Operation RM
Northern Arizona
University
Flagstaff, AZ

William Rogers (Team Lead): wpr29@nau.edu
Isaac Faulkner: lwf2@nau.edu
Andrew Milizia: am5275@nau.edu
Nick Henderson: nsh67@nau.edu

CS476 Requirements Specification

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Operation RM

Client:

General Dynamics Mission Systems

Mentor:

Italo Santos

Team Members:

William Rogers

Isaac Faulkner

Andrew Milizia

Nicholas Henderson

Overview:

      The purpose of this requirement specification document is to establish the set of requirements so that the developed solution will meet the needs of the client. This document will provide a thorough understanding of the project's scope, goals, and execution plan.

11/29/2023

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William Rogers (Operation RM Team Lead)   Date

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William Fahrenkrog (on behalf of General Dynamics Mission Systems)   Date

1. Introduction

In today's world, the need for secure, efficient, and tactical communication in the defense, public safety and intelligence communities can not be understated. General Dynamics Mission Systems has tasked Operation RM with developing a solution to solve the problem of inefficient communication with a radio modem on a mobile device.

General Dynamics Mission Systems (GDMS) is a defense contractor that specializes in the development of mission-critical products and systems. GDMS has developed many widely-used technologies and programs such as Rescue 21, which is a system that allows the Coast Guard to locate people and vessels in distress. Probably one of the most commonly known programs at GDMS is developing the next generation of GPS, or the global positioning system. Overall GDMS provides many critical products and systems to the defense, public safety, and intelligence communities.

GDMS has tasked Operation RM with developing an android application that can provide two-way communication with a radio modem, in addition to being able to select a specific waveform to use for transmitting and receiving. Developing a mobile application that is able to communicate with a radio modem efficiently is crucial for General Dynamics Mission Systems. Currently, communication with the radio modem is done through a web interface that is difficult and inefficient to access and add attachments on mobile devices. With an android app, the clients will be able to communicate in a more efficient and tactical manner. In addition, the advantages include not only the ability to send and receive files efficiently, but also the ability to easily send images in the field using the integrated android camera application. GDMS has provided a remote control interface (RCI) that is crucial to learn and understand for the development of this project. The RCI will be the primary way the application will connect to the modem.

Many requirements have been developed in order to ensure that the proposed solution will meet the needs of GDMS and their clients. In the following sections, a more detailed overview of the project will be provided, in addition to describing the functional and nonfunctional requirements for this project.

2. Problem Statement

The clients are currently able to control the radio modem through an HTML web application that has to be connected through to the user device's web browser. Even though the clients have a working system in place, there are multiple issues with it. With the current implementation, the primary device that is used to control the radio modem is a personal computer. There is some support for mobile devices, but it is limited. Figure 1 below illustrates how the current system works.
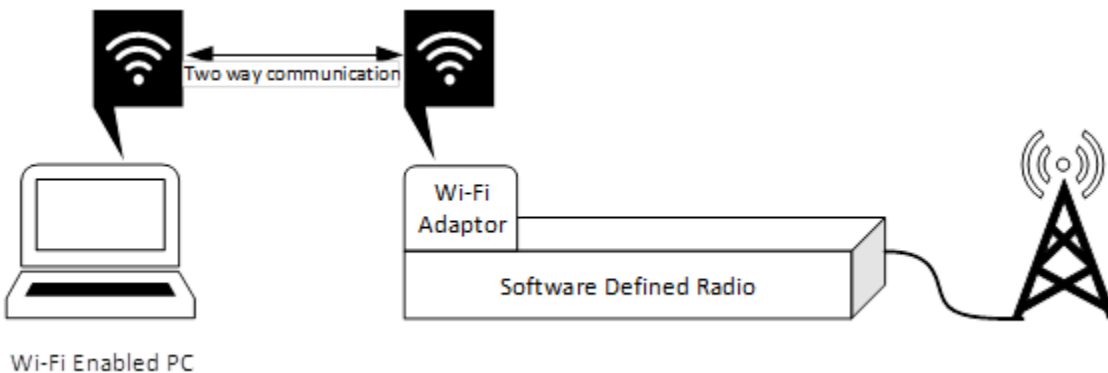
Current System Diagram:

