

## A. Artifact Appendix

### A.1 Abstract

The artifact contains the source code and hardware design of SmartShell that can be obtained from a GitHub repository. Reproducing the results in this paper requires the dedicated hardware (SmartShell hardware) and dedicated APP installed on the Android phone to run our algorithm. We also describe the experimental workflow and necessary steps to reproduce the results in this paper.

### A.2 Artifact check-list (meta-information)

- **Algorithm:** QS-control antenna array.
- **Compilation:** TI ARM C/C+ compiler, v20.2.2.LTS; Android Studio default JDK, version 11.0.13.
- **Run-time environment:** Android that need root access, MCU.
- **Hardware:** Android phone (Xiaomi or HONOR phone recommended), SmartShell hardware.
- **Metrics:** Received signal strength(dBm)
- **Output:** Received signal strength and AP name.
- **Experiments:** See below.
- **How much disk space required (approximately)?:** 20 MBytes for APP installation.
- **How much time is needed to prepare workflow (approximately)?:** Within 1 hour.
- **How much time is needed to complete experiments (approximately)?:** 2 hours.
- **Publicly available?:** Yes.
- **Code licenses (if publicly available)?:** MIT

### A.3 Description

#### A.3.1 How to access

Our source code and hardware design can available on GitHub: <https://github.com/UraniumZ/SmartShell>. It needs about 500 MBytes disk space after unpacking our artifact.

#### A.3.2 Hardware dependencies

Android phone (we used Xiaomi and HONOR phones), SmartShell hardware.

#### A.3.3 Software dependencies

Texas Instruments Code Composer Studio 12.1.0 and android studio 2021.3.1.17.

### A.4 Installation

The setup of wireless configuration consists of the following steps:

- Download SmartShell\_MCU.rar from <https://github.com/UraniumZ/SmartShell/tree/main/Software/MCU>.
- Extract it and open it using Code Composer Studio.
- Install SimpleLink-CC13X2-26X2-SDK 4.20.01.04.
- Connect the programmer to the JTAG of the board with the CC2652R chip and burn the program.

The setup of APP consists of the following steps:

- Download SmartShell\_APP.rar from <https://github.com/UraniumZ/SmartShell/tree/main/Software/APP>.
- Extract it and open it using Android Studio.
- Turn on developer rights for the Android phone.
- Connect Android phone to computer via USB cable and install the APP into Android phone.

In addition, the board with MCU and energy harvesting module should be connected to the antenna array board. Measure the battery voltage with a multimeter to check if the battery is still functional. If not, the battery needs to be charged via the coil energy harvesting.

### A.5 Experiment workflow

The experiment workflow consists of the following steps:

- Use a phone (we use iPhone 13) as the Wi-Fi AP and place it in a fixed location.
- Connect the Android phone (we use MI CC 9c and HONOR Play5 and MI8) to the Wi-Fi AP.
- Connect the output pin of the energy harvesting module and the power supply pin of the MCU module via the jumper.
- Open the APP installed on the Android phone, the Android phone will be automatically connected to the Bluetooth peripheral on the MCU, the APP interface shows a successful connection, then click the START button on the APP interface.
- Place the SmartShell close to the Android phone's antenna and record the result.

### A.6 Evaluation and expected results

Depending on the channel conditions, the angle and distance between the antenna array and the Android phone antenna, and the hardware, the results may be a little different from the one presented in the paper.

The steps necessary to reproduce most of key results in the paper consist of the following:

- Use an iPhone 13 as the Wi-Fi AP and place it in a fixed location.
- Connect two Android phones, MI CC 9c (target device) and Honor Play5 (reference device), to the wifi AP and place them in the same location.
- Connect the output pin of the energy harvesting module and the power supply pin of the MCU module via the jumper.
- Open the APP installed on the target device, the target device will be automatically connected to the Bluetooth peripheral on the MCU, the APP interface shows a successful connection, then click the START button on the APP interface.
- Place the SmartShell close to the target device's antenna and record the result.

The steps necessary to reproduce other key results like Fig.17(d) and Fig.18(d) in the paper consist of the following:

- Use an iPhone 13 as the Wi-Fi AP and place it in a fixed location.
- Connect the Android phone (MI CC 9c or HONOR Play5 or MI8) to the Wi-Fi AP.
- Connect the output pin of the energy harvesting module and the power supply pin of the MCU module via the jumper.
- Open the APP installed on the Android phone, the Android phone will be automatically connected to the Bluetooth peripheral on the MCU, the APP interface shows a successful connection, then click the START button on the APP interface.
- Record the result without SmartShell.
- Place the SmartShell close to the Android phone's antenna and record the result.

We recommend that evaluators can take multiple measurements at the same location, changing the angle and distance between

the SmartShell and the target device's antenna. You will get the result that the signal strength of an Android phone equipped with SmartShell can be improved by an average of  $5 \sim 10\text{dB}$ .

## **A.7 Methodology**

Submission, reviewing and badging methodology:

- <https://www.acm.org/publications/policies/artifact-review-badging>
- <http://cTuning.org/ae/submission-20201122.html>
- <http://cTuning.org/ae/reviewing-20201122.html>