



TUESDAY PM: BEACONS

Lesson Description: Students use the microbit's radio capability to locate the position of other microbits that act as beacons. These "receiver" microbits are able to locate beacons based off of signal strength. This activity explores the topics of CIA, (Confidentiality, Integrity and Availability). We explore confidentiality and integrity by showing students that their messages can be intercepted and seen when somebody is also on their same channel. We touch on integrity by showing students that their messages can be more secure by manually tuning into a different channel that they know is not compromised.

Prerequisite Knowledge: Students should be comfortable with, flashing code to their microbits, opening and editing their code in the microbit editor, coding basics such as conditional statements, loops, variables, and radio capabilities.

Length of Completion: This lesson requires ~1 hour and 45 minutes.

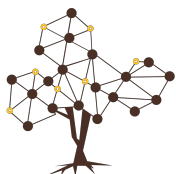
Level of Instruction: Is this lesson intended for high school, middle school, or elementary school. This the lesson appropriate for advanced, intermediate, or beginner learners? This lesson is intended for upper middle school and high school students. This activity is appropriate for all three learners because this activity has multiple levels associated with it, novice, intermediate and expert. Each level has the receiver being updated with more complex features as the levels progress.

Applicable First Principles &/or Concepts: Please select the Principles or Concepts covered in this lesson.

GenCyber First Principles

Domain Separation

Abstraction



Process Isolation

Data Hiding

Resource Encapsulation

Layering

Modularity

Simplicity

Least Privilege

Minimization

GenCyber Cybersecurity Concepts

Defense in Depth

Availability

Confidentiality

Think Like an Adversary

Integrity

Keep it Simple

Resources that are Needed: The resources needed include, the base code for the receivers titled NEW_Base.hex, the base code but in javascript titled NEW_Base.js, and of course a computer, microbit, and cord to flash code to the microbit.

Accommodations Needed:

No special accommodations are needed. Students receive verbal commands and walk around the room to locate beacons.

LEARNING OUTCOMES

LESSON LEARNING OUTCOMES

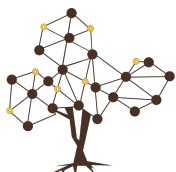
Students will be able to:

Novice

- Describe how signal strength is measured.
- Explain how we determine which signal icon to display
- Explain how we cycle through our wordbank

Intermediate

- Relate the activity to the concepts of confidentiality and integrity.
- Implement a working iterative loop



- Use variables

Expert

- Argue why scanning through channels is easier than manually changing them
- Assemble a short program from scratch, thus, create a scanner
- Explain how to create an efficient scanner
- Create an efficient scanner that captures beacons in a room

LESSON DETAILS

Interconnection: Students understand the hand and apply the concepts.

Assessment: Formative assessment - Instructors walk around and observe students, ask questions, and prompt students to consider how beacons work and how to make them more efficient.

Instructions will be delivered through oral presentation. As activities proceed, leaders make observations on students who are struggling, exceeding expectations, or asking good questions and move students to another group if needed. During the activity leaders address any overarching questions or solve any common issues amongst students.

Extension Activities:

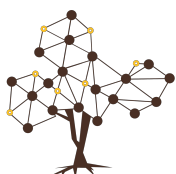
Locate a cell phone - triangulate where a cell phone is located.

Article for review:

<https://www.isemag.com/2017/04/human-network-how-cybercriminals-and-spies-threaten-to-attack-your-remote-cellular-network/>

Differentiated Learning Opportunities:

For the more advanced students, they add extra functionality to the scanner. More specifically, scan through all ten channels and find out which channel had the greatest amount of beacons.



LESSON

Warm Up: Have a cell phone ring for 15 seconds. After the ringing concludes, pose the following question - "Why did only this cell phone ring?" "Have you ever had a strong signal, weak signal, no cell signal?" Do you know why?

Leaders explain the challenge of using their microbits as receivers in order to locate beacons based off of their signal strength. Leaders will then have students plan on paper how they intend to solve and implement their solution.

