United Electronic Industries

The High-Performance Alternative

DNA-CAR-550
PCI Express Mini Card
Module Carrier
(for UEIPAC series only)
—
User Manual

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Note: Specifications shown in this document are subject to change without notice. Please check with UEI for current status.

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Chapter 1 Introduction

This document outlines the feature-set and operation of the UEI DNA-CAR-550 PC Express Mini Card module carrier. This board allows direct connection between a UEIPAC series I/O module and CELL/WIFI networks and also between a UEIPAC and GPS antennas. It is compatible with CELL/WIFI/GPS cards from many vendors and also has a standard mini card USB 2.0 interface.

1.1 Organization of this manual

This DNA-CAR-550 User Manual is organized as follows:

- **Chapter 1- Introduction**
  This section provides an overview of the document content, an overview of the device architecture, connectivity, and logic of the board.
- **Chapter 2 – Connecting to the Internet with the DNA-CAR-550**
  This section explains how to connect the UEIPAC to the Internet through the CAR-550 via PCI Express or USB 2.0. It also describes prerequisites for using the board such as a cell phone data plan, a SIM card, and account activation. Procedures for manual configuration and automatic startup are also included in this section.
- **Chapter 3 – Programming with the Low-Level API**
  This section describes a low level function that may be used to enable and disable the wireless interface.
- **Appendix – A. Accessories**
  This appendix contains a list of associated equipment typically used with the unit.
- **Index**
  This is an alphabetical listing of topics covered in this manual.

Manual Conventions

To help you get the most out of this manual and our products, please note that we use the following conventions:

Tips are designed to highlight quick ways to get the job done, or reveal good ideas you might not discover on your own.

NOTE: Notes alert you to important information.

CAUTION! Caution advises you of precautions to take to avoid injury, data loss, and damage to your boards or a system crash.

Text formatted in bold typeface generally represents text that should be entered verbatim. For instance, it can represent a command, as in the following example: “You can instruct users how to run setup using a command such as setup.exe.”

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1.2 DNA-CAR-550 Carrier Board Features

The DNA-CAR-550 module carrier board has the following features:

- Allows UEIPAC direct connection to CELL/WIFI networks
- Allows UEIPAC direct connection to GPS antennas
- Supports CELL/WIFI/GPS cards from many vendors
- Standard Mini Card USB interface
- Connects internally to UEIPAC USB port
- 2 external RF/Coax connectors
- External access for carrier SIM/UIM card
- Includes replacement faceplate for UEIPAC Cube
- UEI 10-year Availability Guarantee

