First Responder Mobile Application Development

Best Practices Guide

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Homeland Security

First Responder Mobile Application Development Best Practices

The Department of Homeland Security (DHS) developed this brochure through its Office of Emergency Communications (OEC) and the Mobile Applications for Public Safety (MAPS) program. The MAPS program is a coordination platform for the lifecycle of public safety mobile applications. Working with industry, academia and government, the MAPS program seeks to enable and streamline the development, discovery and distribution of mobile applications for first responders. In addition, MAPS promotes security, functionality and performance requirements for mobile applications for first responders.

If you have additional questions or comments, please contact DHS_MAPS@hq.dhs.gov

Websites, companies, and products mentioned within this document are for reference purposes only. DHS does not endorse or have any affiliation with these entities.

First Responder Mobile Application Development Best Practices

Welcome to mobile applications (apps) for first responders development. This document can assist you as you develop mobile apps by:

Introducing You to the First Responder Community

Providing You with the Ideal Attributes of a Mobile App for First Responders

Identifying Recommendations for Designing to the Ideals

Offering Direction to Resources to Assist You in Your Development Efforts

First responders need mobile applications that distill data and analysis into simple, intuitive interfaces that convey accurate, critical information pertinent to the current situation/environment immediately. Apps that support public safety functions, such as saving lives and property, are vitally important to help first responders make use of emerging technology. The next app helping these responders could be yours. The MAPS program is here to assist you in understanding the public safety environment and offer recommendations to help you make your app as successful as possible. The best practices contained in this guide are simply recommendations to help smooth your entry into this exciting marketplace.

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What is a "First Responder"?

The term "first responder" refers to those individuals who, in the early stages of an incident, are responsible for the protection and preservation of life, property, evidence, and the environment. This includes emergency response providers as defined in Section 2 of the Homeland Security Act of 2002, as well as emergency management, public health, clinical care, public works, and other skilled support personnel (such as equipment operators) that provide immediate support services during prevention, response, and recovery operations.*

Homeland Security Act of 2002 – Section 2
(6) The term ''emergency response providers'' includes Federal, State, and local emergency public safety, law enforcement, emergency response, emergency medical (including hospital emergency facilities), and related personnel, agencies, and authorities.

First Responder Disciplines

* Homeland Security
Presidential Directive 8

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Protection of the Public – First responders of all disciplines are committed to protecting the lives and property of the public. In order to successfully achieve these goals, first responders require necessary and appropriate communications, interoperability and information sharing between all personnel, including command staff from all responding disciplines. The Incident Command System (ICS)/ National Incident Management System (NIMS) framework documents command practices.

Protection of First Responders – The first objective for first responders is the safety of each other. A first responder must be able to safely navigate to and operate at a scene. Situational awareness - knowing what's going on, where it is happening and what is affected - before and during an incident is critical. Acquiring and maintaining situational awareness has been a mainstay of all public safety disciplines. The introduction of mobile applications provides an opportunity to change the dynamics of how situational awareness is gained and how it is maintained.

First responders operate in a dynamic environment. Failure to constantly monitor, assess, and evaluate the ever-changing possibilities and human factors during an event can cause undue loss of property, injuries, and/or death to the first responders and citizens. On the next few pages, you'll find information on the roles and challenges of first responders and recommendations for building applications that meet their unique needs.

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What Challenges Do First Responders Face?

First responders face a myriad of challenges:

- Ensuring effective and timely responses to protect people and property.
- Identifying, communicating, and mitigating any risks or threats.
- Accomplishing administrative requirements and tactical response.
- Querying databases to gain as much information as possible.
- Responding to dynamic events that may vary in scale over the course of the event.
- Rapidly processing a flood of information, filtering out only what is relevant at that moment.
- Coordinating personnel, resources, and pedestrian/vehicular traffic around an event.
- Attaining and maintaining situational awareness of the response location, responding personnel, patient(s) condition, and availability of nearby emergency medical facilities.
- Working in highly stressful situations and conditions where sights, sounds, smells, and other sensations can cause emotional and physiological responses and risks to well-being.
- Coordinating between agencies at the local, county, tribal, state, and federal levels.

The challenges on this page are universal for first responders; however, using the sites found on page 24 and current first responder input, we've provided additional introduction to six first responder disciplines within this booklet. We encourage you to develop your app in conjunction with experienced response individuals and organizations to best understand their unique functions and environments.

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Emergency Medical Services (EMS) Characteristics:

- Local, state, federal, and private/commercial services providing pre-hospital basic and advanced life support emergency medical care and transportation using ground, air and marine assets;

- Highly trained professionals, including: volunteer and career pre-hospital personnel (emergency medical dispatchers, emergency medical technicians, paramedics), physicians, nurses, administrators, government officials, and non-government personnel; and

- Emergency rooms/departments of hospitals, emergent/urgent care centers, dedicated trauma centers, and specialty emergency care centers.

Challenges of the EMS Operational Environment:

Identifying the type of pre-hospital event, as well as discerning and assigning the closest and most appropriate response resources.

Routing to the correct emergency medical facilities; sometimes the closest hospital may be full, or may be inaccessible because of traffic or damage.

