# Skywire™ BeagleBone Cape Lite Data Sheet

**NimbeLink Corp**

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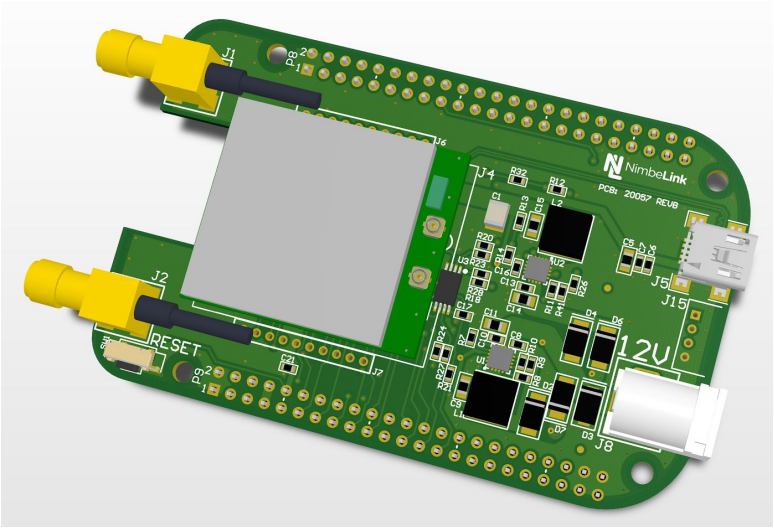


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# 1. Introduction

## 1.1 Overview

This document is the data sheet for the Skywire™ BeagleBone Cape Lite Development Kit. Throughout the document Skywire™ BeagleBone Cape Lite Development Kit will often be referred to as "the cape", although it may be referred to by its full name.

The NimbeLink Skywire™ modem is available with bundled data plans from leading cellular carriers. Visit Go.Nimbelink.com for cellular data plan details.

The Skywire™ cellular modem and antennas are sold separately.

Make sure you check the Nimbelink's Skywire™ Beaglebone Cape Lite product page for the most up to date information.

## 1.2 Product Description

The Skywire™ BeagleBone Cape Lite is a cape that allows easy access to the Internet of Things (IoT) via cellular connection. BeagleBone Black and BeagleBone Green are low-cost, community-supported development platforms that allows quick, easy application development. They accepts plug-in boards called “capes” that allow a wide variety of expanded capabilities. The Skywire™ BeagleBone Cape Lite supports any of NimbeLink’s end-device certified Skywire™ plug-in cellular modems with optional bundled, no-contract cellular plans and in addition to cellular connectivity offers:

- Wide power supply input 5V-12V
- Compatible with: BeagleBone Black, BeagleBone Black Wireless BeagleBone Black Industrial, and BeagleBone Green
- BeagleBone Green Wireless can be used with additional standoffs
- Two user populatable Grove sensor interface for unlimited sensor flexibility

Fast, easy prototyping made possible by the Skywire™ BeagleBone Cape Lite.

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## 1.3 Orderable Parts

| Number | Description | Manufacturer | Carrier | Network Type |
|---|---|---|---|---|
| NL-AB-BBCL | Skywire™ BeagleBone Cape Lite Development Kit | Nimbelink | | |
| NL-SW-LTE-SVZM20-ES | Skywire™, 4G LTE CAT M1, Verizon, Engineering Sample | Nimbelink | Verizon | 4G LTE |
| NL-SW-LTE-GELS3-C | Skywire™, 4G LTE CAT 1, Verizon | Nimbelink | Verizon | 4G LTE |
| NL-SW-LTE-WM14 | Skywire™, 4G LTE CAT 1, AT&T, T-Mobile | Nimbelink | AT&T, T-Mobile | 4G LTE |
| NL-SW-LTE-TSVG | Skywire™, 4G LTE CAT 3, w/ GNSS, Verizon | Nimbelink | Verizon | 4G LTE |
| NL-SW-LTE-TNAG-B | Skywire™, 4G LTE CAT 3, w/ GNSS, AT&T, T-Mobile | Nimbelink | AT&T, T-Mobile | 4G LTE |
| NL-SW-LTE-S7588-T | Skywire™, 4G LTE CAT 4, AT&T, T-Mobile | Nimbelink | Verizon | 4G LTE |
| NL-SW-LTE-S7588-V | Skywire™, 4G LTE CAT 4, Verizon | Nimbelink | AT&T, T-Mobile | 4G LTE |
| TG.08.0113 | Monopole Cellular Antenna | Taoglas | | |
| TG.30.8113 | Dipole Cellular Antenna | Taoglas | | |

## 1.4 Additional Resources

- Nimbelink's Skywire™ Beaglebone Cape Lite Product Page
- Nimbelink's Skywire™ Beaglebone Cape Lite Device Tree Overlay
- Nimbelink's Skywire™ Beaglebone Cape Lite Schematic
- Nimbelink's Skywire™ Beaglebone Cape Lite Design Files