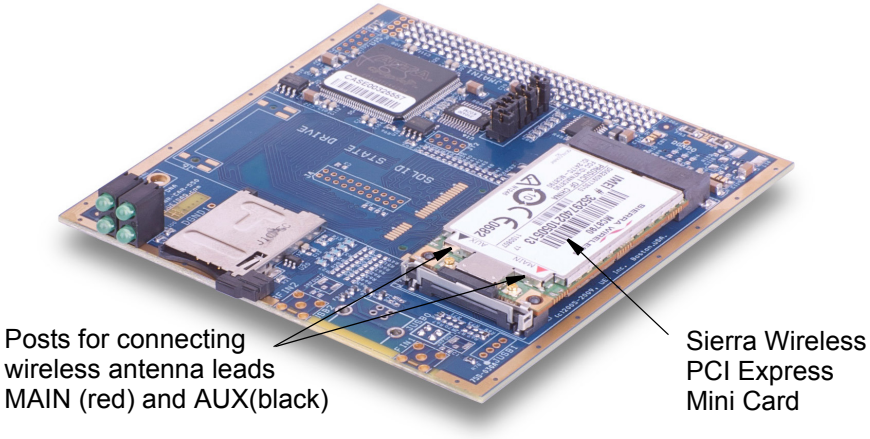

Figure 1-1. DNA-CAR-550 PCI Express Mini Card Module Carrier Board

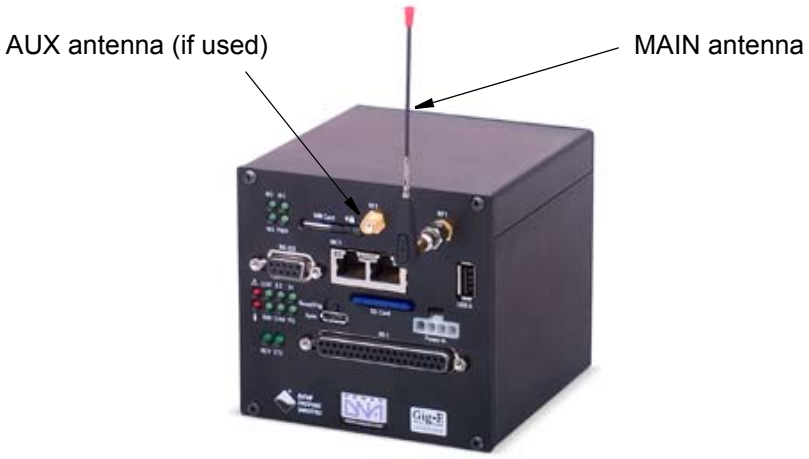

Figure 1-2. UEIPAC Cube with CAR-550 Module Carrier

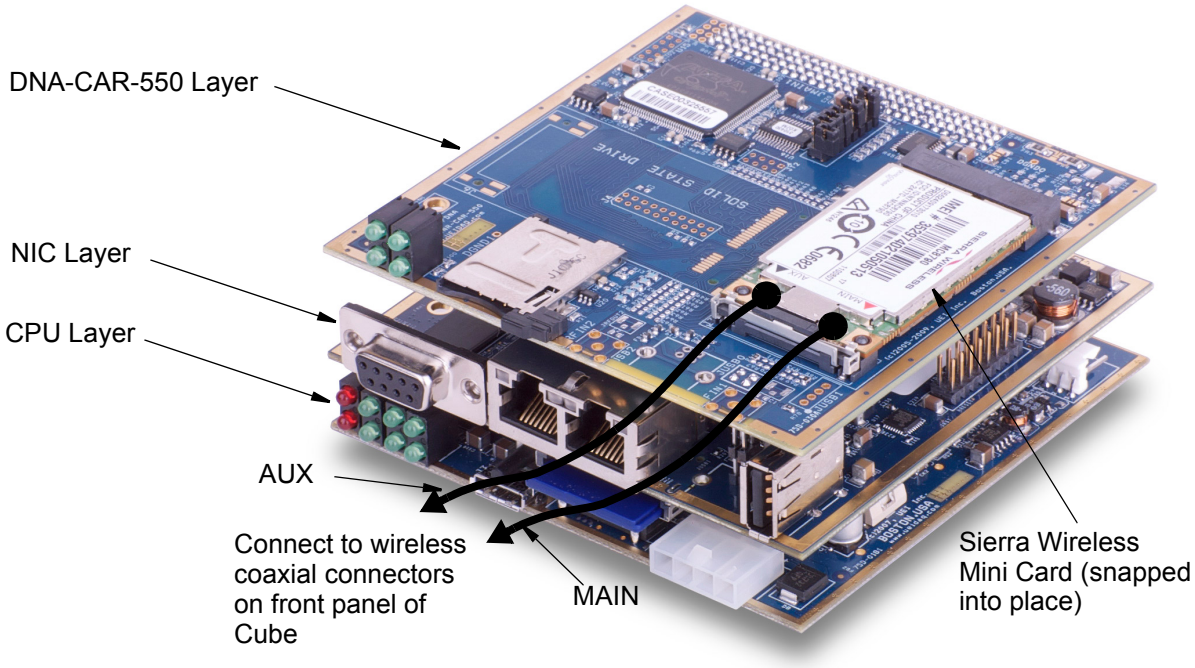

Figure 1-3. CAR-550, UEIPAC NIC, and PPCx-CPU Assembly

1.3 Functional Description

The purpose of the DNA-CAR-550 is to provide an industry-standard wireless interface between UEI UEIPAC GigE-based programmable automation controllers and the Internet. The CAR-550 accepts a standard PCI Express Mini Card that is compatible with a wide range of COTS cell, WIFI, and other communication cards, some of which include a direct GPS interface. Note that only Mini Cards that are based on the USB 2.0 interface are supported by the CAR-550 board.

The USB connection of the Mini Card is connected directly to the USB port of the UEIPAC Cube. The minicard driver is part of the Linux kernel; UEI only supports minicards that are supported by default in Linux. No need for a user to hunt for proprietary drivers.