Figure 1 Current System Diagram

Some of the issues with the current interface identified by GDMS are as follows:

- The client desires more mobile support due to users having easier access to mobile devices instead of computers. This is because mobile devices are significantly more portable than computers which is a necessity for the system's users.
- The current mobile system is not the most user friendly which is an issue since the client wants the system to require minimal training to use.
- The camera integration for the mobile version of the web application requires multiple steps to attach files, photo, or video which is a problem due to the users of the system being in time sensitive environments where every second can make a significant difference.

3. Solution Vision

        Operation RM will solve these problems that General Dynamics Mission Systems has identified using a comprehensive solution. This solution will consist of a mobile android application that is easy-to-use and can be accessed quickly for efficient tactical communication.

Specific features that the solution will provide are:
- A mobile application that can be opened on an Android phone
- The ability to send and receive files between the user and the radio simulator, and therefore the radio modem
- The ability to queue up multiple files for transmission

        The user will be able to either enter text data or choose to attach an external file to the transmitted message. The data will then be sent to the radio modem which will handle the transmission. For the initial application being developed, this will be stored on the radio simulator. Users will be able to queue up multiple messages for transmission (up to 10), which will then be handled in a queue data structure. The user can then select any of those messages to be sent. The user will also be able to see received messages in an inbox.

        This solution will allow the user to send data with greater ease than using the web application, due to the ease of accessing the mobile application from a mobile device, and being able to simply click on the application to open it, rather than using a web browser. This can be seen by Figure 2 below:
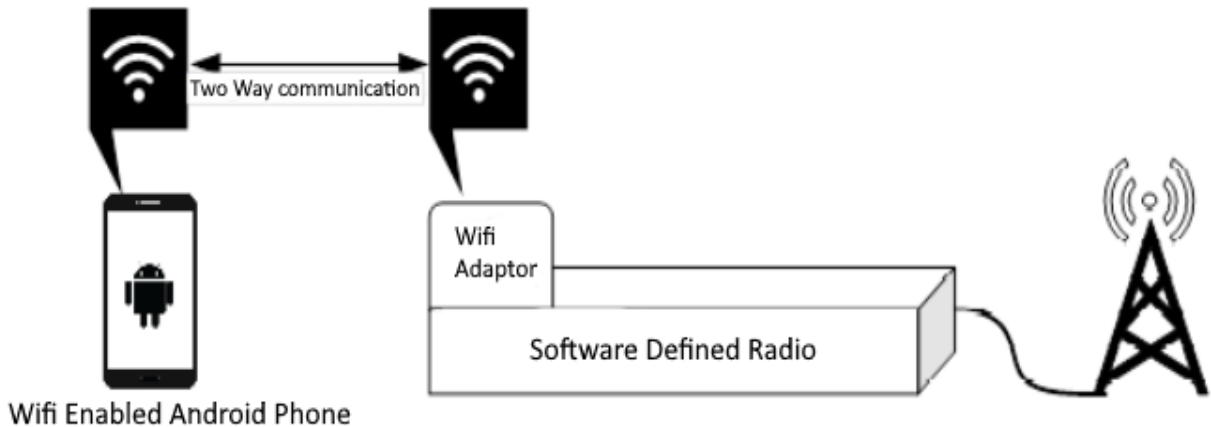
Figure 2 Proposed System Diagram

4. Project Requirements

The importance and need driving the solution has now been identified. It now remains to identify the key requirements for the solution. To begin the various high-level requirements should be identified that the solution will need to conform to:

- The solution should be developed as a mobile application.
- The user can select a radio waveform.
- The user can provision a selected radio waveform.
- The user can activate a radio waveform.
- The user can transfer files over the connected radio simulator.
- The user can receive files over the connected radio simulator.

