

How it works

- Radio waves are **electromagnetic radiation**, like light, but with a lower **frequency**. All electromagnetic radiation travels at the **speed of light**, 3.0×10^8 m/s. Radio waves can travel short or long distances depending on the electrical power of the radio transmitter. The micro:bit's can travel about 70 meters in clear space. Look on the back of your micro:bit card, in the upper left corner. Can you find the radio's gold antenna? This is where the radio waves go in and out of the card.
- The micro:bit radio emits and receives radio waves with frequencies ranging from 2402 - 2486 megahertz; this range is called the radio's spectrum, and the micro:bit's is divided into 1 MHz wide bands called **channels**. There are 84 different radio channels, ranging from 0 to 83, on the micro:bit. Two or more micro:bits must share the *same channel to communicate*.
- In addition to the micro:bit radio channels, there is also a software **group**. The group number is part of the message packet used to route the data, similar to TCP/IP **packets** used on the internet. The group is one byte of the packet and ranges from 0 – 255. Two or more micro:bits must share the *same group number to communicate*.
- Text messages are inserted into a packet, which includes routing and error-checking information. The packet is then added to the radio waves in a process called **digital modulation**.
- When a text message in readable characters is sent over the radio, it is called **cleartext**. It is vulnerable to eavesdropping by an unseen hacker listening on the same radio channel and group. This type of hacking is called a "**man-in-the-middle attack**."

What will you do?

1. Organize your team:
 - a. Work in a team with at least two others, each with an TI-84 Plus CE Python calculator and micro:bit.
 - b. *Your teacher will assign your team a radio channel number.* Do not change the group number.
 - c. Each group member chooses a sender, receiver, or hacker role.
2. Send a text message:
 - Ensure all group members use the same assigned group number.
 - The **receiver**
 - Open '**recv_1.py**,' change the channel to your assigned number, and run the program **before** the sender has run theirs.
 - The **sender**
 - Open '**send_1.py**,' edit the message string, change the channel to your assigned number, and run your program **after** the receiver and hacker have started theirs.
 - The **hacker**
 - Open '**hack_1.py**,' change the channel to your assigned number, and run the program **before** the sender has run theirs.
 - After your team runs the activity, the sender should change their program to a different channel number (0-83) and also change their message. The sender should whisper the new channel to the receiver, who should then change their program to the same channel number. Don't tell the hacker; **keep it private!** Then, rerun the activity. Does the hacker get the new message? Can you explain why?

Code it

Sender role

```

EDITOR: SEND_1
PROGRAM LINE 0001
from microbit import *
from mb_radio import *
# Length must be greater than
# longest msg.
# Channel and group must be
# the same for two cards to
# communicate.
radio.on()
disp_clr()
radio.config(length=250, channel
            =12,power=6,group=1)
Fns... a A # Tools Run Files

```

Receiver role

```

EDITOR: RECV_1
PROGRAM LINE 0001
from microbit import *
from mb_radio import *
# Length must be greater than
# longest msg.
# Channel and group must be
# the same for two cards to
# communicate.
radio.on()
disp_clr()
radio.config(length=250, channel
            =12,power=6,group=1)
Fns... a A # Tools Run Files

```

Hacker role

```

EDITOR: HACK_1
PROGRAM LINE 0001
from microbit import *
from mb_radio import *
# Length must be greater than
# longest msg.
# Channel and group must be
# the same for two cards to
# communicate.
radio.on()
disp_clr()
radio.config(length=250, channel
            =12,power=6,group=1)
Fns... a A # Tools Run Files

```

Go further

- Try a different role in your group.
- Include another group of students and make a large group text.
- Try the activity with the same channel number but a different group number.

Check your understanding

- The receiver must be listening before the sender transmits the message.
- A radio message can be sent on any combination of the micro:bit's 84 radio channels or 256 radio groups.
- For micro:bits to communicate, they must be on the same channel and group.
- Messages sent in cleartext over a known channel and group can be hacked.
- Using a secret channel or group can help to prevent hacking.

Help

- Check that everyone in the group is on the same channel and group numbers.
- Ensure the receiver and hacker run their programs and wait before the sender transmits the message.

Files

- Transfer the activity files below to your calculator using the TI Connect CE Software. The link to download is [here](#). The best practice is to load all files for this cybersecurity activity and then delete them before loading the next set of activity files. This helps keep your calculator organized.

Name	Description
send_1.py	Sends a text message to the receiver.
recv_1.py	Receives a text message from the sender.
hack_1.py	"Man-in-the-middle-attack" between the sender and receiver.