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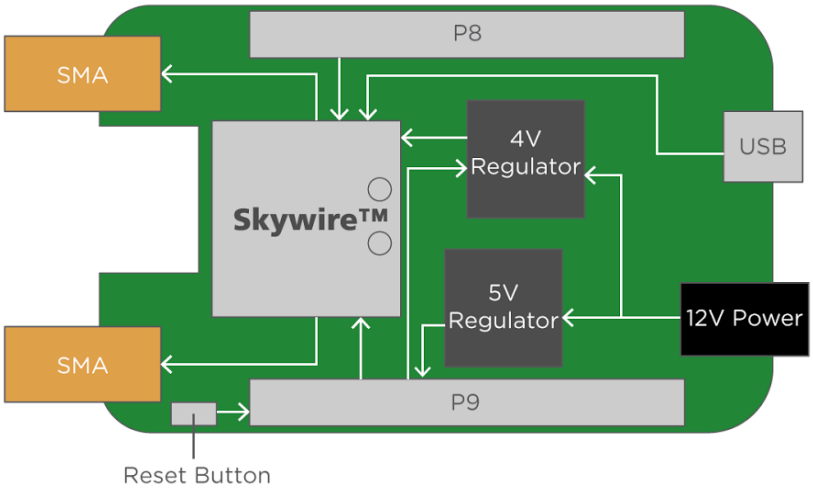
# 2. Technical Specifications

## 2.1 Block Diagram





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## 2.2 Pinout

The cape can use up to 19 GPIO in addition to the GND and VCC connections on the P8 (J10) and P9 (J13) headers.

| PIN Name | Direction | GPIO Name | Connection | Notes |
|---|---|---|---|---|
| P9-11 | Output | UART4_RXD | Skywire™ DOUT | |
| P9-13 | Input | UART4_TXD | Skywire™ DIN | |
| P8-33 | Input | UART4_RTS | Skywire™ RTS | |
| P8-35 | Output | UART4_CTS | Skywire™ CTS | |
| P9-12 | Input | GPIO1_28 | Skywire™ DTR | |
| P9-15 | Input | GPIO1_16 | Skywire™ Reset | |
| P9-27 | Input | GPIO3_19 | Skywire™ ON-OFF | |
| P9-23 | I/O | GPIO1_17 | Skywire™ ADC | Not configured by DTO, not connected |
| P9-22 | I/O | UART1_RXD | Skywire™ DIO2 | Not configured by DTO, not connected |
| P9-24 | I/O | UART1_TXD | Skywire™ DIO3 | Not configured by DTO, not connected |
| P8-17 | Input | GPIO_0_27 | 4V Regulator Enable | |
| P8-26 | Output | GPIO1_29 | 4V Regulator PG | |
| P8-38 | Output | UART5_RXD | Grove UART5 RX | Not configured by DTO |
| P8-37 | Input | UART5_TXD | Grove UART5 TX | Not configured by DTO |
| P9-17 | Input | I2C1_SCL | Grove I2C1 SDA | Not configured by DTO |
| P9-18 | I/O | I2C1_SDA | Grove I2C1 SCL | Not configured by DTO |
| P9-19 | Input | I2C2_SCL | I2C2 SCL | |
| P9-20 | I/O | I2C2_SDA | I2C2 SDA | |
| P9-25 | Input | GPIO3_21 | EEPROM WP | Default Pulled High |