In addition, the following high-level requirements have been identified regarding deliverables to be provided to General Dynamics:

- A demonstration report of the solution
- All necessary source code
- Design documentation
- Design review material

These high-level requirements will now be expanded into the various low-level functional, non-functional, and performance requirements.

4.1. Functional Requirements

Various functional requirements have been established for the purpose of ensuring the solution Operation RM is developing will be sufficient to meet the needs of General Dynamics Mission Systems.

4.1.1. User Operations

The user operations consist of the user interaction with the mobile application. Navigation to the primary user operations should be conducted via the user interface (UI). The UI must have a similar look and feel as the already implemented web application to create consistency within the system along with mitigating the need for training users on a different UI. For the UI to function properly, it provides the following high-level functionality:

- The application should have an inbox page used for viewing and downloading received emails and email attachments.
- The application should have an outbox page for viewing sent emails. This page should allow the user to control how queued emails are sent out, whether it is all at once, a certain selection of emails, or an individual email.
- The application should have a composition screen in which the user can write emails and attach files or photos
- The application should support a sent email history page where sent emails to the radio modem should be displayed.
- The application should have a transfer history page where the user can see the past incoming and outgoing emails through the radio modem and the transmission status of the outgoing emails.

4.1.2. Log-in and Initialization

To begin establishing the low-level requirements for the system, the requirements regarding log-in and initialization of the application will be established.

Logging into the radio modem
- The user should be able to log into the radio modem once the user has provided the correct host address and password. The user should not be able to set the password on the radio modem since this is done on the radio modem itself.
- The application should direct the user to the home screen after logging in.

4.1.3. File Transfer Operations

The file transfer operations consist of sending and receiving the emails between the user's android device and the radio simulator. It is crucial to establish the requirements for such interaction with the application such that efficient tactical communication can be achieved.

Email composition
- The application should support email composition through navigation from the home screen and a dedicated button.
- The application should support an email composition page containing a subject field, a field for the message body content, and a button to attach file(s).
- The application should support placing the composed email in an outbox email queue, or automatically sending the email.

Attaching files to emails
- The application should support adding file attachments to emails during composition by means of a dedicated button to choose between the device file system and the android camera application.

Outbox page
- The application should place outgoing messages into the outbox when the auto-send functionality is disabled.
- The application should have an outbox page in which emails can be individually sent, selected emails can be sent, or all emails can be sent at once.
- The outbox page should display emails as listings containing the subject, content, status, whether the email has an attachment, and timestamp.

- The outbox page should display selection boxes next to each email listing and the application should send each email selected after the user presses the send button.
- The outbox page should support a dedicated button to select all messages in the listing at once.
- The outbox page should support deletion of emails selected using the selection boxes.

Transmit emails with auto-send
- The application should send emails automatically after composition when the auto-sending functionality is enabled.
- The application should allow the user to enable or disable the auto-sending functionality using a switch in the composition screen.

Received emails
- The application should have an inbox page that displays received emails.
- The application should support downloading one or more messages and attachments selected in the inbox page.
- The inbox page should support deletion of emails selected using the selection boxes.

Sent emails
- The application should have a sent screen that displays sent emails.
- The sent page should support deletion of emails selected using the selection boxes.
- The application should show the status of the sent emails, i.e. "sent" or "failed to send".
- The application should support resending emails that failed to send in the sent screen.

Transfer History
- The application should have a transfer history page that displays a console log listing file transfer operations, any errors or timeouts, and preset changing operations.
- The transfer history page should support selection of a date/time range for the log using a filter.
- The transfer history page should display the total number of transmitted files, transmission errors, received files, and reception errors.
- The transfer history page should support the deletion of the logs using a dedicated button.
- The transfer history page should allow saving a local copy of the logs using a dedicated button.
- The transfer history page should support refreshing the data using a dedicated button.

4.1.4. Status

Requirements regarding the status of the system are crucial to be established in order to allow the user to have feedback on the file transfer operations.

