Troubleshooting Cellular and Data Connectivity

1. INTRODUCTION

1.1 Overview

When troubleshooting data connectivity issues with MultiTech devices there are several discrete mechanisms to consider. The first is cellular connectivity. The second is cellular data.

2. TROUBLESHOOTING CELLULAR CONNECTIVITY

When troubleshooting cellular connectivity issues with MultiTech devices there are several discrete mechanisms to consider. The first is Power and Mechanical. This includes power cables, antennas, SIM card installation, and other connections. The second is registration status. The process for registration is mostly performed automatically by the device firmware. The third is radio, this includes signal strength and antenna placement. The fourth is whether the SIM has been provisioned correctly by the provider and how the SIM account has been set up.

2.1 Check Power and Mechanical

- Is the power lead or USB cable attached to device?
- Is the power LED lit?
- Are antennas attached?
- Are the installed antennas provided by MultiTech for use with the device?
- Is the SIM installed correctly?
  - Check SIM orientation.
  - Check SIM size - a 3FF SIM requires an adapter to fit in a MultiTech device with a 2FF SIM carrier.

2.2 Check Modem Status

To check modem status connect to the modem, verify SIM is installed, get the device information, and check registration status.

2.2.1 Connect To Modem

Using a terminal emulation program such as, Terra Term (Windows) or minicom (Linux) connect to the modem's AT command interface.

`AT` determines if the modem's AT command interface is ready to accept commands.

```
AT
OK
```

2.2.2 Verify SIM Is Installed

`AT+CPIN?` detects if a SIM is inserted and readable (example of known good SIM):

```
AT+CPIN?
+CPIN: READY

OK
```

2.2.3 Get Device Info

Use the following commands to get information about the device.

Quectel Example:

```
AT+CGMI
Quectel

OK
AT+CGMM
EG95

OK
AT+CGMR
EG95NAFBR05A04M4G

OK
AT+QGMR
EG95NAFBR05A04M4G_01.005.01.005

OK
```

Telit Example:

```
AT+CGMI
Telit

OK
AT+CGMM
ME910C1-NA

OK
AT+CGMR
M0B.100005

OK
AT#SWPKGV
30.00.128-P0B.120103
M0B.100005
P0B.120103
A0B.120000

OK
AT#CFVR
#CFVR: 3

OK
```

2.2.4 Check Registration Status With Cellular Network

Generally, the device will scan available base stations (cell towers) and identify the ones that belong to the networks (Verizon, AT&T) in the device's list of permitted networks. Once a permitted network is found, the device will send identifying information from the SIM to the network and attempt to register.

`AT+COPS?` This command returns the current operators and their status, and allows setting automatic or manual network selection.

```
AT+COPS?
+COPS: 0,0,"T-Mobile",7
```

```
3
4 OK
```

2.2.4.1 Check Selected Firmware

If the device is not registered to a network and the device model provides dual Verizon/AT&T firmware options, check which firmware is being used with the `AT+FWSWITCH?` command. This example shows a device using the AT&T firmware (0):

```
1 AT#FWSWITCH?
2 #FWSWITCH: 0
3
4 OK
```

This example shows setting the firmware to Verizon (1). The second 1 is a flag indicating that the setting should be saved in the modem's firmware and will persist through power cycles. After the firmware version is set the device will reboot automatically:

```
1 AT#FWSWITCH=1,1
2 OK
```

Once the device firmware is set to match the SIM vendor and the device use `AT+COPS?` and/or registration AT commands to determine registration status.

2.2.4.2 Automatic Registration

A device may automatically attempt to register to the network provider associated with the SIM. The `AT+COPS` command is used to query and control this process. In this example `AT+COPS=2` and the device is not attempting to register with a network.

```
1 AT+COPS?
2 +COPS: 2
3
4 OK
```

Setting `AT+COPS=0` starts the automatic registration process. In this example the automatic registration process is started and when queried returns that the device is registered to the AT&T network using 4G LTE (7):

```
1 AT+COPS=0
2 OK
3 AT+COPS?
4 +COPS: 0,0,"AT&T",7
5
6 OK
```

2.2.4.3 Check Registration State

Some providers will return 0 in response to AT+COPS? even if the device is registered. In this case check Registration using `AT+CREG?`, `AT+CEREG?`, and `AT+CGREG?` AT commands. It's expected to see `+CREG: 0,1` for devices that are connected or `+CREG: 0,5` for devices that are connected and roaming. The example below shows a registration status of connected and roaming `+CREG: 0,5`:

```
1  AT+CREG?
2  +CREG: 0,5
3
4  OK
5  AT+CEREG?
6  +CEREG: 0,5
7
8  OK
9  AT+CGREG?
10 +CGREG: 0,5
```

```
11
12 OK
```

2.3 Check Network Status

`AT+CSQ` returns the signal strength and bit error rate. A signal strength >20 and <26 is very good. Lower is always better for the bit error rate.

```
AT+CSQ
+CSQ: 14,5

OK
```

`AT#SERVINFO` returns information about the serving cell.

```
AT#SERVINFO
#SERVINFO: 5230,-59,"Verizon","311480",000010F,BF35,128,2,-85

OK
```

`AT#RFSTS` reads the current network status.

```
AT#RFSTS
#RFSTS: "311 480",5230,-82,-48,-17.0,bf35,00,,128,3,0,2ED1B01,"311480965589307"7

OK
```

2.4 Check SIM Provisioning

If registration is not possible then it might be the provider and the account associated with the SIM.

