Progressive Web Applications

Tactical applications built for the future

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Any conflict against an adversary will require Marines to operate in an environment that is a dichotomy: data-heavy requirements for an information-enabled force that operates in environments with potential disconnects from sources of data or Marines that are unable to maintain connectivity to higher echelons of command to receive information. As the Marine Corps shifts capabilities and operations to confront adversary capabilities, conventional transmission pathways and *always-on connectivity* may not be available to those troops engaged in conflict.[1] Marines conducting decentralized operations will have to find ways to communicate and share information. Understanding requirements and the operating environment will be critical to enabling Marines on the battlefield to operate independently with maximum lethality.

Acquiring new equipment and technology is a challenge and software acquisitions problems are manifold when it comes to delivering software capabilities to the Marine in the fight. From technical challenges and outside influences on a Marine's ability to move data, variability in end-user device capabilities and a general lack of awareness of how Marines use software applications to support their operations can slow down an entire mission.[2] These problems compound during the acquisitions process, resulting in cost and schedule overruns and delivering capabilities that are obsolete by the time they are released to the FMF. Ultimately, these failures run counter to Commandant of

A Marine with 5th Mar reviews and provides feedback on a new Marine Corps website, the* Infantry Weapons Information Tool, *15 January 2021, aboard Marine Corps Base Camp Pendleton, CA. This easy-to-use, common access, card-enabled site provides Marines with relevant technical doctrine, training manuals, instructional videos, and other tools needed to make them a more effective force. *(Photo by Amy Forsythe.)*

the Marine Corps, Gen David Berger's guidance: "Everything starts and ends with the individual Marine."[3]

To empower Marines with the knowledge required to operate their weapons systems in a communications-denied environment, the Marine Corps Tactical Systems Support Activity's Warfighter Support Division (WSD) in support of Program Manager-Infantry Weapons (PM-IW) built a Progressive Web Application (PWA) that can be accessed with credentials over any network for which it has an authority to operate and can grow and evolve with the needs of the Service.

Creating and disseminating weapon system data was PM-IW's primary opportunity for partnering with WSD's team of professionals. WSD determined that infantry Marines comprised the largest MOS in the Marine Corps with the greatest number of Marines without non-classified Internet Protocol Router Network access, Marine Corps Enterprise Information Technology Services accounts, and access to the numerous other sites hosting training material and technical data on weapons systems listed in the Marine Corps inventory. Ultimately, the Marines who need access to information the most are not afforded the opportunity to access it because of this capability gap. Marines resort to non-secure social media to ask peers and seniors alike to share information. [Author's note: to prevent further dissemination of these websites, we are withholding the data we collected for requirements generation.]

Building a solution mainly for junior Marines operating forward in an environment envisioned by *Force Design 2030*, WSD's development team engaged directly with the FMF and observed them navigate prototypes while providing recommended updates. Through this observation and realtime feedback, developers decided that a progressive web application (PWA) met many of the requirements to operate in a semi- or non-permissive communications environment. PM-IW provided resource oversight of the program, but the broad requirements for the application made a free flow of information between the development team, the fleet Marines, and the program office to expedite decision making and necessary code changes. Additionally, PM-IW detailed a project officer to MCTSSA for twelve months to assist in programmatic decisions and utilized remote working capabilities to ensure program management leadership at Marine Corps Systems Command in Quantico were engaged in the development process.

