

4G LTE CAT 4 Skywire[®] User Manual

NimbeLink Corp

Updated: March 2018



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1. Introduction

1.1 Orderable Part Numbers

Orderable Device	Description	Carrier	Network Type
NL-SWDK	Skywire Development Kit	Any	Any
NL-SW-LTE-S7588-V	LTE CAT4, Verizon	Verizon	LTE
NL-SW-LTE-S7588-T	LTE CAT4, HSPA	AT&T, T-Mobile, etc.	LTE
NL-SIM-ATT	3FF SIM for AT&T	AT&T	GSM/LTE
NL-SIM-TMO	3FF SIM for T-Mobile	T-Mobile	GSM/LTE
NL-SIM-VOD	3FF SIM for Vodafone	Vodafone	GSM/LTE
NL-SIM-COM	3FF SIM for Verizon	Verizon	LTE
TG.30.8113	Taoglas Antenna		Any
CAB.011	Taoglas SMA to UFL cable		

1.2 Product Overview

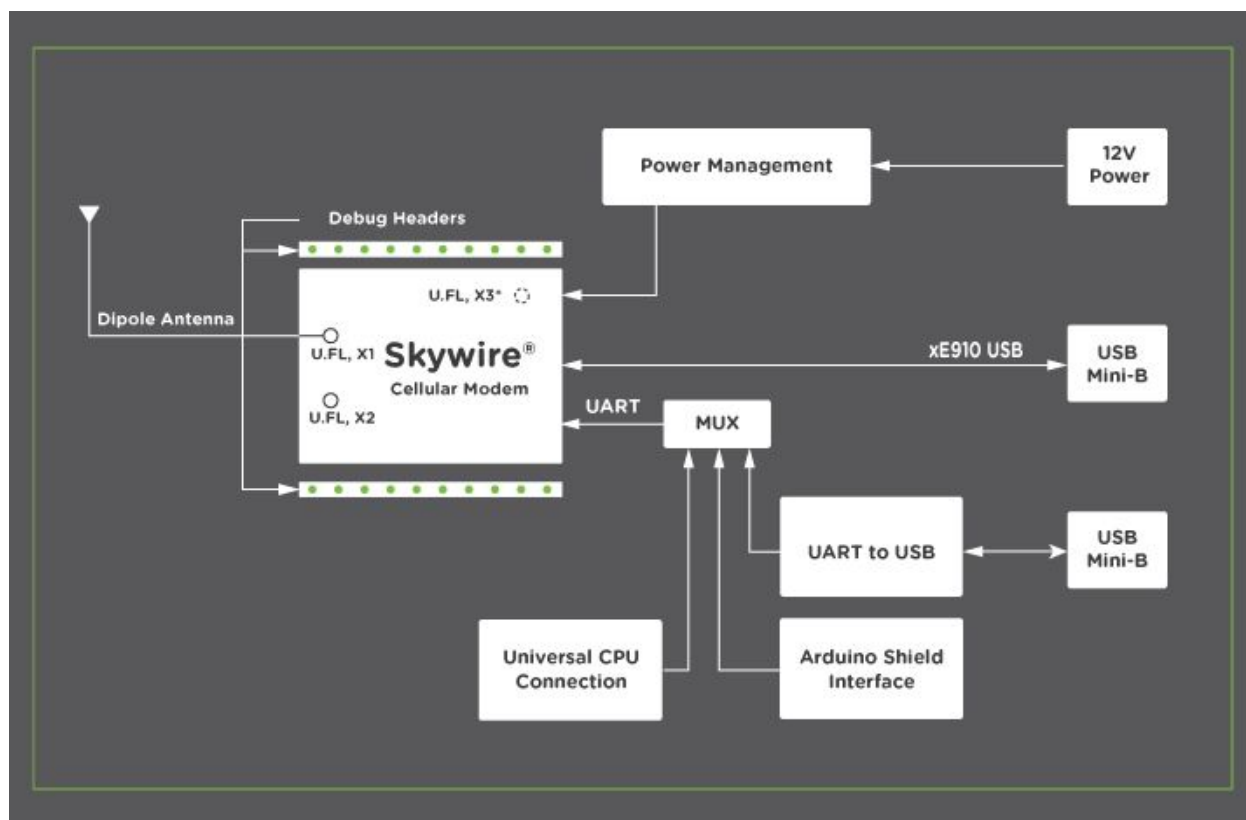
This documents details interfacing with the 4G LTE CAT 4 Skywire® for Verizon or AT&T on the Skywire Development Kit.