The CAR-550 provides a slot and reader for the standard SIM/UIM identity cards commonly provided by network suppliers. The card may be inserted through the front panel of the UEIPAC, which allows the user to add or modify service without having to open the UEIPAC housing.

External RF connections are provided through two standard SMA coaxial. connectors. RPSMA connectors can also be supplied as an option. The coaxial connectors for the antenna are mounted directly on the front panel of the Cube and are connected directly to the Mini Card by flexible leads, as shown in **Figure 1-3**. These connectors can be used to connect to various antennas for Cell, WiFi, or GPS devices.

Four annunciator LEDs are provided. One is lit whenever power is on.The others are controlled by the three LED indicator control pins that are standard with PCI Express Mini Cards.

The CAR-550 not only provides simple, direct connections to a wide range of Cell/CDMA/GSM and WiFi networks, but also enables direct connection to the satellite GPS system.

A functional block diagram of the CAR-550 is illustrated in **Figure 1-4** below.

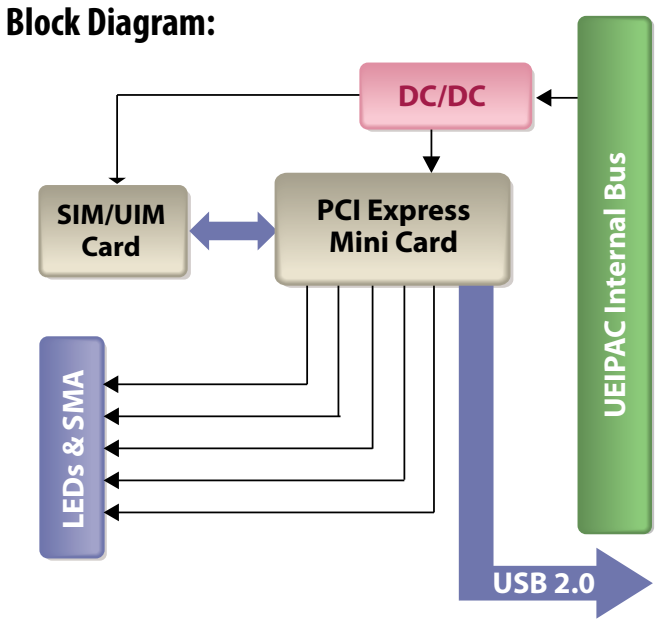

Figure 1-4. Block Diagram of DNA-CAR-550

1.4 Specifications

The following table lists the technical specifications of the CAR-550 board.

Technical Specifications:

Carrier card type	PCI Express Mini Card that utilize the USB Interface
SIM/UIM card interface	Accepts standard cards from Cell carrier. May be installed from outside of chassis
Communications interface	USB 2.0
Indicator LEDs	4 provided (1 indicates power is on, 3 are controlled by PCI Express Mini Card)
RF connectors	2
RF connector type	Standard SMA connector Optional RPSMA connectors also available
Power dissipation	< 1 W, not including PCI Express Card
Operating Temp. Range	Tested -40 to +85 °C
Operating Humidity	95%, non-condensing
Vibration *IEC 60068-2-6* *IEC 60068-2-64*	5 g, 10-500 Hz, sinusoidal 5 g (rms), 10-500 Hz, broad-band random
Shock *IEC 60068-2-27*	50 g, 3 ms half sine, 18 shocks @ 6 orientations 30 g, 11 ms half sine, 18 shocks @ 6 orientations
MTBF	300,000 hours

1.5 What is PCI Express

PCI Express is an extension of the PCI bus standard that greatly increases the bandwidth, range of platforms, and form factors of devices on which it can be used. It is backward-compatible with old PCI applications but also capable of handling a much wider variety of current and future systems such as desktop, mobile, server, communications, workstations, and embedded devices.

1.6 SIM Card

A subscriber identity module (SIM) on a removable SIM card securely stores the service-subscriber key (IMSI) used to identify a subscriber on mobile telephony devices such as computers and mobile phones. The SIM card allows users to change phones (and providers) by simply removing the SIM card from one mobile phone and inserting it into another mobile phone or broadband telephony device.

A SIM card contains its unique serial number, international unique number of the mobile user (IMSI), security authentication and ciphering information, temporary information related to the local network (also temporary local id that has been issued to the user), a list of the services the user has access to and two passwords (PIN for usual use and PUK for unlocking).

