given |
| PH-FSIM PIN | Waiting for phone-to-very-first-SIM PIN to be given |
| PH-FSIM PUK | Waiting for phone-to-very-first-SIM PUK to be given |
| SIM PIN2 | Waiting for SIM PIN2 to be given |
| SIM PUK2 | Waiting for SIM PUK2 to be given |
| PH-NET PIN | Waiting for network personalization PIN to be given |
| PH-NET PUK | Waiting for network personalization PUK to be given |
| PH-NETSUB PIN | Waiting for network subset personalization PIN to be given |
| PH-NETSUB PUK | Waiting for network subset personalization PUK to be given |
| PH-SP PIN | Waiting for service provider personalization PIN to be given |
| PH-SP PUK | Waiting for service provider personalization PUK to be given |
| PH-CORP PIN | Waiting for corporate personalization PIN to be given |
| PH-CORP PUK | Waiting for corporate personalization PUK to be given |

Table 5: Network Type: Domain

| ABBREVIATION | DESCRIPTION |
|--------------|------------------------------------|
| CS_ONLY | CS domain service available |
| PS_ONLY | PS domain service available |
| CS_PS | CS and PS domain service available |
| CAMPED | Camped in a cell |

Table 6: Device Mode: Port Modes

| ABBREVIATION | DESCRIPTION |
|--------------|--------------------------|
| MDM | Modem |
| NDIS | Network card |
| DIAG | 3G application interface |
| PCUI | PC User Interface |
| CDROM | CD image |
| SD | SD card |
| PCSC | Generic smart card |

Table 7: PIN Status: Status

| ABBREVIATION | DESCRIPTION |
|--------------|-----------------------|
| READY | No password requested |
| SIM PIN | SIM PIN requested |
| SIM PUK | SIM PUK requested |
| SIM PIN2 | PIN2 requested |
| SIM PUK2 | PUK2 requested |

If the cellular connection is up, the show command will not show any information. This is because PPP locks the device, meaning that it can't be queried for information. In this case it will show the following output:

```
awplus#show cellular
Interface cellular0
% Status information unavailable. USB modem currently in use.
```

Step 5. Assign chat-script

A common reason for a modem to fail to connect is that it is not being sent the right commands in its chat script. A chat-script is a set of AT (Hayes) commands sent to a modem to cause it to connect.

Specifying a custom chat-script

Some modems will require a non-default chat-script to be specified. This is accomplished by using the **chat-script** command, for example:

```
interface cellular0
encapsulation ppp 0
apn www.example.com
chat-script flash:/modem.chat
```

The chat-script must have the file extension **.chat**. If the file system prefix (e.g. 'flash:' in the example above) is not specified, the file system defaults to flash. If the file does not exist, the default chat-script will be used instead. When a device is inserted and successfully recognized as a cellular modem, the chat-script will be run and its progress will be displayed in the terminal monitor. The following message should confirm whether the specified chat-script was run:

```
19:43:41 ARC pppd[11849]: [ppp0] [19:43:41.172] Script /usr/sbin/chat -E -v -t15 -f /
flash/modem.chat finished (pid 11860), status = 0x0
```

If PPP reports that **Connect script failed**, or **Modem hangup**, or **Connection terminated** then the modem failed to connect to the cellular network. If the progress of the chat-script execution reports the string **CONNECT** and PPP reports **Serial connection established**. then a connection to the cellular network has been established.

The output of the **show ip route** command should confirm this.

Note: Note that setting or unsetting the chat-script will restart the PPP session for that cellular interface (provided that the device is inserted and the APN is configured).

The following is an example of a assigning a default chat-script to a cellular interface:

```
awplus#configure terminal
awplus(config)#int cellular0
awplus(config-if)#chat-script connect.chat
```

Writing chat scripts

Sending commands to a device or configuring a chat-script requires some knowledge of AT (Hayes) commands. Chat-scripts consist of a list of **expect-send** pairs of messages. For each pair of messages, the chat program waits to receive the first message from the AR-Series Firewall, and once it has received it, it sends the second message to the modem. The messages sent to the modem are AT (Hayes) commands. Different vendors and models of modems support different sets of commands, but most modems have some commands in common. In the chat-script, anywhere that the text \$APN is specified is substituted with the configured APN.

AT (Hayes) commands references are available for various models of modems that list the supported AT (Hayes) commands for that device as well as their outputs and syntax. See the following manuals for more information:

- [AT Command Set for ZTE Modules](#)
- [Huawei AT command reference](#)

The following is an example of the default chat-script contents:

```
ABORT 'BUSY'
ABORT 'NO CARRIER'
ABORT 'VOICE'
ABORT 'NO DIALTONE'
ABORT 'NO DIAL TONE'
ABORT 'NO ANSWER'
ABORT 'DELAYED'
REPORT CONNECT
TIMEOUT 6
'' 'ATH E1'
'' 'ATQ0'
'OK-AT-OK' 'ATZ'
TIMEOUT 3
'OK\d-AT-OK' 'ATI'
'OK' 'ATZ'
'OK' 'ATQ0 V1 E1 S0=0'
'OK' 'AT&C1 &D2'
'OK' 'AT+FCLASS=0'
'OK-AT-OK' 'AT+CGDCONT=1,"IP", "$APN"'
'OK' 'ATDT*99***1#'
TIMEOUT 30
CONNECT ''
```

Table 8: AT (Hayes) commands

| COMMAND | DESCRIPTION |
|---|--|
| AT+FCLASS=0 | This message tells the modem to set the Active Service Class to 'data mode'. |
| ABORT | This command causes the chat-script to stop if the following message is reported by the modem. |
| TIMEOUT | This command sets the maximum amount of time for the chat program to wait for a response from the modem. |
| \$APN | Any occurrences of the text \$APN in the script are substituted with the APN configured on the interface. |
| CONNECT | If the string CONNECT is received from the modem, a connection to the cellular network has been established. |
| 'OK-AT-OK' 'AT+CGDCONT=1,"IP", "\$APN"' | Sets the APN. |
| 'OK' 'ATDT*99***1#' | Dials the carrier network. |

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