WiFi Lab C

Event Objective: Teams will construct an antenna prior to the tournament that is designed to transmit a signal at 2.4 GHz and complete a written test on the principles of electromagnetic wave propagation.

Equipment Needs:

- Tables for the students taking tests, depending on the maximum number of teams per hour
- A transmitter for connecting student antennas (see WiFi Transmitter Guide and rules for more information)
- A Laptop with inSSIDer or related software for measuring signal strength of 2.4 GHz WiFi signal coming from antenna
- A cart that can hold the laptop and move easily
- A tape measure to determine the distance between the transmitter and the laptop (receiver)
- At least one table for completing scoring
- Caution tape for making an area for the impounding of student devices and charts
- Caution tape for the antenna test area
- Signs that tell spectators “NO CELL PHONE USE IN THE AREA”, “NO COMPUTER/TABLET USE IN THE AREA”, “IMPOUND AREA”, and “SPECTATOR AREA” if the event is run spectator-friendly.

Number of Volunteers Needed:

- One impound/table greeter that can be used as a test volunteer or transmitter volunteer during the day
- One transmitter volunteer
- If possible, another test volunteer who can grade tests during the day as well as score charts
- For the state tournament you will be provided names and contact info for your volunteers and YESS team. It is required that you contact them prior to the tournament to relay any event-specific information.

Prior to the Event:

- Read and re-read the event rules
- Get in contact with tournament director to learn more about competition area and determine the maximum possible distance (the farther the distance, the better, consider gymnasiums, long hallways, or other very long distances).
- Get a copy of the official scoring/check-in worksheet on the national website: www.soinc.org
- Print off enough check in worksheets from the national website to have one sheet per team, plus a
  few extra sheets. If you have time, put the names of the teams on the top of the sheets (one team per
  sheet) and, if you have the times that each team will compete, put the team’s competition

time also
on the top of the sheet.

- Put the team names into the scoring spreadsheet from the national website to save time on competition day.
- Create fake results to test the scoring spreadsheets, including Exam Score, Antenna Successful Connection Distance (m), Chart Score, Impound Bonus (y/n), and Max Distance Bonus (if applicable). Ensure that you know how to properly use the scoring spreadsheet and correct results are created by manually calculating the scores.
- Review event penalties:
    - Devices not impounded have their successful connection distance multiplied by 0.7
    - Devices that are unsafe or will damage the transmitting device are not allowed to be tested
    - Devices that are fixed/corrected from unsafe or damaging to the transmitting device during the five minute testing period have their successful connection distance multiplied by 0.7

The Written Test (Exam Score ES):

- Finalize writing the test well before the competition (if possible) and check it over well. Consider having another person evaluate the test. It should have a mix of easy, medium, and hard questions and tiebreaker questions to separate teams.
    - Be sure to follow the topics in the rules for the test. For 2018, there must be at least five questions from each of the following areas:
        - The Electromagnetic Spectrum, radio waves, and EM wave propagation
        - Relating velocity, wavelength, and frequency for waves, with emphasis on radio waves
        - Common antenna designs, compare/contrast different types of antennas
        - Gain patterns, the radar equation, impedance, bandwidth, noise, and information
    - Have a variety in the difficulty of questions within each topic throughout the test
    - Student competitors must be given a minimum of 20 minutes to complete the written test.
- Aim for the following goals for the written test:
    - There should be no perfect scores or very few perfect scores
    - There should be no zero scores
    - High score in the target range of 75% to 95%
    - Low score is in the target range of 10% - 30%

    - Less than 5% of teams score above 90%
    - Less than 5% of teams score less than 15%
    - Less than 10% of teams are involved in ties
- A good mix of easy, medium, difficult, and extremely challenging problems will often obtain the above results. Also, make sure the test is long enough to separate the "contenders" from the "pretenders"...remember, kids can bring in a binder!
- When scoring the test, the team that earns the highest score on the test earns 45 points. All other team's scores are divided by the highest raw exam score and then multiplied by 45 (rule 6d).

Day of the Competition:

- Show up at your room as early as you can (even the day before if possible)
- Set up the room and WiFi transmitter as early as you can (even the day before if possible)
- Lay out tests, answer sheets, scrap paper, equipment, and ensure you have planned out walkways and lab space
- Provide general instructions on a white/chalkboard or overhead if available
- Cover the plan with all volunteers, including all of their assignments
- Determine the connection threshold dBm reading with the 3.1 cm monopole antenna at a distance of 3.0 m. Do not share this number with student competitors. Student competitors are only informed if their device makes connection at a certain distance or not.

Impounding of Devices:

- Antennas that are impounded in a box receive an Antenna Bonus (AB) of 3 points.
- Students must impound antennas and charts before competition begins during the impound time period. Teams that fail to impound their antennas will have their maximum successful connection distance score multiplied by 0.7
- Tools, supplies, and three-ring binders do not need to be impounded
- Assign at least one individual to impound. It is critical that students avoid stepping on or damaging other devices when checking in OR when retrieving devices for competition
- Have students line up for check-in, first come, first served. Students needing to fix or change their device need to exit the line and go to the end. Anybody in line at the end of the impound window is allowed to impound their device with no penalty, but the students must be IN LINE at the end of the impound window.
- Make sure that the impound area is taped off and not accessible to students, coaches, or spectators. Make sure that student's impounded antennas and charts are in a safe area.