The Skywire Development Kit includes one baseboard, antenna, power supply, SIM cards, and debug cables. Skywire modems must be purchased separately. The kit enables you to develop your application directly on the Skywire modem with three different ways to connect:

- Connect your PC to the Skywire modem UART port via onboard USB-to-UART converter and send AT commands directly to the modem through PC terminal applications. You can also connect over USB for access to multiple COM ports.
- The kit is an Arduino shield, so you can plug the kit directly onto an Arduino microcontroller. Please see Section 3: Common Next Steps for links to example documentation.
- To connect the kit to a different processor or development kit, a 14-pin header breaks out the necessary signals for easy connection to any device. The modem supports I/O levels from 1.65-5.5V, simplifying connection to other systems.

Skywire modems and development kits are sold separately. Users will need to activate a data plan through the carrier of their choice to allow the Skywire to connect to the network. Data plans may be activated at go.nimbelink.com.

1.3 Block Diagram



1.4 Data Plans

NimbeLink's Skywire cellular modems help speed up product development and integration of cellular connectivity, and our cellular data plans help eliminate one more step in getting your customers up and running and connected to the cellular network.

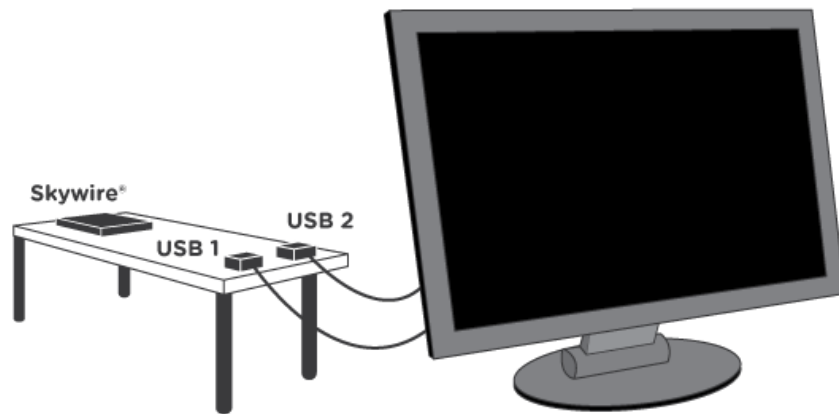
Tiered data plans from Nimbelink can support any application from a few text messages a month to gigabytes of streaming data, and competitive pricing and automatic billing will appeal to both you and your customers.

Please visit go.nimbelink.com to set up a plan for your device.

Data plans from NimbeLink provide access to all of the cellular technologies supported by Skywire modems including LTE, EVDO, and 1xRTT. Simplify product development and rollout, save time and money, and streamline installation and access for your customers with NimbeLink's bundled data plans.

2. Connect to Kit using a PC

This section covers how to connect your development kit to a PC and provision the modem with your cellular plan. It also covers how to communicate over the serial port to the Skywire modem which only requires the use of USB port and connector marked J14 or USB2 in the diagram below. USB1 (connector J5) is used for high speed data connections and firmware updates to the modem and is not used in this section.



2.1 Unpack Kit Contents



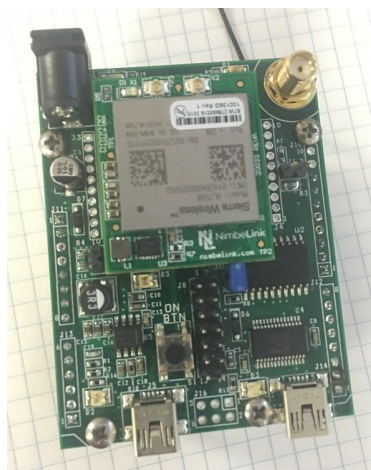
2.2 Skywire Placement

To mount your Skywire Cellular modem follow these steps:

1. Gather the following:
 - a. Skywire Development Kit board
 - b. 4G LTE CAT 4 Skywire Cellular Modem
 - c. U.FL extractor tool (Always use a U.FL extractor tool when placing or removing U.FL cables on the Skywire modem to avoid damaging the U.FL connectors).
 - b. 3FF SIM card
2. Insert the SIM card into the SIM Card socket on the Skywire. The metal contacts should be inserted so they are facing the Skywire's circuit board. As shown in the image on the right.