SIM cards are available in two standard sizes. The first is the size of a credit card (85.60 mm × 53.98 mm x 0.76 mm). The newer, more popular miniature version has a width of 25 mm, a length of 15 mm, and a thickness of 0.76 mm. However, most SIM cards are still supplied as a full-sized card with the smaller card held in place by a few plastic links; it can easily be broken off to be used in a phone that uses the smaller SIM

1.7 USB 2.0

The USB 1.0 specification was introduced in 1996.for the purpose of making it easy to connect external devices to PCs by replacing the multitude of connectors at the back of PCs, addressing the usability problems of existing interfaces, and to simplify software configuration of all devices connected to the bus, as well as to permit greater bandwidth for external devices. The original USB 1.0 specification had a data transfer rate of 12 Mbit/s.

The USB 2.0 specification, which specifies a higher data transfer rate than the USB 1.0 specification (480 Mbit/s vs.12 Mbit/s) was released in April 2000 and was standardized by the USB-IF at the end of 2001.

1.8 Wiring & Connectors

Since the CAR-550 is a wireless device, no external connections, (except the antennas) are provided for the layer. All non-wireless interconnection between the CAR-550 and other devices is handled within the Cube housing via the interlayer bus.

1.9 Inserting the PCI Express Mini Card

The recommended procedure for inserting a PCI Express Mini Card into the receptacle on the CAR-550 is as follows:

STEP 1: Remove power from the UEIPAC and place it on a clean surface.

STEP 2: Remove the four retaining screws from the front panel of the UEIPAC Cube.

STEP 3: Pull the stack of boards out of the front of the UEIPAC.

STEP 4: Locate the receiving connector for the Mini Card on the top of the CAR-550 board. As shown in **Figure 1-5**, insert the PCI Express Mini Card into the receiving receptacle and then snap the card into place on the board.

STEP 5: Snap the connectors on the antenna leads onto the color coded MAIN and AUX posts on the Sierra Wireless Card (See **Figure 1-3** on page 3). Carefully align the boards with the grooves in the UEIPAC housing and then reinsert the stack of boards into the housing.

STEP 6: Insert the four screws for the front plate into the housing and then reconnect power, antennas or coaxial cables, if used, and USB cables, if any.

STEP 7: Insert your SIM card and lock into place by sliding the locking tab on the SIM Card Reader to the left.

STEP 8: Turn on power and verify that the proper LEDs are lit.

This completes the assembly procedure. Refer to Chapter 2 for the startup procedure for connecting the UEIPAC to the Internet via the CAR-550.

To remove the Mini Card, follow Steps 1 through 3 above and then pull the two retaining springs on the Mini Card receptacle away from the card until it releases. Remove the antenna leads from the Mini Card and then remove the card from its mating connector. Then follow Steps 5 and 6 above. This completes the procedure.