Status icons
- The application should have status icons that displays the following information at the top of the application:
  - Current time
  - Currently selected waveform
  - Preset activation status
  - Radio is actively transmitting
  - Radio is actively receiving
  - One or more warnings are present
  - One or more failures are present

Error handling
- The application should display an error message if transmission hangs up or doesn't complete.

- The application should allow message transmissions to be aborted and update status and pages accordingly.

4.1.5. Waveform Presets

The radio waveform used for transmitting and receiving messages in the radio simulator must be able to be selected by the user. It is important to establish the requirements regarding such selection.

Radio waveform selection
- The application should support selecting a radio waveform from a predefined preset list.
- The application should support activating a radio waveform and using it when sending and receiving files.
- The application should support deactivation of the radio waveform.

4.1.6. Dark Mode Selection

The application should be able to be switched to dark mode to support tactical applications during night, and also as best practice to support the vision of the users.

Set app to light and dark mode
- The application should contain a toggle switch to change the app to light or dark mode in the app settings.
- The dark mode setting should change stylistic elements of the application as soon as it is enabled.
- The light mode setting should return the stylistic elements to default when dark mode is disabled.

4.1.7. Documentation and Deliverables

The following requirements regarding the documentation and deliverables will now be established for the mobile application. As part of the required deliverables for GDMS, documentation must be provided for the application developed. In addition the source code must be provided with all tools needed for GDMS to replicate the environment Operation RM uses.

Demonstration Report
- The demonstration report should list what behaved as expected and what went wrong.
- The report should include any end product change requests.
- The report should include recommendations for future development efforts.

Source Code
- The source code should be provided to GDMS including all necessary tools and files to build the project in the same environment and conditions that it was developed in.

Design Documentation
- The design documentation should include instructions to build and install the requisite software and libraries used.
- The documentation should include instructions on building the project files for the mobile application.
- The documentation should include screenshots of the various screens in the application.

4.1.8. Validation

It is crucial to establish a method for validating the requirements set forth in this document to ensure that Operation RM is able to provide GDMS with a solution that fulfills the needs of their clients.

Communication with the Radio Modem
- The application should successfully communicate with the radio simulator. This will be demonstrated during the technical demonstration.

User Interface
- The user interface should have the same look and feel as the pre-existing web application. This will be verified by GDMS through various conference calls throughout the development process to ensure that it meets their standards.

- The user interface should have a dark mode that meets the desires of GDMS. This will also be done through continuous feedback and development since there is no template from which to base this on.

Documentation
- The documentation should be provided along with the source code hosted on a private GitHub repository. Any relevant code not available on the github will be provided over email. The quality of these will be validated by GDMS over conference call prior to final release.

Final Validation
- The application must be able to run on the provided android phones as a standalone application with full functionality.

4.2. Performance (Non-Functional) Requirements

In addition to the various functional requirements, it is also crucial to establish the nonfunctional or performance requirements that the solution must conform to. Specifically, GDMS has identified a desire to focus on the speed, reliability, security and the usability of the application.

Reliability
- The status bar should display the correct status at any given time such as sending and receiving status.

Security
- The application should support a user logging in from either admin, user, or test accounts after entering the correct username and password.
- The data sent between the application and the radio modem should be securely handled and use best practices.

Usability
- The application should be similar in style to the current web application for less of a learning curve for the users.
- The application should have easy and intuitive navigation.

Responsiveness
- The application should not take longer than 30 seconds to load.
- The application should display a progress bar if the loading time takes longer than 3 seconds.
- The icon bar at the top of the screen should be updated every 0.5 to 2 seconds.
- The icon bar should utilize a low amount of resources to update.

Notifications
- The application should display a notification confirming the success of sending operation(s).
- The application should display a notification with an error message if transmission operation(s) are unsuccessful.
- The application should display a notification upon a successful download.
- The application should display a notification with an error message if the download fails.