Lesson: This guided inquiry lab consists of several scaffolded activities that build up to the creation of a radio scanner. In this activity, students build three different receivers that can locate and extract strings from 6 different Beacons.

For each receiver, students use their receiver to locate six (6) different beacons and collect six (6) unique strings. These six (6) unique strings will form a sentence once unscrambled and the students then must report back to you in person with the unscrambled sentence.

Lab Procedure

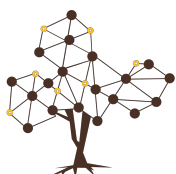
Step 1: Flash the Base Code

Have the students locate the file titled NEW_Base.hex and flash the file to their microbit.

Step 2: Programming

Test the base code. This code should start by displaying a diamond. When you are in range of the beacon, it will show a check mark. Have the students open up the base code in their microbit text editors. The javascript base code is titled NEW_Base.js.

Next, complete the standard receiver. The receiver sets the group to 1, shows a diamond icon to indicate that the receiver is on, determines the strength of a received signal (on a scale from 1 to 5), and displays icons to show how strong the signal is. If a received signal is strong enough to



warrant a 1 then you must store the transmitted word preferably in an array. We must also add functionality to retrieve all the words we've collected so far. Add the following to the base code:

- Display an image for the strongest signal strength (or leave as a check-mark)
- Display an image for the second strongest signal strength
- Display an image for the medium signal strength
- Display an image for the second weakest signal strength
- Display an image for the weakest signal strength (in the else statement)
- Store the transmitted word once achieving the strongest signal, if word has not been read, display the new length of your array of words.
- Use the A+B button input to display all the words you've collected up to that point.

A finished version of this receiver can be found within the files, this file is titled, `NEW_Receiver-1-SameChannel.js` or `NEW_Receiver-1-SameChannel.hex`

Have the students flash this finished receiver hex code and have them find all 6 unique words. The beacons come preloaded with 6 words already, once unscramble the sentence is, "the brown fox ran very fast".

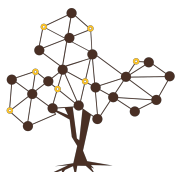
Step 3: Programming the tune-able receiver and modifying beacons

As the instructors, we need to change the words in the word bank on the beacons so that the students can have a new sentence to unscramble. Go into the `NEW_Beacon.js` file and change the words within the array titled, "list" to create a new six word sentence that needs to be unscrambled.

Now that we have a receiver that can check for beacons on channel 1, we now need to be able to control on which channel we are searching on. Use the A button to decrement the channel and B to increment the channel. For this lab we will only be tuning through channels 1-10

Directions that would be useful for students:

- Create a variable called group and initialize it to 1 on start.



- ❑ Create an input blocks for "on button A pressed" and "on button B pressed"
- ❑ In the A button pressed block, if group is greater than zero, set group to group-1 and then set the radio group to group.
- ❑ In the B button pressed block, if group is less than nine, set group to group+1 and then set the radio group to group.
- ❑ At the end of each button block (outside of the if-statement), display the group.

Once students complete this new receiver have them search for all 6 beacons and have them report back to you on what the new unscrambled sentence is.

A finished copy of this receiver can be found within the files and is titled NEW_Receiver-2-Tuner.js.

Step 4: Creating a Scanning Receiver

Once again as the the instructors we will need to change the words located within the word bank to form a new 6 word sentence in the NEW_Beacon.js file and then flash the corresponding hex to all beacons.

For this receiver, we will disregard the icons that are associated with the signal strength. This receiver will simply switch channels every 300 ms and once signal strength in that given channel is stronger than -55 we will display the checkmark icon and add the given word to our found words array if it has not already been added. In addition to adding our word to our array if we haven't seen it, we also need to display the new length of our collected words array. We will need to create a function that updates the channel every 300 ms and this function will only scan from channels 1 - 10. This receiver also needs to include our A+B input that lists off all words we've discovered.

A finished copy of this receiver can be found within the files and the file is titled, NEW_Receiver-3-Scanner.js

Step 5: Advanced challenges

Build a scanner to loop through first 10 channels and display the channel with the highest number of beacons.