3. Line up your Skywire's cellular U.FL connector(s) on the side of the board closest to the antenna connector. Then carefully seat your Skywire into the board's Skywire socket (U1). Take care to ensure that the pins are correctly aligned. Failure to properly align the pins may damage your Skywire.





A common issue is accidentally inserting the modem with pins misaligned by one row. Check pin alignment BEFORE applying power to prevent modem damage.

4. To avoid damage to the U.FL connector and maximize connector life, a U.FL removal tool should be used when attaching/removing the U.FL connector. Always insert and remove the U.FL connector with a force perpendicular to the board.
5. Attach the U.FL cable to the top U.FL connector X1 on the Skywire. The x1 connection on the Skywire is for the primary cellular antenna. Attach a second antenna (sold separately, not pictured) to connector X2 to connect the diversity cellular antenna.



A properly mounted Skywire Modem with U.FL cable attached to top U.FL connector X1

2.3 Attach Antenna to Baseboard

Antenna screws onto SMA connector with a clockwise rotation

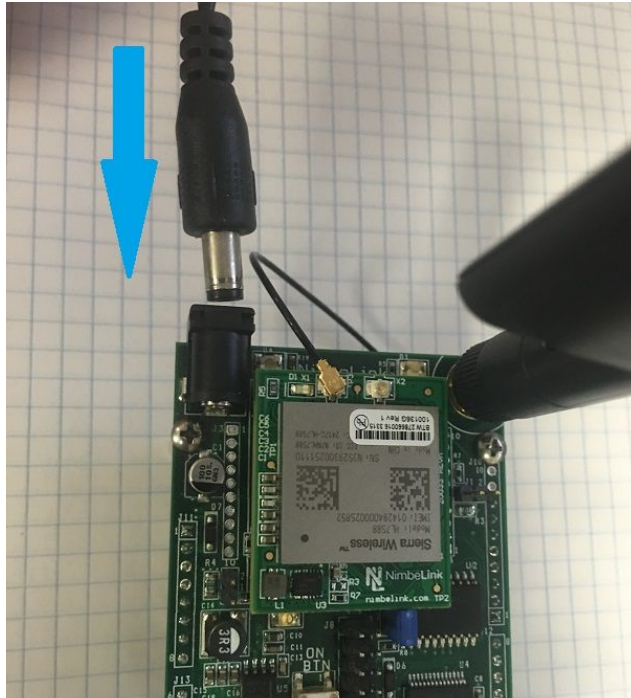


2.4 Ensure header J6 is shorted with 2 pin Jumper

This enables USB to UART communication between the PC and the modem.

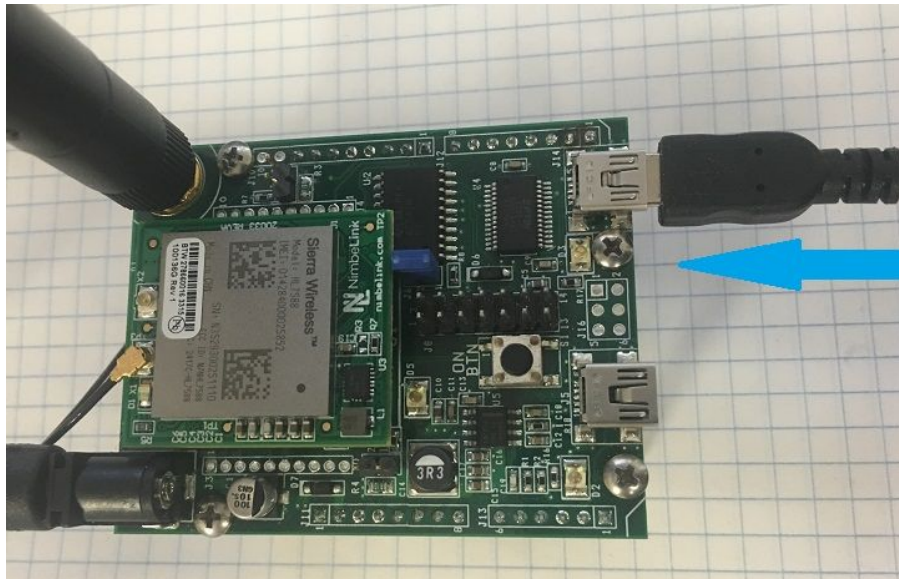


2.5 Plug in 12V Power Supply to connector J15



-LED's D4 and D5 will illuminate on the development kit (not pictured)