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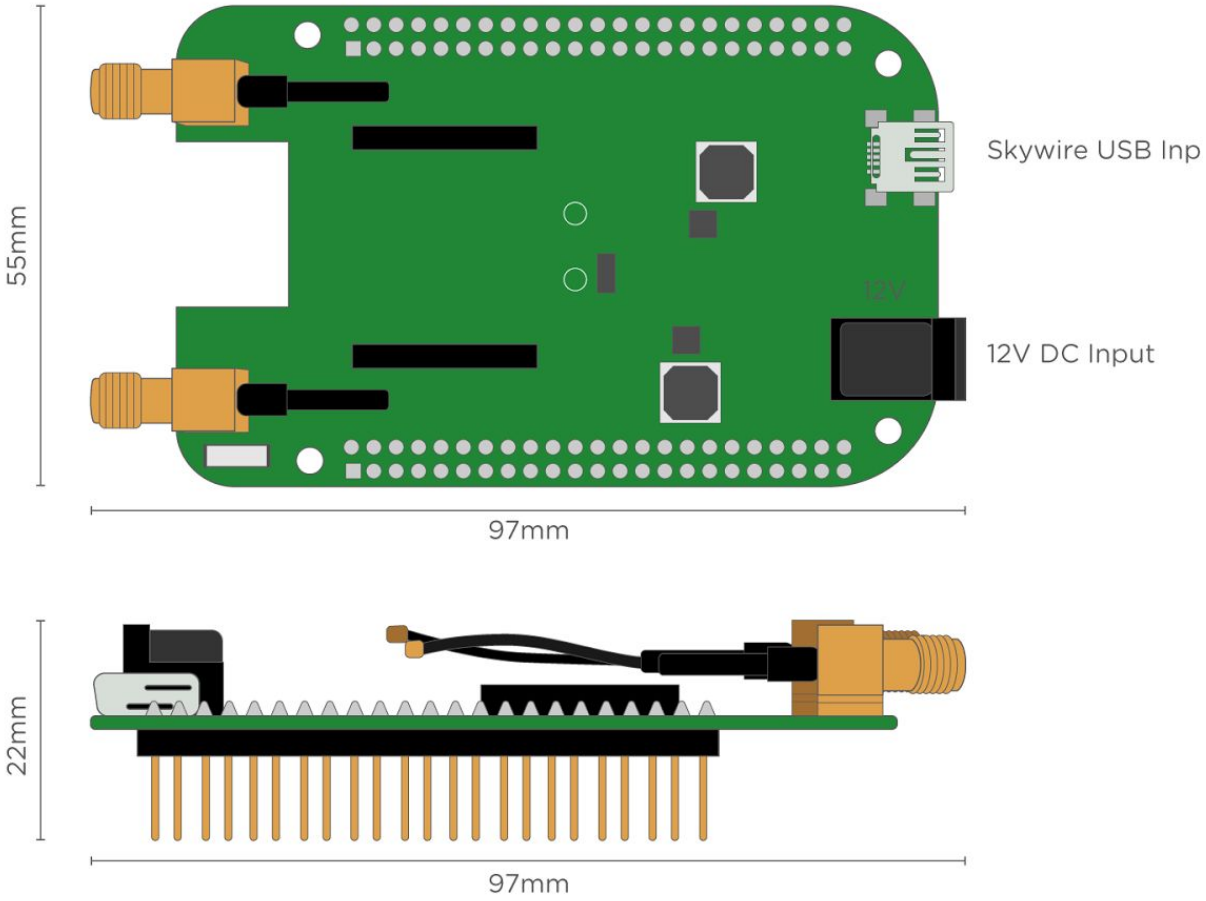
## 2.3 Mechanical Specifications

| Mechanical Specifications | |
|---|---|
| **Parameter** | **Value** |
| Mechanical Size | 97x55x22mm |
| PCB Layers | 4 |
| PCB Thickness | 1.6mm |
| RoHS | Yes |





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## 2.4 Electrical Specifications

| Electrical Specifications | | | | |
|---|---|---|---|---|
| **Parameter** | **Min** | **Typ** | **Max** | **Unit** |
| J8 Input Voltage | 6 | 12 | 15 | V |
| J8 Current Requirements | 1.6 | 1.6 | | A |
| VDD_5V Current Requirements (if powered by Beaglebone) | 1.5 | 2 | | A |
| VDD_5V_SYS | 0 | 0 | | A |
| VCC_3V3 | 3 | 4 | | mA |

## 2.5 Beaglebone Compatibility

NimbeLink's Skywire™ BeagleBone Cape has been designed to be drop in compatible with the following Beagle Bones:

- BeagleBone Black
- BeagleBone Black Wireless
- BeagleBone Black Industrial
- BeagleBone Green

Users using the BeagleBone Green Wireless will need to use stand off headers to provide additional clearance over the BeagleBone Green Wireless USB connectors. Nimbelink recommends the following stand-off headers:

- Adafruit 706
- Major League Electronics SSHQ-123-D-08-GT-LF

Users will need to ensure they have updated their device tree to the latest version to ensure the cape's device tree overlay (DTO) has been installed.

## 2.6 Power Requirements

The cape's primary power path is through the cape's DC barrel jack (J8). The cape will accept a DC input of 6-15V. Nimbelink recommends using a 12V DC 1.6A supply such as the CUI Inc. SWI18-12-N-P6. When using the primary power input on the cape an onboard DC switching regulator will supply 5V/2A to the attached BeagleBone.

If 12V is not available the cape can draw from the VDD_5V pins on P9 to power the Skywire™. This feature is available for BeagleBones that connect the 5V barrel jack to the VDD_5V pins such as the Beaglebone Black and BeagleBone Black Wireless. Users using the Beaglebone Green will need to power the cape through the 12V interface as the Beaglebone green does not connect the 5V USB input to the VDD_5V pins.

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Due to the amperage limitations of typical USB ports, the cape should not be powered from a PC's USB port. The available power is insufficient to power most Skywire™ modems, which can cause damage and void the warranty.

