# GSOC'20:port FreeRTOS to Portenta

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# 1. Basic Information :

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# 2. The Project :

## 2.1 Abstract:

**FreeRTOS is a real-time OS for microcontrollers & microprocessors.FreeRTOS port is a board-specific implementation of APIs for the required FreeRTOS libraries and the FreeRTOS.**

**The port enables the APIs to work on the board, and implements the required integration with the device drivers and BSPs that are provided by the platform vendor (here Arduino) for Portenta board H7 here.The port should also include any configuration adjustments (e.g. clock rate, stack size, heap size) that are required by the portenta board.**

## 2.2 Background:

**FreeRTOS is an open-source project developed in partnership with the world's leading chip companies over a 15-year period, and now downloaded every 175 seconds, FreeRTOS is a market-leading real-time operating system (RTOS) for microcontrollers and small microprocessors. Distributed freely under the MIT open source license, FreeRTOS includes a kernel and a growing set of libraries suitable for use across all industry sectors. FreeRTOS is built with an emphasis on reliability and ease of use.FreeRTOS includes libraries for connectivity, security, and over-the-air (OTA) updates. FreeRTOS also includes demo applications that show FreeRTOS features on qualified boards.**

## 2.3 Why do I want to port FreeRTOS to Portenta?

### Why this project?

**I've worked last year on porting FreeRTOS to one of the IOT device using the documentation provided by aws and also with the help of one of the youtube channel (Fastbit Embedded Brain Academy) and since then I've gained experience in porting FreeRTOS.The task to port FreeRTOS to Protenta board require the skills that I've gained.**

**Since, Portenta H7 (IOT device) board's main processor is the dual core STM32H747 including a Cortex M7 running at 480 MHz and a Cortex M4 running at 240 MHz which is newer to me.So,I can't wait to work for it.**

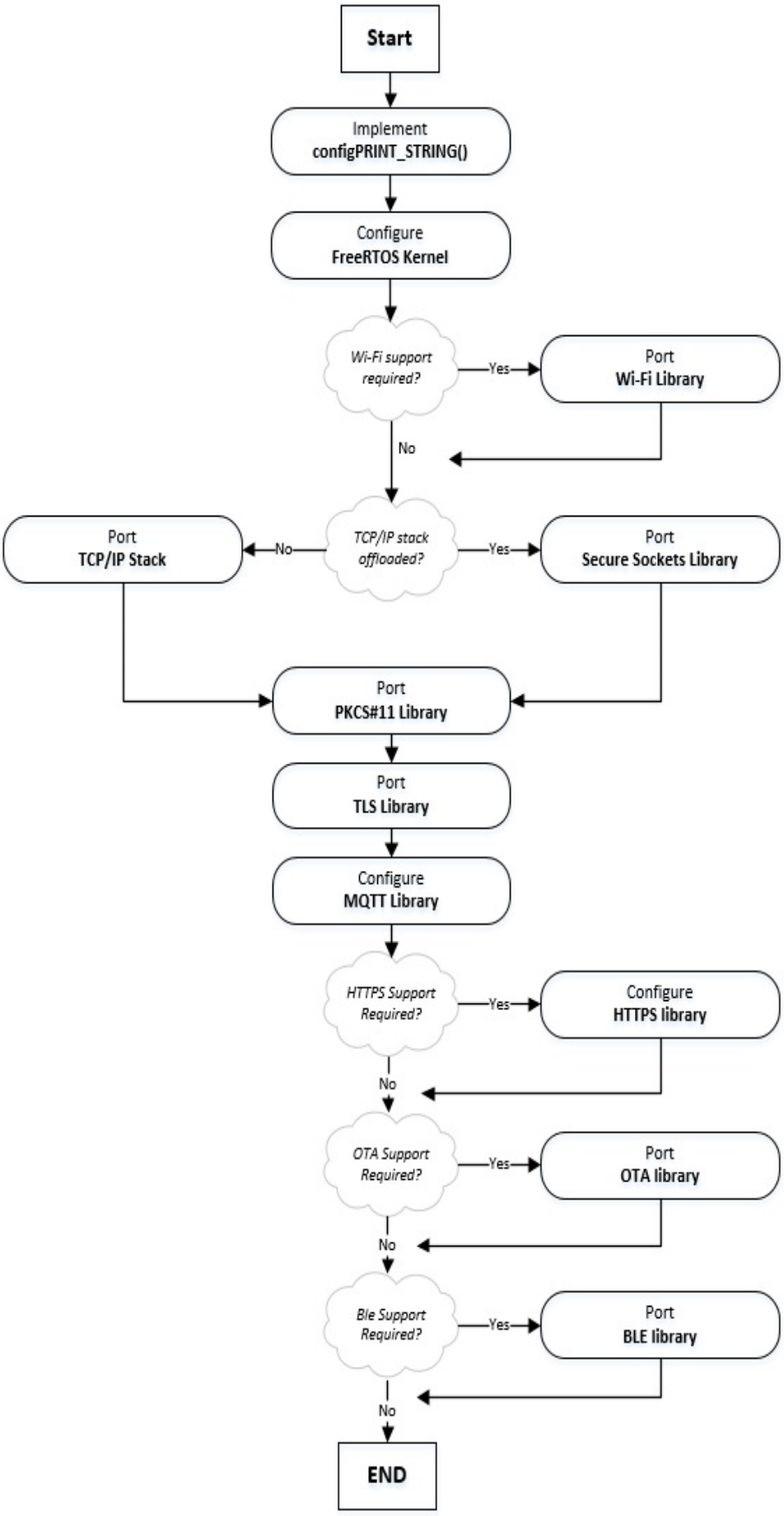
**Above all, I'm highly motivated to contribute to Arduino with the knowledge I've gained and want to be part of the team to finalize an important part of the organisation.**