Interacting with health monitoring groups (for example: Medic Alert, pacemaker monitoring).

Effectively communicating information about an event to the next level of care (medical facilities).

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Fire Fighter Characteristics:

- Local, regional, state and federal fire suppression services in structural and wild land environments;

- Services provided by government entities at all levels and private/commercial providers using highly trained paid and/or volunteer personnel;

- Arson and suspicious fire/explosives investigative units; and

- Fire inspections, prevention, and education services.

Challenges of the Fire Fighter Operational Environment:

- Often operating in poor weather and lighting, and with high potential for personal physical over-stress.

- Dealing with reduced dexterity in restrictive personal protective equipment (PPE), including wearing heavy equipment that changes balance and center of gravity and gloves that preclude easy manipulation of device screens or buttons.

- Continuously monitoring the environment to watch for changes in the temperature and structural soundness; often working in environments with unknown materials; working in a dynamically changing, life-threatening environment.

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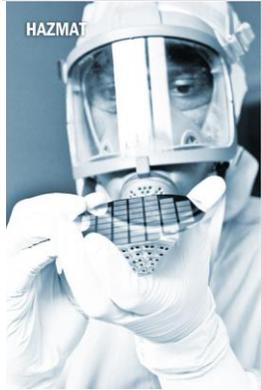
Hazardous Materials (HAZMAT) Characteristics:

- Highly specialized teams found at the local, state or federal levels. There are also private/commercial services that provide Hazmat mitigation/cleanup services.
- May specialize in Weapons of Mass Destruction (WMD) and the identification of unknown materials/agents.
- Identification of biological pathogens, chemical-weapon agents and radiological materials.
- Respond to calls for service involving unintended release of hazardous materials/chemicals and investigations of environmental crimes.

Challenges of the HAZMAT Operational Environment:

- Operating in the presence of dangerous and toxic industrial chemicals, explosives, and radiological materials.
- Experiencing reduced dexterity imposed by PPE in less than optimal weather and lighting conditions.
- Rapid information gathering and continuous monitoring of the situation despite frequent personnel turnover at the scene due to safety concerns.
- Monitoring PPE integrity over the course of the event to ensure the equipment continues to provide an acceptable level of protection.

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Law Enforcement Characteristics:

- Local, regional, state, and federal departments and agencies, as well as special jurisdictions (such as academic institutions or agencies serving transportation systems and facilities) responsible for the detection, apprehension and temporary detention of violators of criminal laws;
- Facilitate service and enforcement of warrants, writs, and other court orders and the operation of some correctional facilities;
- Provide protection for public facilities and infrastructure, maintain public order and provide for the protection of public officials;
- Various criminal investigative and specialized (example: bomb tech) units; and
- Crime prevention/education and community services.

Challenges of the Law Enforcement Operational Environment:

- Operating in challenging weather and environmental conditions, in rural and urban landscapes, and in the proximity of dangerous people, places, and things.
- Traveling in pursuit on foot or in vehicle while trying to communicate with other officers.
- Working alone, unlike other first responders (example: single officer in the car).
- Limited ability to travel, personnel often cannot leave their jurisdiction.
- Responding to situations that can change rapidly and require immediate information transfer to additional personnel as the event unfolds.

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Search and Rescue Characteristics:

- Search and rescue includes many specialties primarily determined by the type of terrain where a search is conducted. Specialties include mountain/rugged terrain, ground, urban, high-angle/confined space, combat and air-sea search and rescue.

- Search and rescue incorporates highly trained professionals, including volunteer and career public safety and military personnel using specialized equipment and resources.

- Functions and services are also provided by private/commercial companies and nonprofit organizations.

Challenges of the Search and Rescue Operational Environment:

- Operating in all types of terrains and environments including operations in poor weather and varied lighting conditions, while above or below ground and in confined spaces.
- Identifying and coordinating all search and rescue units and resources that may be used within the search area and establishing close liaison and agreements with other services, agencies, and organizations.
- Operating over large geographical areas with potentially varying ability to communicate externally.
- Re-tasking without the ability to return to a centralized location.
- Storing and uploading information regardless of communications infrastructure availability and/or coverage.

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Public Works and Other Secondary Responder Characteristics:

- Utilities are primarily operated by private commercial entities and organizations, but also as enterprises of public governmental agencies.

- Responsible for providing timely restoration and return to service of critical infrastructure services such as natural gas, water, sewer, electricity and telecommunications.

Challenges of the Public Works and Secondary Responder Operational Environment:

- Operating in challenging weather and environmental conditions.

- Encountering difficult access to impacted areas or travel routes as a result of debris.

- Coordinating, interacting, and integrating with first responders and other utilities and services to facilitate efficient, synergistic response.

- Obtaining authorized physical access, ensuring adequate force security for personnel and property, and coordinating acquisition of fuel resources within an incident area during elongated responses (such as large scale disasters, hurricanes, and tornadoes).

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Ideal Attributes of a Mobile App for First Responder Use

Mobile applications for use by first responders should focus on the attributes of function/operation, security, and performance. Details of these attributes are shown below, and subsequent pages provide the top recommendations for public safety application development based on first responder input and the best practices and guidelines referenced in the "Further Resources" section.