## 2.7 Antenna Specifications

The SMA connectors are connected to the PCBs ground plane, This allows for mono-pole antennas, such as a Taoglas TG.08.0113, to be used.

For optimum performance a dipole antenna, such as a Taoglas TG.30.8113 antenna, is recommended.

## 2.8 Features

Nimbelink's Skywire™ Beaglebone Black Cape is designed to be a low cost, adaptable cellular gateway for the BeagleBone development platforms. The cape enables diverse connectivity options by including a Skywire™ Cellular Modem socket for cellular/GPS connections, allowing users to use any of Nimbelink's 2G, 3G, or 4G Skywire™ modems.

### 2.8.1 Skywire™ Cellular Modem

The cape's Skywire™ socket allows for the Skywire™ cellular modem to communicate with the Beaglebone Black development kit over UART or through a USB connection. The Skywire's™ 20-pin form factor allows for compatibility across all of the Skywire™ product line and interchangeability between 2G, 3G, and 4G cellular technologies.

### 2.8.2 Grove Connectors

There are two user populatable Grove Connectors onboard the cape that allow users to attach additional digital Grove compatible sensors. Users will need to order and solder the connectors in place if they wish to use them. Nimbelink recommends using JST's S4B-PH-K-S(LF)(SN).

Grove connector J15 connects to UART5 and connector J16 connects to I2C1. The cape's DTO does not load pin configurations for J15 or J16, but many distributions will automatically configure I2C1 at boot.

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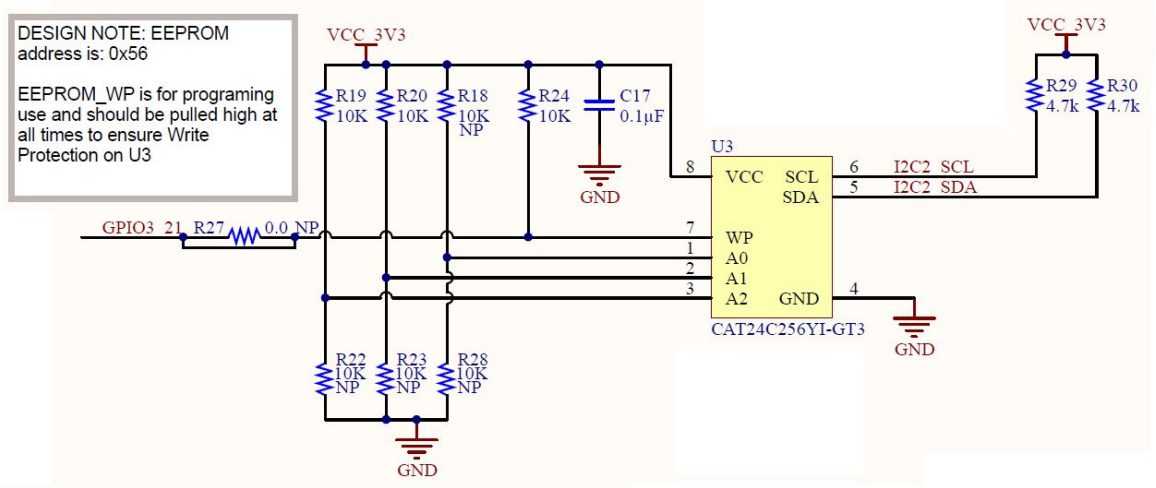
## 2.8.3 EEPROM

The cape has an onboard EEPROM containing the cape's device tree overlay information per the Beaglebone EEPROM Data Format Revision A1. By default the EEPROM has write protection enabled to protect the EEPROM from data corruption, but if users need to modify the EEPROM or would like to use the free space on the EEPROM they can control the WP pin using GPIO3_21. The EEPROM is configured by default to use I2C2 address 0x56.




## 2.8.4 Device Tree Overlay

The cape's onboard EEPROM contains information that will automatically configure the Beaglebone's device tree to enable the cape's required pins. The most recent device tree overlay can be downloaded here. The device tree will automatically configure the following:

| Pin | Configuration | Use | I/O | Initialized Value |
|---|---|---|---|---|
| P9.11 | UART4 RXD | UART4 RXD | I | |
| P9.13 | UART4 TXD | UART4 TXD | O | |
| P8.33 | UART4 RTS | UART4 RTS | O | Low |
| P8.35 | UART4 CTS | UART4 CTS | I | |
| P8.17 | GPIO0_27 | Sky_PWR_EN | O | High |
| P8.26 | GPIO1_29 | Sky_PWR_PG | I | |
| P9.12 | GPIO1_28 | Sky_DTR | O | Low |
| P9.15 | GPIO1_16 | Sky_Reset | O | Low |
| P9.25 | GPIO3_21 | EEPROM_WP | O | High |
| P9.27 | GPIO3_21 | Sky_On_Off | O | High |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