### Why Arduino?

**Choosing Arduino as the organisation to work with during summers is a choice motivated by one of the best reason and that is  I'm quiet passionate about working with IOT devices and Arduino is  one of the popular tool for IOT product development as well as one of the most successful tools for STEM/STEAM education.**

### 2.4 Technical Details:-

**Flow Chart for porting FreeRTOS to Portenta H7 board is given below:-**

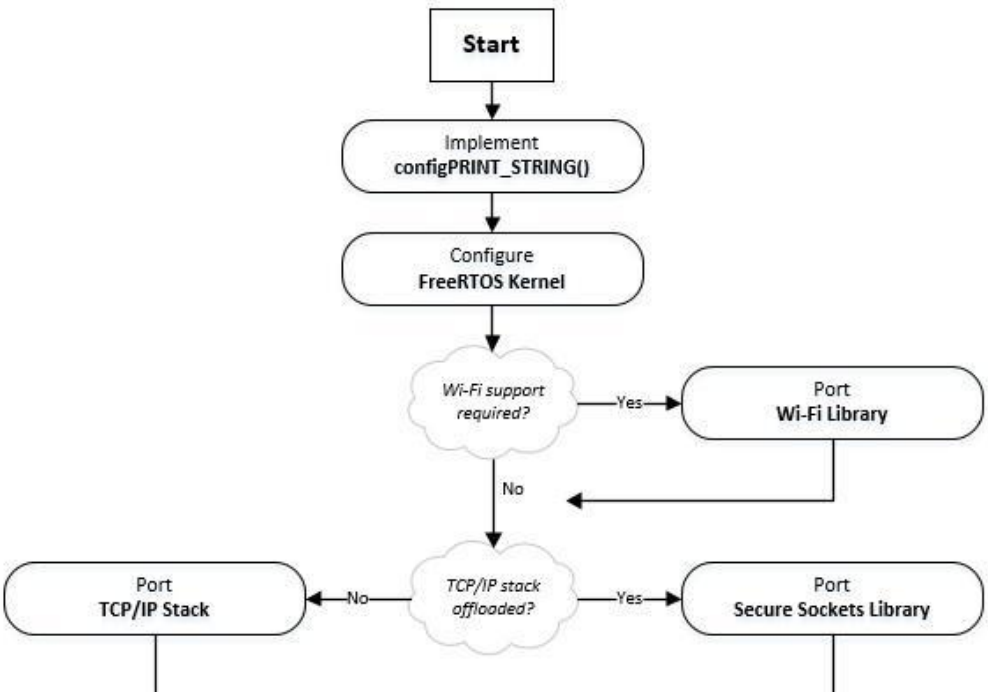

Start
Implement
configPRINT_STRING()
Configure
FreeRTOS Kernel
Wi-Fi support required?
Yes
Port
Wi-Fi Library
No
Port
TCP/IP Stack
No
TCP/IP stack offloaded?
Yes
Port
Secure Sockets Library
Port
PKCS#11 Library
Port
TLS Library
Configure
MQTT Library
HTTPS Support Required?
Yes
Configure
HTTPS library
No
OTA Support Required?
Yes
Port
OTA library
No
Ble Support Required?
Yes
Port
BLE library
No
END

**To port FreeRTOS to our device i'll,**

- Follow the instructions in Downloading FreeRTOS for Porting to download the latest version of FreeRTOS for porting.
- Follow the instructions in Setting Up Your FreeRTOS Source Code for Porting to configure the files and folders in your FreeRTOS download for porting and testing.
- Follow the instructions in Porting the FreeRTOS Libraries to port the FreeRTOS libraries to our device. Each porting topic includes instructions on testing the ports.

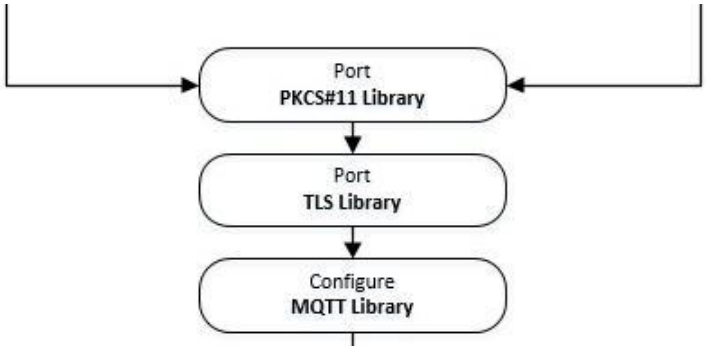
## 2.5 Proposed deliverables (during GSOC):