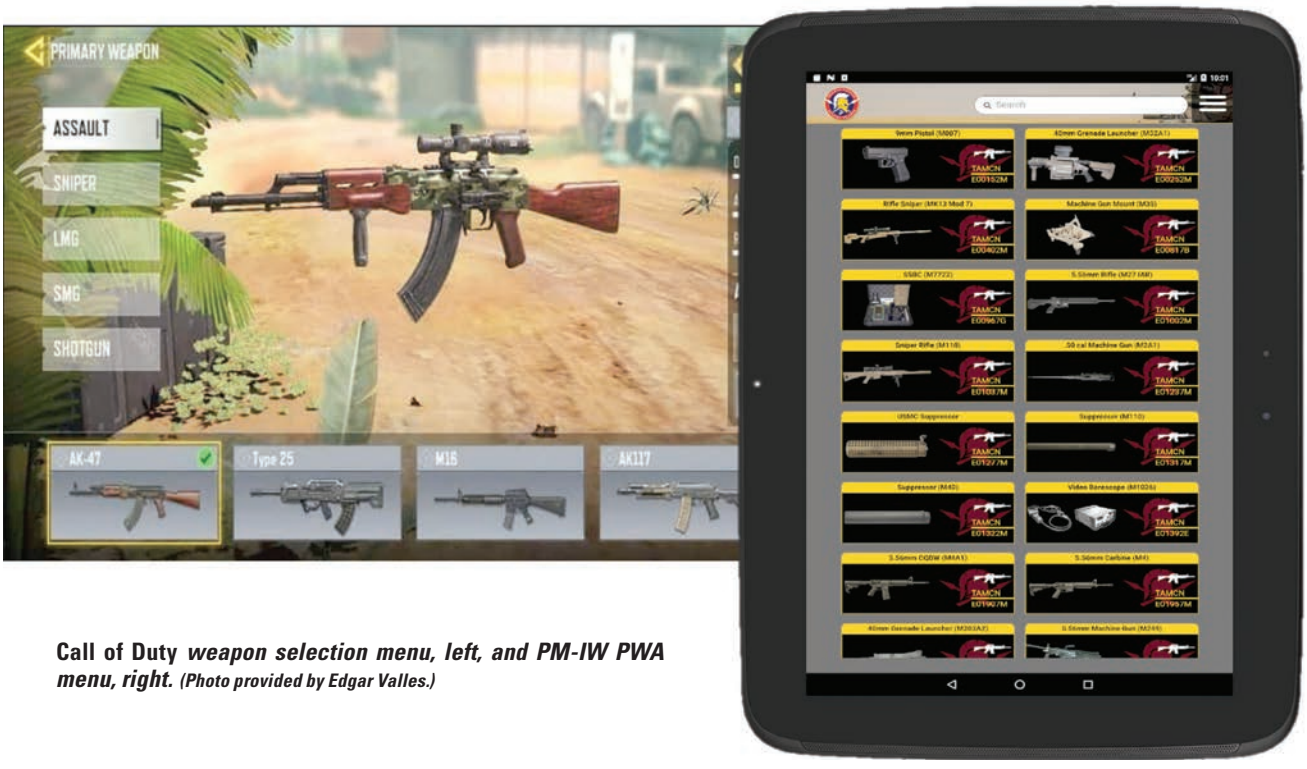
Through iterative fleet engagement and Program Office guidance, the development team decided that a PWA would provide a rapid solution that runs on an Android tablet, with the look and feel of a native Android application. This was important because the current inventory of handheld devices fielded by Marine Corps System Command are Android-based operating systems. Creating a PWA allowed WSD to leverage its current workforce of web, software, and user interface development teams without the need of hiring Android-specific developers. WSD also utilized the talents of a software engineering college intern from the University of California at San Diego and supported the development team for the summer. PWA's use of web technologies allows developers to create an application that is compatible with most systems that support mobile browsing, which met the requirement from PM-IW.

Leveraging this technology allowed WSD to build a web application (PM-IW website) that could be converted into a PWA with minor changes being made. For the PM-IWs use case, the PWA had to be packaged into an Android Application Package because of the use of offline mobile devices. PWA's can be packaged to all common operating systems allowing them to be compatible with current and future programs of records within the Marine Corps.

Building the Future

The first step in building a PWA was to access the documented and cataloged information related to Infantry Weapons on MCTSSA's Common Access Card (CAC)-enabled SharePoint site.

Screen grabs from the application running on an Android Tablet emulator from left to right: PM-IW Hompage, PM-IW Navigation, PM-IW Documents View, and PM-IW Weapons View. ***(Photos provided by Edgar Valles.)***



Call of Duty ***weapon selection menu, left, and PM-IW PWA menu, right.*** ***(Photo provided by Edgar Valles.)***

Utilizing an authoritative source for data mitigates the ubiquitous version control issues across the FMF or Marines referencing out-of-date information. MCTSSA's site allows for two-way conversation between fleet Marines and the Program Office, but it is CAC-enabled and limited the type of access required for a junior fleet Marine.

PWA requirements vary, but using Google's list of requirements for developers provided a start point for determining if a PWA would meet the requirements of not only PM-IW but any Marine forward deployed as part of a Marine Littoral Regiment.[4] Some of the requirements included inherent security, the ability to operate offline (disconnected from the source of data), and fast load times on latent or slower networks when a Marine was able to connect. Additionally, once connected, a Marine should only pull data that has actually changed ("delta" changes), vice an entire update to the application.

This decrease in data usage has real-world implications for signature management and force protection considerations, enabling survivability and lethality by allowing the Marine to practice an *I'm up, they see me, I'm down* technique in the electromagnetic spectrum against a peer adversary. A Marine can select which delta changes they are interested in updating, allowing the user to individually customize the size of the data package they are willing to download in their current operating environment.

Utilizing Scrum as the development framework allowed the team to create iterative prototypes and near-constant feedback loops between the development team, fleet Marines, and the Program Office. Scrum is a software development methodology that is supported by the Centers for Adaptive Warfighting and is part of the NavalX and the Assistant Secretary of the Navy for Research, Development, and Acquisitions. Using Scrum, the development team applied customer requirements and translated them into a feature list, which it then presented to the program manager for approval.