Color Blind Considerations
- The application should use safe colors to account for any color blindness such as Deuteranopia, Protanopia, and Tritanopia.

4.3. Environmental Requirements

The following environmental requirements outline the non-functional requirements that originate from client needs, integration necessity, and eternal standards.

Network Connectivity
- The application must be compatible with the network generated by the radio simulator.

Android Compatible
- The application should be developed as a mobile android application.
- The application should be compatible with android versions 12, 13, and 14, with primary focus on android 13.

Programming Language
- This application should utilize Java and C to enable communication between the mobile application and the simulator.

Screen Compatibility
- The application should support different screen sizes such as phones and tablets.
- The application should automatically adjust for screen orientation such as portrait and landscape.

Sending/ Receiving Emails
- The application should be able to send and receive emails up to 20 MB each.
- The application should support up to 10 emails queued for transmission.

5. Potential Risks

This potential risk section delves into a critical aspect of project management. Through identifying and analyzing factors that could hinder the successful development of the project and by foreseeing potential hurdles and their consequences, this section allows Operation RM to proactively devise strategies that mitigate these challenges, ensuring an efficient project execution. This will serve as a strategic tool for risk management.

Severity assessment was conducted on the basis of priority and importance, identifying the risks that are crucial to resolve if any difficulties arise.

5.1 Interfacing with Radio Simulator (High Severity)

Communication between the application and the client's radio simulator is a critical component to the application. This component needs to be both efficient and reliable to ensure the project's success.

The potential risk is that the Java mobile application will not be able to communicate with the C radio simulator. There are a few options being considered for interfacing the two languages and components, however if any unforeseen issues occur that do not allow the full communication between these two components, it would create drastic problems since these two must connect.

The team intends to leverage the help of GDMS to troubleshoot any possible connectivity issues that may be encountered. The team intends to keep General Dynamics aware of any setbacks as they arise to seek possible guidance on how to reach a solution.

5.2 Application Appearance (Mild Severity)

It is important to create a UI that meets the clients needs. Namely it should resemble the existing web application, utilize a dark mode feature, and take into account color blind considerations.

A potential risk would be the ability to develop the android application with the same or similar look and feel to the web application potentially due to any limitations that android has that the web application was not constrained to.

If Operation RM encounters such an issue, GDMS will be notified and guidance on any potential alternatives would be discussed. While it is important that the mobile application has a similar look and feel to the web application, if slight differences are required due to constraints with android or java, there is potential for remedial action.

5.3 Technological Familiarity (Mild Severity)

It is imperative to the success of this application that it utilizes different languages as well as environments. This requires the team to be acquainted and acquire familiarity with the technologies being used.

A possible issue that may be encountered would be the team struggling to get familiar utilizing android studio, Java, or C. This could cause problems in efficiency when it comes to completing tasks in a timely manner.

To mitigate this problem the team will utilize the resources available at Northern Arizona University. This will ensure the team has the knowledge to solve possible technological problems that may arise.

6. Project Plan

The initial priority is documentation. It is important to establish documentation for the solution so that steps can easily be recreated and progress is not lost due to any unforeseen circumstances. In addition, the documentation of the existing radio simulator needs to be analyzed and understood by Operation RM in order to better understand implementation.

Next, the user interface needs to be developed according to the requirements set in this document. This will be a long-term initial task that is crucial since the solution is largely a front-facing one.

Once again, documentation will be added as the remaining tasks are developed so that progress is not lost, and to ensure that all the documentation will not need to be written post-development.

The log-in and initialization of the application and radio simulator will then be developed in order to lead into basic communication between the two. This is crucial to ensure proper functionality as it is listed as a high severity risk.

Next, the actual file transfer operations ought to be developed such that basic files can be received and transmitted between the mobile application and the radio simulator.

The status bar present at the top of the screen is also important to be added in order to provide adequate feedback to the user regarding various settings of the radio modem, as well as file transfer status.