### #Coding Period 1 :-



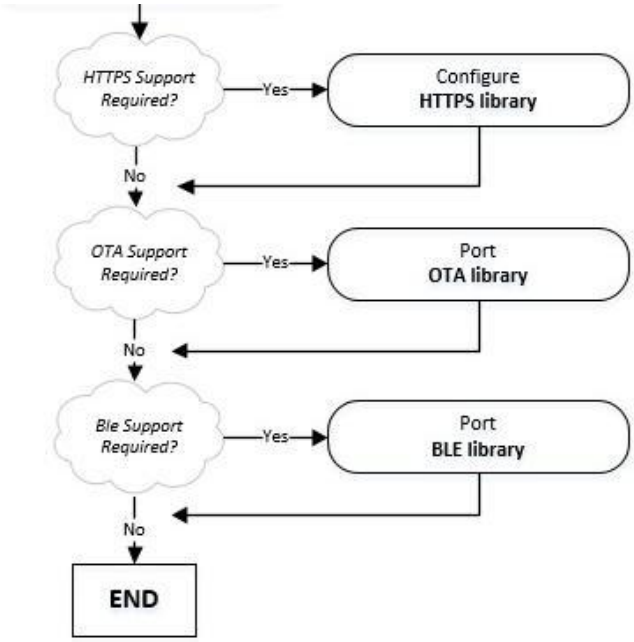

**In Coding Period-1 I'll complete all the above steps as per the flow chart given above.**

### #Coding Period-2 :-




**In during the Coding Period-2 I'll complete the above steps as per the flow chart.**

### #Coding Period-3 :-




**In during the Coding period-3 I'll finish the project to port FreeRTOS to Portenta H7 as per the above flow.**

## 2.6 Brief Working & Implementation:

**(Reference to AWS documentation as per link included in the table of contents section)**

## 2.7 Brief Timeline:

- **(Phase 0) Till 3 May: Pre-GSoC Period**
- **(Phase 1) 4 May - 1 june: Community Bonding Period**
- **(Phase 2) 1 June - 29 June:  Coding Period 1**
- **(Phase 3) 29 June - 3 July: Phase 1 Evaluations**
- **(Phase 4) 4 July - 27 July: Coding Period 2**
- **(Phase 5) 27 July - 31 July: Phase 2 Evaluations**
- **(Phase 6) 31 July - 24 August: Coding Period 3**
- **(Phase 7) 24 August - 30 August: Phase 3 Evaluation**
- **(Phase 8) 1 September - 7 September: Final Evaluation**

## 2.8 Detailed Project Timeline

### Phase 0 [Pre-GSoC Period]

- **2 Weeks (1 April - 14 April)**

**I've been getting familiar with the process of porting freeRTOS code as per the AWS documentation . I've already worked on it a year later and will be  once again revising all the steps during this time. I aim to have gained a better understanding of the Portenta board from my mentors.**

**I'll also gain more insights about the technologies and dependencies to be used, and also make note of different error cases so that I can prepare the error handlers easily.**

- **3 Weeks (14 April - 6 May)**

**End semester exams begin at my institute, and I will not be contributing actively during this period. Nonetheless, I'll be actively following the progress and participate in conversations through email.**

**Reference: https://www.gkv.ac.in/**

### Phase 1 [Community Bonding Period]

- **2 Weeks (7 May - 1 June)**

**During the community bonding, the main focus will be to frame a roadmap for the project with the guidance of the mentor (along with improving bonding, which is what the period is for). This period will**

**also involve continuing the groundwork for porting FreeRTOS to Paterenta. I'll begin as per the flow chart already described above.**

**A dropbox paper with task listing and distribution will be created which will be jointly managed by mentors and me to keep track of progress.**

### Phase 2 [Coding Period 1]

- **3 Weeks (1 June - 22 June)**

**This period will be given to the first set of microtasks;**Downloading FreeRTOS for Porting,Setting Up Your FreeRTOS Source Code for Porting**[**Configuring the FreeRTOS Download,Setting Up Your FreeRTOS Source Code for Testing**[**Creating an IDE Project,**{**Creating a CMake List File(Prerequisites,CMakeLists.txt Template,Building FreeRTOS with CMake **)}]].**

**From there on, I'll start** Porting the FreeRTOS Libraries

  - configPRINT_STRING()
  - FreeRTOS Kernel
  - Wi-Fi
  - TCP/IP
    - Porting FreeRTOS+TCP
    - Porting lwIP
  - Secure Sockets
    - Setting Up an Echo Server
      - Setting Up the TLS Echo Server
      - Setting Up the Echo Server (Without TLS)

- **1 Week (22 June - 29 June)**

**During this period I'll test whether I've followed the above process perfectly or not.I'll also test the desired output of that time before submitting it for evaluation.**

### Phase 3 [GSoC Phase 1 Evaluations]

**This period will be used to write a detailed report on the work done in Coding Period 1. All the work done will be sent as separate PRs and all concerning documentation will be done.**

#### Deliverables

- **Showcasing of porting different libraries on the portenta board.**

### Phase 4 [Coding Period 2]

- **2 Weeks (4 July - 19 July)**

**This period will be utilized solely for porting next libraries** PKCS #11

2.10.1.1. TLS

2.10.1.1.1. Connecting Your Device to AWS IoT

2.10.1.1.2. Setting Up Certificates and Keys for the TLS Tests

2.10.1.1.3. Creating a BYOC (ECDSA)

2.10.1.1.3.1. ca.config

2.10.1.2. MQTT

- **1 Week (20 July - 27 July)**

**The work from the previous two weeks will be finished this week. Thorough testing of the implementation will be done in this week.**