Competition:

- Meet all teams outside the room for final instructions including
    - Turning all cell phones off and clearly explain what happens if a cell phone should go off (the Event Supervisor may ask them to raise their hand and not touch the cell

phone at all)
    - Explain any other policies and if you have assigned seating or what they can do (i.e. can they look at the test)
- Let teams in one at a time
    - Check that they have wristbands if used at your tournament
    - Check that their binders do not have loose material by gently shaking them by the spine to see if anything falls out...if any papers fall out they are not allowed to be used in the exam (especially for state tournament).
    - Allow single team members to enter if they are waiting for their partner
        - Generally a person can show up late to an event, but after the event has started you may not leave and reenter (so if the teammates have to leave, they cannot return)
- Go over the specifics on the test and on how the antenna test will work, answering questions
- Begin the examination period and start whatever timer you will use
    - Always have the exam be a minimum of five minutes less than the allotted session time and be consistent among all sections (i.e. if they are 50 minute sessions, you have a 45 min exam)
- Call up teams one at a time to test their antenna
    - Teams are allowed to send only one person up to do the antenna test to allow the other team member to continue to work on the test or they may both do the antenna test
    - Ensure the team fills out the gray area of the checklist (available from www.soinc.org)
    - Ensure that one volunteer is positioned at the transmitter to help the students (if needed) and one volunteer/lead event supervisor (preferred) is positioned at the receiving laptop keeping an eye on the signal strength.
    - Go over the process with the students:
        - Students start by selecting an initial distance (measured to the nearest 50.0 cm)
        - Volunteer starts the five minute timer for the testing period
        - Students connect antenna to transmitter and inform volunteer or event supervisor when they are complete
        - Students step away from the transmitter setup and the five minute timer is paused while connection is assessed
        - Lead supervisor watches the dBm reading over a 10 second period and determines if average is equal to or higher than the threshold dBm reading, which determines connection
        - Students are informed if connection is achieved or not
        - If connection is achieved, students may select a farther distance, measured to the nearest 50.0 cm. If connection was not achieved, a distance no farther than the most recent failed connection attempt may be selected.
        - The five minute timer is started again and the students can modify the connection of their antenna to the transmitting device. When they are ready they inform the volunteer/event supervisor and step away from the transmitting de-

vice.
        - The process is repeated until three connection attempts are completed or the five minute testing period expires.
    - Students are asked if they have any questions, and if not, proceed with asking students for their first connection distance.
    - Start the timer for their setup.
        - Students can begin connecting their antenna to the transmitter
        - Give teams a 60 second warning when they are about to run out of time for doing the antenna test
        - Once the students are ready to test their antenna they should inform you or the volunteer and step away from the transmitter.
    - Event supervisors must record each connection distance attempt, whether connection was successful or not, and if the connection was successful at the farthest distance, the dBm reading should be recorded in case of the max distance bonus (multiple teams achieve connection at the furthest distance).
    - Enter the data on the checklist
    - Have the students sign and agree to the numbers on the checklist
    - If there is a disagreement or something unusual, make as many measurements as possible and take pictures if possible to mark what is unusual. Also put all the additional measurements and notes on the back of the form.
        - The students should still sign it, even if they plan on filing an arbitration, but with the additional information on the form you can easily assign whatever points the arbitration committee determines (it is tough to retest an antenna)
- Reset the antenna test transmitter and receiver in preparation for the next team
- Call up the next team
- When scoring teams antennas, the farthest successful connection distance earns 42 points. All other team's farthest successful distance is divided by the farthest successful distance of the day and the multiplied by 42, according to rule 6c.
- If two or more teams achieve successful connection at the farthest distance, the team with the highest dBm reading earns an additional 5 points, called the Max Bonus (MB) by rule 6g.
- If a team has no successful connections, then their antenna score must be a zero.

Chart Score (CS)

During the day, if you have enough volunteers, scoring of the graphs/charts may take place. These graphs must be impounded and students must impound up to four graphs for maximum points. Graphs may be hand drawn or computer generated.

The scoring rubric for the graphs is as follows (partial credit may be given):

- 2 points for including data spanning at least 5 m of distance
- 2 points for including at least 10 data points
- 2 points for proper labeling (e.g., title, team name, units)
- 1 point for each graph or table turned in (up to 4 total, as long as they are not all the same)

Scoring at End of Day:

- Calculate a team's final raw score by adding up the Exam Score (ES), Antenna Score (AS), Chart Score (CS), Impound Bonus (IB), and Max Bonus (MB). The maximum score possible is 105 points, only if multiple teams achieve connection at the farthest distance. Otherwise, the maximum possible score is 100 points.
- Write all team final raw scores on the provided scorecard and take all tests, team score checklists, and scorecards to scoring at the end of the day.