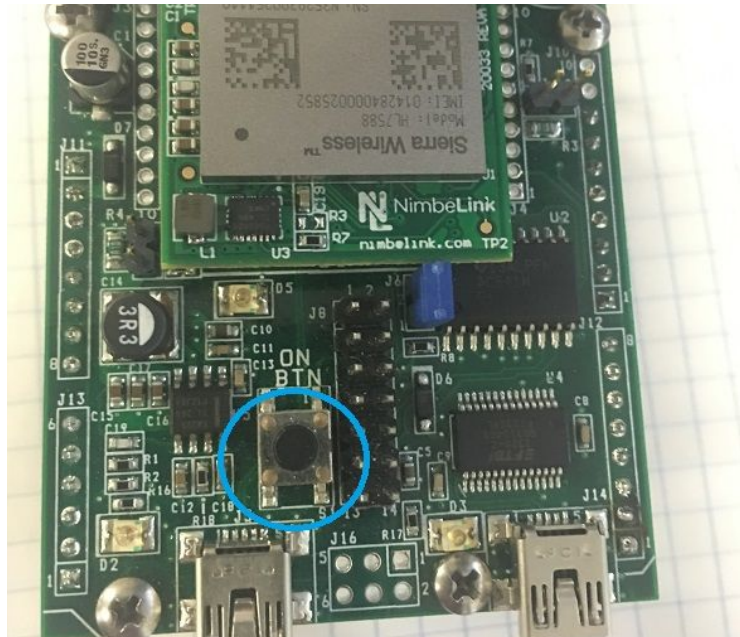
2.6 Plug USB cable into connector J14 and PC



-LED D3 on the development kit will illuminate (not pictured)

2.7 Press and hold button S1 to power on the modem

Please see the table below for the length of time needed to hold down button S1 for your particular modem.



Device	Hold Time (t_h) for Button S1 To Power On the Modem	Wait Time (t_w) Before Software Communication*	LED D1 Activity
NL-SW--LTE-S7588-V	$t_h > 25$ mS	$t_w > 2$ seconds	LED turns on
NL-SW--LTE-S7588-T	$t_h > 25$ mS	$t_w > 2$ seconds	Blinks once

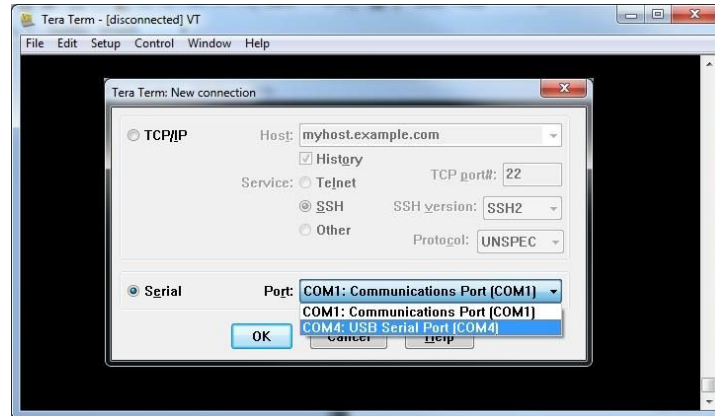
NOTE: Depending on your modem and depending on the setup, the modem may be available for use before t_w .

NOTE: When the modem has completed booting it will output '+PBREADY' onto the serial line.

2.8 Open Tera Term or similar terminal emulator

If you do not have a terminal emulator program, you can get Tera Term here:
<http://logmett.com/index.php?/download/tera-term-486-freeware.html>

Your PC may have multiple COM ports. Select appropriate USB COM port to communicate with the development kit.