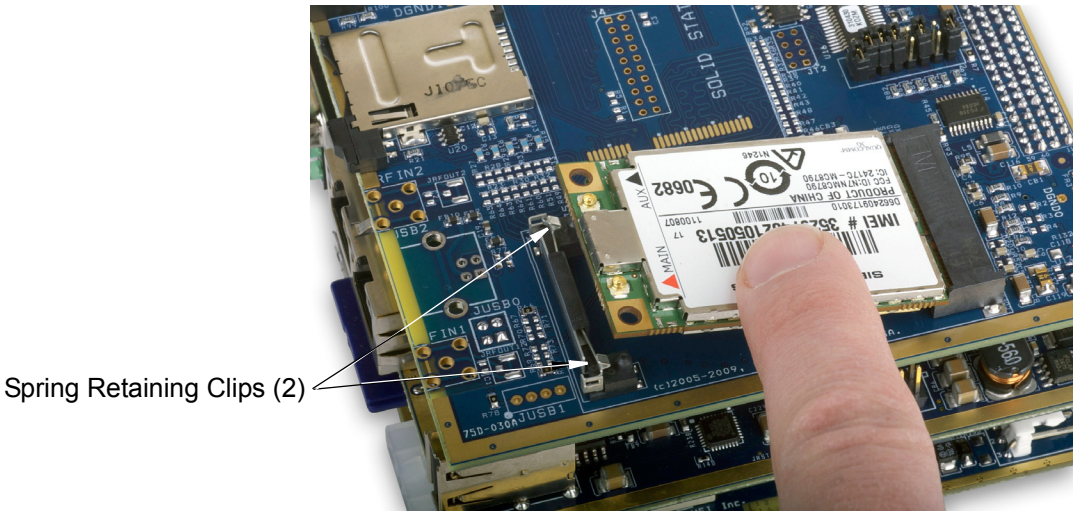

Figure 1-5. Inserting/Removing PCI Express Mini Wireless Card

Chapter 2 Connecting to the Internet with CAR-550

2.1 Configuring Your PCI Express Mini Card

The CAR-550 is a carrier card for PCI Express Mini Cards. Those mini cards can interface with a host using either PCI Express or USB 2.0 connectivity.

The CAR-550 only gives access to the USB 2.0 connectivity. It connects the PCI Express mini card USB pins to the USB host port on the CPU layer.

Although you can use the CAR-550 with various types of PCI Express mini cards, this manual focuses on using a Sierra wireless MC8790 card that offers UMTS/HSPA and quad-band GSM/GPRS/EDGE network access for roaming on high-speed networks worldwide.

Note that CAR-550 is only supported by the UEIPAC.

2.1.1 Prerequisites

You need to purchase a data plan with a cell phone provider that supports UMTS and/or GSM/GPRS. ATT and T-Mobile provide such a service in the USA.

Once you purchase a data plan, you will receive a SIM card that you need to insert in the CAR-550 before being able to establish a connection.

Don't forget to activate your account as soon as you receive your SIM card (usually done over the phone or on-line).

2.1.2 Manual Configuration

From the UEIPAC point of view, the wireless modem is seen as a serial port to which it can send Hayes AT commands as if it were an old fashioned RTC modem.

UEIPAC uses the PPP software to control the modem and configure a network connection with your phone provider.

2.1.3 Load Kernel Modules

At the command line prompt, type the following commands:

```
modprobe sierra
modprobe ppp
```

You should see the following messages printed on the console:

```
~ # modprobe sierra
usbcore: registered new interface driver usbserial
usbserial: USB Serial Driver core
USB Serial support registered for Sierra USB modem
sierra 1-1:1.0: Sierra USB modem converter detected
usb 1-1: Sierra USB modem converter now attached to
ttyUSB0
sierra 1-1:1.1: Sierra USB modem converter detected
usb 1-1: Sierra USB modem converter now attached to
ttyUSB1
sierra 1-1:1.2: Sierra USB modem converter detected
usb 1-1: Sierra USB modem converter now attached to
ttyUSB2
sierra 1-1:1.3: Sierra USB modem converter detected
usb 1-1: Sierra USB modem converter now attached to
ttyUSB3
sierra 1-1:1.4: Sierra USB modem converter detected
usb 1-1: Sierra USB modem converter now attached to
ttyUSB4
sierra 1-1:1.5: Sierra USB modem converter detected
```

```
usb 1-1: Sierra USB modem converter now attached to
ttyUSB5
sierra 1-1:1.6: Sierra USB modem converter detected
usb 1-1: Sierra USB modem converter now attached to
ttyUSB6
usbcore: registered new interface driver sierra
sierra: v.1.3.2:USB Driver for Sierra Wireless USB
modems
~ # modprobe ppp
PPP generic driver version 2.4.2
```

2.1.4 Configure Provider

The system is pre-configured to connect to ATT network. If you are using a different provider, edit the file /etc/ppp/peers/gsm_chat

Look for the following line:

```
OK     'AT+CGDCONT=1,"IP","ISP.CINGULAR"'
```

Replace it with the APN (Access Point Name) of your provider.

For example, T-mobile's APN is "**epc.tmobile.com**", so the line in /etc/ppp/peers/gsm_chat becomes:

```
OK     'AT+CGDCONT=1,"IP","EPC.TMOBILE.COM"'
```

2.1.5 Start PPP Daemon

Issue the following command to start the PPP daemon and configure the network connection.

```
/etc/init.d/pppd start
```

After a few seconds, the script will return printing the message "[OK]" if it successfully configured the network connection or "[Failed]" if it did not.

```
~ # /etc/init.d/pppd start
Starting pppd...PPP BSD Compression module registered
PPP Deflate Compression module registered[  OK  ]
```

In case of failure, type the command "`dmesg`" to print the log and send that information to UEI technical support.

