# XBee Guideline

The idea of this guideline is to collect all issues and solutions while operating the XBee nodes. The document should be edited by students, lab assistant, and professor.

## Practical Stuff

### Detecting local XBee modules in XCTU

* no script should run on the Arduino; upload the bare minimum i.e. empty setup and loop
* nothing MUST run on the port: no putty, no Arduino serial monitor, no Arduino script set to this port
* after disconnecting Arduino from the port reconnect the USB cable
* then detect the local device in XCTU

## Basics

### Radio module operating modes

source: http://ftp1.digi.com/support/documentation/html/90001399/90001399\_A/Files/XBee-concepts.html

The operating mode of an XBee radio module establishes the way a user or any microcontroller attached to the XBee communicates with the module through the Universal Asynchronous Receiver/Transmitter (UART) or serial interface.Depending on the firmware and its configuration, the radio modules can work in three different operating modes:

* [AT (transparent) operating mode](http://ftp1.digi.com/support/documentation/html/90001399/90001399_A/Files/XBee-concepts.html" \l "_Toc384719506)
* [API operating mode](http://ftp1.digi.com/support/documentation/html/90001399/90001399_A/Files/XBee-concepts.html" \l "_Toc384719507)
* [API escaped operating mode](http://ftp1.digi.com/support/documentation/html/90001399/90001399_A/Files/XBee-concepts.html" \l "_Toc384719508)

In some cases, the operating mode of a radio module is established by the firmware version, which determines whether the operating mode is AT or API, and the AP setting of the firmware, which determines if the API mode is escaped (AP=2) or not (AP=1).   
In other cases, the operating mode is only determined by the AP setting, which allows you for configure the mode to be AT (AP=0), API (AP=1) or API escaped (AP=2).

The XBee Series 1 (802.15.4) radio module allow setting the AP mode.

### Application Transparent (AT) operating mode

In Application Transparent (AT) or transparent operating mode, all serial data received by the radio module is queued up for RF transmission. When RF data is received by the module, the data is sent out though the serial interface.  
To configure an XBee module operating in AT, put it in AT Command mode to send the configuration commands.

### AT Command mode

When the radio module is working in AT operating mode, settings are configured using the AT Command mode interface.  
To enter AT command mode, you must send the 3-character command sequence through the serial interface of the radio module , usually **+++**, within one second. Once the AT command mode has been established, the module sends the reply **OK\r**, the command mode timer is started, and the radio module can receive AT commands.

The structure of an AT command follows:

AT[ASCII command][Space (optional)] [Parameter (optional)][Carriage return]

Example:

ATNI MyDevice\r

If no valid AT commands are received within the command mode timeout, the radio module automatically exits AT Command mode. You can also exit command mode issuing the CN command (ATCN\r). Take car, the timeout is not very long!!!

A list of AT commands for the XBee 802.15.4 modules is found here: http://examples.digi.com/wp-content/uploads/2012/07/XBee\_802.15.4\_AT\_Commands.pdf

### API operating mode

Application Programming Interface (API) operation mode is an alternative to AT mode. This requires that communication with the module be done through a structured interface; in other words, data is communicated in API frames. For more information about API frames, see [API Frames](http://ftp1.digi.com/support/documentation/html/90001399/90001399_A/Files/XBee-concepts.html" \l "_Toc384719510).

The API specifies how commands, command responses, and module status messages are sent and received from the module using the serial interface. API operation mode enables many operations such as the following:

* Configuration of the XBee module itself.
* Configuration of remote modules in the network.
* Data management and transmission to multiple destinations.
* Receive success/failure status of each transmitted RF packet.
* Identify the source address of each received packet.

Depending on the AP parameter value, the radio module can operate in one of two modes: API (AP=1 ) or API escaped (AP=2) operating mode.

### API escaped operating mode

API escaped operating mode (AP = 2) works similarly to API mode. The only difference is that when working in API escaped mode, some bytes of the API frame specific data must be escaped.

API escaped operating mode is used to add reliability to the RF transmission avoiding conflicts with special characters such as the start-of-frame byte (0x7E). Since 0x7E can only appear at the start of an API packet, if 0x7E is received at any time, it can be assumed that a new packet has started regardless of length. In API escaped mode, those special bytes are escaped.

## XCTU

* The XCTU software can be used to configure the XBee Modules