Serial Settings should be as follows (these are the default settings):

Baud Rate:	115,200 bps
Data:	8bit
Parity:	none
Stop:	1bit
Flow Control:	none

2.9 Test Serial Communication

In the terminal program, type the command:

AT

followed by the Enter key, and the terminal should respond with:

OK

Note: You may need to turn echo on in order to see what you are typing. If you type the command:

AT

and don't see it being typed on your screen, hit the Enter key, and type the following command:

ATE1

followed by the Enter key, and the terminal program should respond with:

OK

Type the following command:

AT

to verify you can see the command you are typing. After pressing the Enter key, the terminal program will respond with:

OK

2.10 Test Signal Strength

In the terminal program, type the command:

AT+CESQ

followed by the Enter key, and the terminal should respond with:

+CESQ: aa,bb,ccc,ddd,xx,yy

The important parameters are the last two. **xx** is the Reference Signal Received Quality (RSRQ) and **yy** is the Reference Signal Received Power (RSRP). Typical values are as follows:

Values of xx	RSRQ (Reference Signal Received Quality)
0	$\text{RSRQ} < -19.5 \text{ dB}$
1	$-19.5 \text{ dB} \leq \text{RSRQ} < -19 \text{ dB}$
2	$-19 \text{ dB} \leq \text{RSRQ} < -18.5 \text{ dB}$
...	...
32	$-4 \text{ dB} \leq \text{RSRQ} < -3.5 \text{ dB}$
33	$-3.5 \text{ dB} \leq \text{RSRQ} < -3 \text{ dB}$
34	$-3 \text{ dB} \leq \text{RSRQ}$
255	Not known or detectable

Values of yy	RSRP (Reference Signal Received Power)
0	$\text{RSRP} < -140 \text{ dBm}$
1	$-140 \text{ dBm} \leq \text{RSRP} < -139 \text{ dBm}$
2	$-139 \text{ dBm} \leq \text{RSRP} < -138 \text{ dBm}$
...	...
95	$-46 \text{ dBm} \leq \text{RSRP} < -45 \text{ dBm}$
96	$-45 \text{ dBm} \leq \text{RSRP} < -44$
97	$-44 \text{ dBm} \leq \text{RSRP}$
255	Not known or not detectable

Here are estimated signal qualities based on the above values:

Values of xx	RSRQ	Values of yy	RSRP	Quality
0	$\text{RSRQ} < -19.5 \text{ dB}$	0 - 40	$\text{RSRP} < -100 \text{ dBm}$	Marginal
1 - 9	$-19.5 \text{ dB} \leq \text{RSRQ} < -15 \text{ dB}$	41 - 50	$-100 \text{ dBm} \leq \text{RSRP} < -90 \text{ dBm}$	Fair
10 - 19	$-15 \text{ dB} \leq \text{RSRQ} < -10 \text{ dB}$	51 - 59	$-90 \text{ dBm} \leq \text{RSRP} < -80 \text{ dBm}$	Good
20 - 34	$\geq -10 \text{ dB}$	60 - 97	$\geq -80 \text{ dBm}$	Excellent

Note: The NL-SW-LTE-S7588-V and -T both calculate the CSQ value differently than other Skywire modems. Therefore, we recommend using the command AT+CESQ to verify signal strength and quality.

2.11 Activate Modem (one-time step)



If you are using a new Skywire cellular module, it does not have an active cellular plan. To activate a data plan, visit <http://go.nimbelink.com> and fill out the “Cellular Data Plan Activation Request Form”.

Please see below pictures for the location of the IMEI



2.14 Setup PDP Context

Before you can successfully communicate with the network using a LTE Skywire, you need to define the PDP context.

2.14.1 For NL-SW-LTE-S7588-T (ATT/GSM Firmware):

In the terminal program, type the command:

AT+CGDCONT = 1,"IP","APN","",0,0,0,0,0

where **APN** is the individual APN for your network, followed by the Enter key, and the terminal program should respond with:

OK

Note: Consult Section 3: APN Setup for help with your APN.

To verify that the APN was set correctly, in the terminal program type the command:

AT+CGDCONT?

followed by the Enter key, and the terminal should respond with:

+CGDCONT: 1,"IP","APN","",0,0,0,0,0

as well as the other PDP context information on the device. To enable this setting, in the terminal program type the command:

AT+CGACT=1,1

followed by the enter key, and the terminal should respond with:

OK

To verify the modem successfully connected to the network type

AT+CGDCONT?

followed by the enter key, and the terminal should respond with:

+CGDCONT: 1,"IP","APN",<IP Address>,0,0,0,0,0

where **<IP Address>** is the Skywire modem's IP address.