Type the command "`ifconfig`" to print the network connections currently configured on your UEIPAC. There should be three connections: **local**, **eth0** and **ppp0**.

```
eth0      Link encap:Ethernet
HWaddr 00:0C:94:00:C5:CB  inet addr:192.168.100.2
Bcast:192.168.100.255  Mask:255.255.255.0
UP BROADCAST RUNNING MULTICAST  MTU:1500
Metric:1RX packets:0 errors:0 dropped:0 overruns:0
frame:0  X packets:0 errors:0 dropped:0 overruns:0
carrier:0  collisions:0 txqueuelen:1000
RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)
          Base address:0x4000

lo Link encap:Local Loopback
         inet addr:127.0.0.1  Mask:255.0.0.0
         UP LOOPBACK RUNNING  MTU:16436  Metric:1
RX packets:0 errors:0 dropped:0 overruns:0   frame:0 X
packets:0 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:0
```

```
RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)
ppp0      Link encap:Point-to-Point Protocol
          inet addr:166.203.211.199
P-t-P:10.64.64.64  Mask:255.255.255.255
UP POINTOPOINT RUNNING NOARP MULTICAST
MTU:1500  Metric:1 RX packets:14 errors:0 dropped:0
overruns:0 frame:0 TX packets:15 errors:0 dropped:0
overruns:0 carrier:0 collisions:0 txqueuelen:3
RX bytes:182 (182.0 B)  TX bytes:257 (257.0 B)
Make sure that ppp0 was assigned an IP address.
```

You can now connect to the internet from your UEIPAC.

2.1.6 Automatic Startup

To automatically load the kernel modules, edit the file **/etc/modules** and add the following lines at the end of the file:

```
sierra
ppp
```

To automatically start the **ppp daemon**, add a symbolic link to **/etc/init.d/pppd** in the directory **`/etc/rc.d`** with the following command:

```
ln -s /etc/init.d/pppd /etc/rc.d/S30pppd
```

2.2 Connecting to a Wifi Network with CAR-550

The UEIPAC comes with drivers for Wifi network usb interfaces that use the following chipsets:

- Realtek RTL8187
- Ralink RT2570, RT2571

To connect a CAR-550 to a WiFI network, use the following procedure:

2.2.1 Load Kernel Modules

At the command line prompt, type one of the following commands depending on the wifi chipset you are using:

```
modprobe rtl8187
modprobe rt200xusb
modprobe rt2500usb
modprobe rt73usb
```

Wifi network interface are names **wlan0, wlan1,** etc…

The **iwconfig** utility is used to configure wifi communication parameters.

You can verify that your interface was properly detected by typing the command **iwconfig.**

A new entry **wlan0** should appear:

```
lo        no wireless extensions.
eth0      no wireless extensions.
eth1      no wireless extensions.
wmaster0  no wireless extensions.
wlan0     IEEE 802.11bg  ESSID:""
          Mode:Managed  Frequency:2.412 GHz
          Access Point: Not-Associated
          Tx-Power=0 dBm
```

```
Retry min limit:7   RTS thr:off
Fragment thr=2352 B
Encryption key:off
Power Management:off
Link Quality:0  Signal level:0
Noise level:0
Rx invalid nwid:0  Rx invalid crypt:0
Rx invalid frag:0
Tx excessive retries:0  Invalid misc:0
Missed beacon:0
```

2.2.2 Connect to an Open Access Point

Specify that you want to connect as a client to a network with an access point:

```
iwconfig wlan0 mode managed
```

STEP 1: Set the ESSID of the access point:

```
iwconfig wlan0 essid <name of your access point>
```

STEP 2: Bring up the wifi interface:

```
ifconfig wlan0 up
```

You can now scan the access points accessible by your wifi interface:

```
iwlist wlan0 scan
```

If there is a DHCP server on your network, get an IP address for your wifi interface:

```
udhcpc –i wlan0 –s /etd/udhcpc/default.script
```

Otherwise, assign a static IP address to your wifi interface:

```
ifconfig wlan0 192.168.100.3 netmask 255.255.255.0
route add default gateway 192.168.100.1
```

2.2.3 Connect to an Access Point with WEP Security

The procedure is almost identical to connecting to an open access point. In addition, you need to specify your WEP key, as follows:

```
iwconfig wlan0 key <WEP key in hexadecimal>
```