### Phase 5 [Phase 2 Evaluations]

**A detailed report on the working of the second coding period will be written during this time.**

#### Deliverables

- **Showcasing of the libraries imported and the testing showcases.**

### Phase 6 [Coding Period 3]

- **1 Weeks (31 July - 6August)**

**This period will also be utilized solely for porting next libraries** HTTPS

2.10.1.3. Over-the-Air (OTA) Updates

2.10.1.4. Bluetooth Low Energy

2.10.1.5. Common I/O

- **2 Weeks (7 August - 24 August)**

**Finishing up, any leftover library porting and unit tests or configuration(so that i can test my finally ported FreeRTOS to Portenta H7 board), documentation updates, bug fixes, and other fixations will be completed.**

**This will also be used as a buffer period in case of any lag in the schedule.**

### Phase 7 & 8 [Final Evaluation]

**All documentation, improvements, and unit tests will be provided as per the prescribed ways by the mentors.**

**All the deliverables promised for GSoC will be provided by this stage.**

### 2.9 Additional Information Regarding Timeline

- **The above timeline is tentative and gives a rough idea of my planned project work. I'll try to keep progress at, at the very least, the proposed schedule. I'll share a detailed plan of work with my mentor at the beginning of each week.**
- **I've no other commitments during summer and hence, will be able to dedicate 30 hours to 36 hours a week. During the last month of the project, my college will begin and I'll be able to denote a max of 20 hours a week. Due to the same, a major portion of the work will be done during the first and middle phase of the timeline.**
- **Each week, time will be divided (according to workload) amongst planning, learning, coding, documenting and testing features. All documentation will go hand in hand with the development (in the form of docstrings and typings). This will help to keep a profound grasp over the code implementation and working, minimizing bugs in the later stages.**
- **Weekends will be mostly non-working unless there has been any schedule. Monthly (per phase) blogs will be maintained and will include highlights of the development process and also methods used to overcome hurdles.**

- **This year my above proposed schedule may be changed slightly because of the current vacation going on due to COVID-19 .**

### 2.10 Requirements

- **Portenta H7 board**

## Personal Information

### Personal Details

**I'm Amritanshu Kumar Verma, an undergraduate student at Gurukula Kangri University, Haridwar (India).I'm also a Developer Student Club Lead of my university at Google Developers.I had been fascinated by programming since I was 15; aligned my work to always involve fun and programming at the same time.**

**This is my first-time experience with open source.Being DSC Lead of my university I've worked on many Google Technologies to solve the local problems.**

**I have a firm knowledge of C, C++, Python and experience with web development technologies such as HTML, CSS, and PHP as well as on mobile development with flutter.**

### Working Environment And Schedule

**I'll be mostly working full-time on the code on weekdays. On weekends, I'll be focusing on clearing any delay in the schedule, otherwise utilising it to communicate progress with my mentor. My awake hours would usually be between 10 AM IST (4:30 AM UTC) to 2 AM IST the next day (8:30 PM UTC) and I'm comfortable working anytime during this period.**

**Except for a week or so of excursion (which I'll be informing in advance to my mentor), I'll be having no other absences. Anyhow, in cases of emergency, I'll responsibly notify my mentor of the same with enough detailing.**

**I'll be initially working from home where I've a constant internet connection. In the latter parts of the project, I'll be working from my college campus which provides unlimited high-speed internet.**

### Communication

**I'm very flexible with my schedule and already have the habit of working at night and hence timezone variation (with my mentor) won't be an issue. I'm comfortable with any form of communication that suits my mentor. Below are the various options available:**

- **Email:** amritanshu26dec@gmail.com
- **Phone (Call and WhatsApp):** (+91) 6205805714
- **Hangouts:** amritanshu26dec@gmail.com

### Post-GSoC Plans

**I'm not applying for GSoC under any other organisation this year.**

## References

**In the research and making of this proposal, multiple sources have been used and they have been hyperlinked at the place of their usage for ease of reading and verification.**

**All the diagrams were made with the help of draw.io's interactive editor.**

**The timeline, methods, and technologies mentioned in the proposal are tentative, and a more robust discussion will be done when beginning each part of the task (deliverable).**