Finally, the waveform presets will be developed so that users will be able to select a specific waveform on the radio simulator. While this is important, it is a priority to first establish initial communication with a single waveform before continuing to develop support for multiple waveforms.

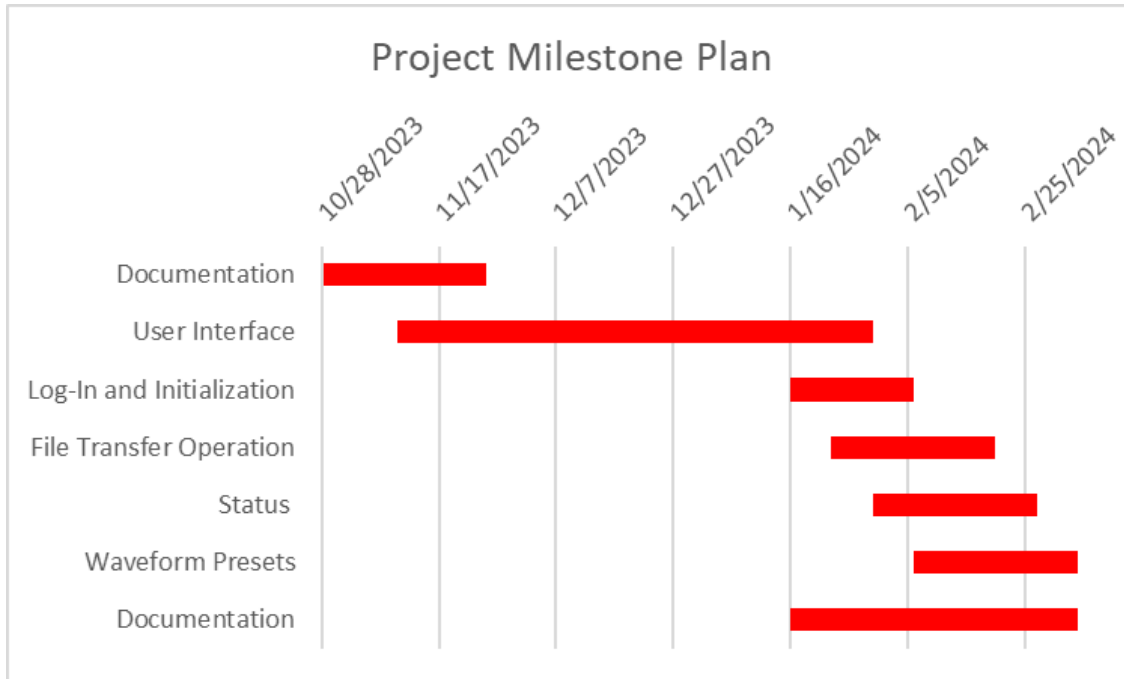Figure 3 shows the project milestone plan for this project below:

Figure 3 Project Milestone Plan

7. Conclusion

Operation RM is taking on the development of a mobile android application that will support the needs of General Dynamics Mission Systems. GDMS has identified the need for a mobile application version of an existing web application used for communication with a radio modem. Currently, the existing application is difficult to use on a mobile device. This makes it difficult to communicate with the radio modem in an efficient and tactical manner. This is crucial for defense applications.

Using a provided radio simulator, Operation RM will be developing an android application that will be able to select a waveform, and send and receive messages using the radio simulator. In addition, various deliverables are required of Operation RM such as documentation. This solution will solve the issues that the existing web application has, while also including new features such as a dark mode.

This document has established the requirements for such a solution in order to ensure that the developed application will meet the needs of General Dynamics Mission Systems and their clients.

While there is always a potential for unforeseen problems in development, establishing this set of requirements and conducting a risk assessment provides the best chances for a successful development process and being able to provide an adequate solution to the client.

Overall, Operation RM has set forth detailed requirements that will guide the team in developing a successful application that will solve the problems identified by General Dynamics Mission Systems.

8. Appendices

8.1 Acronyms

RCI - Remote Control Interface
GDMS - General Dynamics Mission Systems