Paramount throughout each development cycle was testing the capabilities in a closed-test environment that mirrored the command and control (C2) architecture deployed Marines would utilize, including Samsung tablets and bandwidth limitations that mimicked an AN/PRC-117G radio operating on ultra-high-frequency bands.

WSD also capitalized on the co-location of the MCTSSA Global Support Center to ensure that key subject-matter experts were on hand to establish networks, run application installation steps for documentation, and test features based on real-world fleet Marine operations at a speed that made updates relevant and timely for the end-user. Additionally, PM-IW arranged to have the applications field-tested with infantry battalions aboard Marine Corps Base Camp Pendleton, with programmers both on-site and in remote locations to collect feedback on the application and make changes or talk through more complex corrections to the code and layout to ensure it met the Marines' intent.

Then-Assistant Secretary of the Navy for Research, Development & Acquisitions, James Geurts stated at Modern Day Marine 2020, "Anytime we can close down the distance between operator [and] acquirer ... you automatically can better illuminate opportunities and

better handle issues." With this guidance, the development team aimed to close that loop to create faster capabilities and was able to move the application from idea conception to prototype and field testing with junior Marines in under three months. By reusing code, updates and changes were minimal and allowed the developers to create new features requested by the program and fleet.

Feedback: Meeting Marines Where They Are

Feedback loops were instrumental in accelerating the development of the PWA. One feedback session focused on ways to reduce the training required to utilize the application; the development team researched the best way to get Marines to use the PWA, and the development team decided on a *Call of Duty* videogame-style graphical user interface (GUI) to capitalize on usability and knowledge fleet Marines already had for navigating the videogame menus.

Based on observed and anecdotal feedback from Marines, the *Call of Duty* menu for selecting weapons during gameplay was viewed as ubiquitous by the development team and approved by PM-IW as the GUI to link Marines with the weapons system information they are seeking. Field testing in January 2021 with 1/5 Mar aboard Camp Pendleton allowed the developers to modify the GUI in near realtime to meet the expectations of the Marines, with most change requests occurring within a week of receipt.

Future Web Applications in EABO

Progressive web applications within the FMF could and should be an option for future application development. Hosting content in a cloud-enabled, authenticated source and making it downloadable on-demand preserves a commander's valuable bandwidth in a tactical or denied environment. The maturation of PWAs in the Marine Corps could lead to two-way communication flows between fleet Marines and supporting establishment through that same architecture, ensuring Marines are receiving updates to technical documentation and have subject-matter experts available to talk to when they are able to connect. Ultimately, this will move Marines off social media for sharing equipment tactics, techniques, and procedures, best practices, and other non-public information that should not be stored on commercial, non-secure servers.

Progressive web applications can be built to support anything, from headspace to cyberspace, providing critical information to those who need it most.

Originally designed specifically for PM-IW as a communication tool for widespread dissemination of technical knowledge, MCTSSA has laid the groundwork and built the architecture to completely revolutionize the world of logistics, training, and technical support communication with Marines forward deployed in a semi- or non-permissive operating environment. This is accomplished by hosting or querying all technical doctrine from multiple service databases into a single, intuitive platform.

While a technical solution is no match for the ingenuity of the individual Marine, helping them understand their own capabilities with the information they need on-demand in a disconnected environment increases survivability and lethality of those forward deployed forces as realized through recently developed concepts like the Stand-in Force, Expeditionary Advanced Base Operations, and formations like the Marine Littoral Regiment.

The infantry weapons app is in its infancy with the potential to grow past any initial expectations. It provides Marines with a CAC anonymous portal where they can access information over any network for which it has the authorization to operate without needing additional SAAR forms or email accounts in an easy-to-digest format. This application paired with new and ever-developing tactics, techniques, and procedures have limitless capabilities in a denied environment with a reconnaissance/counter-reconnaissance mindset. The idea of only connecting to the network when required, with pre-determined uploads and downloads based on individual tablet connection history, will effectively create signature management down to the lowest level. Built-in algorithms know what to pull from the application's last update, so the user is only connected for a fraction of the time it takes for current systems to update. Progressive web applications can be built to support anything, from headspace to cyberspace, providing critical information to those who need it most. Inherently, this will make Marines more capable, lethal, and less detectable.

Notes

1. Courtney Kube, "Russia Has Figured Out How To Jam U.S. Drones in Syria, Officials Say," *NBC News*, (April 2018), available at https://www.nbcnews.com.

2. Staff, "DOD Acquisition: Status of and Challenges Related to Reform Efforts," (Washington, DC: Government Accountability Office, September 2021).

3. Gen David H. Berger, *38th Commandant's Planning Guidance,* (Washington, DC: July 2019).

4. Addy Osamani, "Getting Started with Progressive Web Apps," *Google Developers*, (n.d.), available at https://developers.google.com.

5. Secretary James Geurts, "Modern Day Marine Address," (speech, Modern Day Marine, Quantico, VA, September 2020).