If the **AT+CGACT** command does not work, the terminal will respond with

+CME ERROR: <Error Number>

and further setup may be necessary. Check the signal strength with **AT+CESQ** to verify the Skywire is getting an acceptable signal. Otherwise, consult the [Sierra AT Command Reference Guide](#) for your particular error number.

2.14.2 For the NL-SW-LTE-S7588-V (Verizon Firmware):

In the terminal program, type the command:

AT+CGDCONT = 3,"IP","APN","",0,0,0,0,0

where **APN** is the individual APN for your network, followed by the Enter key, and the terminal program should respond with:

OK

Note: Consult Section 3: APN Setup for help with your APN.

Verizon devices should always define the APN in context 3.

To verify that the APN was set correctly, in the terminal program type the command:

AT+CGDCONT?

followed by the Enter key, and the terminal should respond with:

+CGDCONT: 3,"IP","APN","",0,0,0,0,0

as well as the other PDP context information on the device. To enable this setting, in the terminal program type the command:

AT+CGACT=1,3

followed by the enter key, and the terminal should respond with:

OK

To verify the modem successfully connected to the network type

AT+CGDCONT?

followed by the enter key, and the terminal should respond with:

+CGDCONT: 3,"IP","APN","<IP Address>",0,0,0,0,0

where **<IP Address>** is the Skywire modem's IP address.

If the **AT+CGACT** command does not work, the terminal will respond with

+CME ERROR: <Error Number>

and further setup may be necessary. Check the signal strength with **AT+CESQ** to verify the Skywire is getting an acceptable signal. Otherwise, consult the [Sierra AT Command Reference Guide](#) for your particular error number.

2.15 Test Network Communication

In the terminal program, type the command:

AT+CGREG?

followed by the Enter key, and the terminal should respond with:

+CGREG: 0,1 or **+CGREG: 0,5**

For all other responses, review network status responses in the AT Command Manual.



Reset power, and repeat steps 2.5 through 2.15 (as applicable) before moving on to Section 3.

3. APN Setup

3.1 Introduction

GSM and LTE-based Skywire modems can be setup to use different APNs. For Skywires that use AT&T and T-Mobile service, the correct APN is often needed to register on the network and pass data. For Verizon Skywires, it may be beneficial to use a setup that necessitates using a different APN.

3.2 Common Verizon APNs

The most common reason for needing a different APN is because you are using a particular IP address type.

If you activated your Skywire modem on <https://go.nimbelink.com>, it uses a Private IP address and the APN:

NIMBLINK.GW12.VZWENTP

If you have changed your IP address type to a Public Dynamic IP address, the APN will be:

VZWINTERNET

Finally, if you have changed your IP address type to a Public Static IP address, the APN is most likely:

MW01.VZWINTERNET

However, it may be different depending on your location.

For changing your IP address type, or to get your APN, please contact us at product.support@nimbelink.com.

Please include the following information:

- IMEI of your Skywire modem
- Model of your Skywire modem
- SIM ID of your SIM card

If you activated your service for your Skywire from Verizon directly or another carrier, please contact your representative at that company for the APN you should use.

3.2 Common AT&T/T-Mobile APNs

Cellular carries based on AT&T and T-Mobile service requires using a unique APN to register on the network and pass data.

If you activated your Skywire modem on <https://go.nimbelink.com>, here are the following APNs to use:

AT&T Service

10569.mcs

T-Mobile Service

c1.korem2m.com

If you activated your service for your Skywire from AT&T or T-Mobile directly or another carrier, please contact your representative at that company for the APN you should use.

4. Common Next Steps

Once the network setup and testing is complete, you are ready to start developing with your Skywire modem. Common application examples include sending and receiving SMS messages, FTP file transfer, TCP/UDP packets, and using the modem with an external microcontroller, such as an Arduino. Please consult these application notes on the 4G LTE Cat 4 Skywire [product page](#) for specific examples of each type of operation.

5. Additional Resources

- [4G LTE Cat 4 Skywire Product Page](#)
- [4G LTE Cat 4 Skywire Data Sheet](#)
- [Sending SMS](#)
- [Configuring linux 'pppd'](#)
- [Sending and Receiving data using socket dial](#)
- [Sierra's HL7588 Product Technical Resources](#)
- [Sierra's HL7588 AT Command Manual](#)
- [Sierra's HL7588 Verizon Firmware Update](#)
- [Sierra's HL7588 AT&T Firmware Update](#)