128 bit WEP uses 26 hex characters, 64 bit WEP uses 10

2.2.4 Connect to an Access Point with WPA/ WPA2 Security

Generate the pre-shared key using the access point's password:

```
wpa_passphrase <name of your access point>
<access point password>
```

Edit the file **/etc/wpa_supplicant.conf** and update the **ssid** and **psk** entry to match the key generated by **wpa_passphrase**

```
ctrl_interface=/var/run/wpa_supplicant
ctrl_interface_group=0
```

```
ap_scan=1

network={
    ssid=<put your access point ESSID here>
    proto=WPA
    key_mgmt=WPA-PSK
    pairwise=TKIP
    group=TKIP
    psk=<put your pre-shared key generated with
    wpa_passphrase here>
    priority=2
}
```

Specify that you want to connect as a client to a network with an access point in managed mode:

```
iwconfig wlan0 essid <name of your access point>
mode managed
```

Run **wpa_supplicant** in daemon mode to authenticate with the access point:

```
wpa_supplicant –iwlan0 –c/etc/wpa_supplicant.conf –
Dwext –B
```

Run **iwconfig** to verify that the authentication worked:

```
wlan0     IEEE 802.11bg  ESSID:"fred"
Mode:Managed  Frequency:2.447 GHz  Access Point:
00:13:10:AA:FA:10
         Bit Rate=1 Mb/s   Tx-Power=27 dBm
          Retry min limit:7   RTS thr:off
          Fragment thr=2352 B
          Encryption key:B507-40C4-9A48-806D-D664-
910F-B354-6CF4-DEBF-EA54-CE6F-B291-BD0E-593F-BFA9-
405D [2]   Security mode:open
          Power Management:off
          Link Quality=80/100  Signal level:-31 dBm
          Rx invalid nwid:0  Rx invalid crypt:0
          Rx invalid frag:0
          Tx excessive retries:0  Invalid misc:0
          Missed beacon:0
```

If there is a DHCP server on your network, get an IP address for your wifi interface:

```
udhcpc –i wlan0 –s /etc/udhcpc/default.script
```

Otherwise, assign a static IP address to your wifi interface, as follows:

```
ifconfig wlan0 192.168.100.3 netmask 255.255.255.0
route add default gateway 192.168.100.1
```

Chapter 3 Programming with the Low-Level API

The low-level API offers direct access to PowerDNA DaqBIOS protocol and allows you to access device registers directly.

Please refer to the `API Reference Manual` document under:

`Start » Programs » UEI » PowerDNA » Documentation`

for pre-defined types, error codes, and functions for use with this board.

NOTE: High-level UEI Framework support for this layer is not available in the current release of the CAR-550 board.

At present, only one low-level function is available for use with the CAR-550 board, as described below:

3.1 Low-Level DqAdv Functions

DqAdvSetWirelessState( )

- **Syntax**:
  `DqAdvSetWirelessState(int hd, int devn, uint32 cmd, uint32 data)`

- **Command**:

DQE

Input	
int hd	Handle to the IOM received from DqOpenIOM()
int devn	Layer inside the IOM
uint32 cmd	What parameter to set
uint32 data	Value depending on cmd parameter. If cmd is DQ_CAR550_WIRELESS_EN_DIS, data is 32-bit value to enable or disable wireless system. Zero to disable wireless, non-zero to enable.
Output	None
Return	
DQ_ILLEGAL_HANDLE	Illegal IOM Descriptor or communication wasn't established.
DQ_BAD_DEVN	Device indicated by devn does not exist or is not a CAR-550.
DQ_SEND_ERROR	Unable to send the Command to IOM.
DQ_TIMEOUT_ERROR	Nothing is heard from the IOM for Time out duration.
DQ_IOM_ERROR	Error occurred at the IOM when performing this command.
DQ_SUCCESS	Successful completion.
Other negative values	Low level IOM error.

- **Description**:

This function is used to enable or disable the wireless interface installed on a CAR-550.

- **Note**:

None.

Appendix

A. Accessories

This appendix provides a list of accessories typically used with CAR-550 carrier board(s). They are all available from a number of suppliers.

- **PCI Express Mini Cards**
- **SIM/UIM Cards**
- **Coaxial Cables with SMA or RPSMA (reverse polarity) connectors**

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