Some common questions to ask the SIM provider:

- Is the account still valid?
- Is the SIM provisioned for data?
- What is the APN?
- How old is the SIM?
    - Was the SIM used in a different non-MultiTech product?
        - Was the linked account re-provisioned to work with the MultiTech product?
            - Was the re-provisioning correct?

3. TROUBLESHOOTING CELLULAR DATA

3.1 Overview

To troubleshoot a cellular data connection, check the packet data protocol (PDP) context, and test TCP/IP connectivity by pinging a remote host.

3.2 PDP Context

Cellular carriers provide packet data services for various protocols. This document focuses on configuring and troubleshooting the TCP/IP packet data protocol used by the modem's internal TCP/IP stack. The following assumptions are made:

- The SIM has been provisioned as data-only
- The MultiTech device is configured and able to successfully register with the cellular network

Carriers distinguish the packet data services they provide with an Access Point Name. Common APN's for TCP/IP PDPs might be "vzwinternet", "broadband", or "super".

3.2.1 List PDP Context Details

Use the `AT+CGDCONT?` command to list the APN's that are currently set on the device.

AT&T Example:

```
AT+CGDCONT?
+CGDCONT: 1,"IP","broadband","",0,0

OK
```

AT&T usually requires the APN to be set manually. If the APN is unknown contact AT&T.

Verizon Example:

```
AT+CGDCONT?
+CGDCONT: 1,"IPV4V6","vzwims","",0,0
+CGDCONT: 2,"IPV4V6","vzwadmin","",0,0
+CGDCONT: 3,"IPV4V6","ne01.VZWSTATIC","",0,0
+CGDCONT: 4,"IPV4V6","vzwapp","",0,0
+CGDCONT: 5,"IPV4V6","vzw800","",0,0
+CGDCONT: 6,"IPV4V6","vzwclass6","",0,0

OK
```

Verizon will usually push the APN to the modem automatically. The Verizon APN for TCP/IP should be in PDP context 3. In the example above the APN for the TCP/IP PDP is "ne01.VZWSTATIC".

Altering the default Verizon APNs and PDP contexts provided with the modem might result in a failure to automatically push the APN by Verizon.

Before setting the APN, use `AT+COPS=2` to unregister the device from the cellular network.

A reboot and/or power cycle may be required before the new APN is recognized by the network.

3.2.2 Set PDP APN (AT&T)

Use `AT+CGDCONT=1,"IPV4V6","<apn-name>"` to set the APN.

Set AT&T APN Example:

```
AT+COPS=2
OK
AT+CGDCONT=1,"IPV4V6","broadband"
OK

AT+COPS=0
OK
AT+CGDCONT?
+CGDCONT: 1,"IPV4V6","broadband","",0,0

OK
AT#REBOOT
OK
```

3.2.3 Set PDP APN (Verizon)

Use `AT+CGDCONT=3,"IPV4V6","<apn-name>"` to set the APN.

Set Verizon APN Example:

```
AT+COPS=2
OK
AT+CGDCONT=3,"IPV4V6","vzwinternet"
OK

AT+COPS=0
OK
AT+CGDCONT?
+CGDCONT: 3,"IPV4V6","vzwinternet","",0,0

OK
AT#REBOOT
OK
```

3.3 Test TCP/IP Connectivity

Use AT commands to test the TCP/IP connectivity using the device's internal TCP/IP stack. See the AT command reference for the specific device for details about each AT command.

3.3.1 Ping Example

The following examples activate the TCP/IP PDP context, shows the status of socket 1, pings the IP address 8.8.8.8, and deactivates the TCP/IP context.

Telit AT&T (PDP Context 1):

```
AT#SGACT=1,1
#SGACT: 100.85.253.11

OK
AT#SS=1
#SS: 1,0

OK
AT#PING="8.8.8.8"
#PING: 01,"8.8.8.8",3,109
#PING: 02,"8.8.8.8",2,109
#PING: 03,"8.8.8.8",1,109
#PING: 04,"8.8.8.8",2,109

OK
AT#SGACT=1,0
OK
```

Quectel AT&T (PDP Context 1):

```
AT+QIACT=1
OK
AT+QIACT?
+QIACT: 1,1,1,"162.191.14.200"

OK
AT+QPING=1,"www.google.com"
OK

+QPING: 0,"142.250.191.132",32,37,255

```

```
+QPING: 0,"142.250.191.132",32,39,255

+QPING: 0,"142.250.191.132",32,40,255

+QPING: 0,"142.250.191.132",32,41,255

+QPING: 0,4,4,0,37,41,38

AT+QIDEACT=1
OK
```