Function	Security	Performance
• Tailored to first responder use, including enhanced user experience and quality aspects • Operates well within first responder organizational and operational environments	• Employs up-to-date device, operating system, and programming security mechanisms and practices • Protects data from privacy intrusions, accidental leakage and malicious attacks	• Optimizes use of device and network resources (e.g., device battery life, network bandwidth) • Scales to the size of the public safety event • Minimizes distraction for the first responder

Some device basics to keep in mind: first responders may be using either commercial devices or specially-provisioned devices from their unit. They will not be allowed to operate jailbroken or rooted devices, and they may be sharing devices or have a change of role during an event.

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Top Recommendations for Function

1) **Design With and For End Users**

   First responder input from multiple sources at the beginning phase of development and in regular, iterative reviews can correct course on approach and implementation. Understanding the characteristics of the intended audience (for example: median age, education, communications usage/patterns) and operational challenges (as discussed earlier) can be beneficial to creating the most useful app. Developers can obtain this understanding either through rigorous research and/or direct interaction with first responders.

2) **Provide At-A-Glance Information**

   An app is most useful when it distills recent data and analysis into a simple, intuitive interface that conveys accurate, critical information pertinent to the current situation/environment immediately. The information may be solicited by the user or supplemented by unsolicited data, but should keep to mission specifics.

3) **Offer Convenience**

   First responders will be more likely to use an app with easy installation, launch, operation and maintenance. Over-the-air download, consistent appearance of app after an install/upgrade, progress indicators for long launch times, intuitive screens, and automatic updates with documentation of changes can increase an app's attractiveness. For first responders, this may also mean that the app can seamlessly communicate with other devices and accessories, for example, desktop applications and/or heads-up displays.

4) Consider Reliability

Though network, server, and/or database availability may be beyond the control of a developer, developers should design the app to be available under all circumstances. This could mean implementing availability indicators, providing function regardless of network support, and/or reducing downtimes associated with suspend/resume, multi-tasking or upgrades. In addition, the app may require a fail-safe mechanism that prevents the loss of information and accommodates continuity of operations, such as printed materials or information routinely stored on server, if the app should fail.

5) Capitalize on Device Features, but Be Available On Most Devices

First responders will benefit from apps that employ the full capabilities of a device while the app remains consistent in function, feel, security and performance regardless of the device or platform that it is on. Ideally, this will also mean interoperability regardless of device type and data such as voice, video, images, location, and/or timestamp, as well as backwards compatibility within reason for legacy networks, devices and databases.

6) Require Minimal Training

First responders should be able to use an app without formal training, or with just a little help from a peer. Universally familiar actions, contextual assistance, and/or support documentation will assist the first responder in adopting more complex apps. In addition, first responders are more likely to want an app with the ability to contact technical support (either real-time or for follow-up) to help identify and resolve common issues quickly.

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Top Recommendations for Security

1) Ensure It's the Right User

Identity management is critical for first responders, and enabling the right person to have the necessary access to sensitive information at the right time is essential. First responder apps will be expected to recognize distinct user profiles and respond accordingly – with strong authentication, priority indicators, and encryption, when necessary. In addition, access rights may change dynamically during response to a situation, so being efficient through single sign on is absolutely important to avoid delaying response; however, providing the ability to handle a change to permissions is also encouraged.

2) Follow Available Requirements

First responders typically have established guidelines for software that they may use, and almost always have operational requirements they must follow. For example, interaction with 9-1-1 communications centers – public safety answering points (PSAPs) – requires disclosure of operation, routing, data management, and cost information. As another example, developers may need to follow the Health Insurance Portability and Accountability Act of 1996 regulations from Health and Human Services or Mobile Medical Device guidance from the Food and Drug Administration when developing a medical app. Even the primary organization or set of individuals the app serves may have its own procedural or operational requirements for the app that developers will need to incorporate for widespread first responder adoption.

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3) Engage in A Secure Development Process

Developers should follow a proven software development process or the software development lifecycle of the primary organization or group of targeted individuals to avoid later redesign and insecurities. In the absence of that information, developers should avoid the CWE/SANS Top 25 programming errors and Open Web Application Security Project (OWASP) Top 10 security risks. These errors and risks are updated annually and can be found at the sites provided on page 23. Guidance on secure development is available commercially, but at a minimum, first responder apps should be protected by a password (not stored on the device) and have all sensitive information encrypted. In addition, apps must comply with applicable laws (see privacy law as an example), and have easy-to-understand privacy and location data use notices for explicit acceptance by users.

4) Request Minimal Permissions

Apps should be developed so that they request only the minimal permissions necessary for app functionality. For first responders, it is especially important that the user is aware of any permission to access private/sensitive data, location data, or any service requiring additional payment [such as short message service (SMS)].

5) Participate in Third Party App Security Review

Several app vetting tools and vendors are available commercially to review apps for performance, operation and security issues. In addition, various agencies may have a formal vetting process. For instance, the DHS Office of Chief Information Officer has established a vetting service that may be incorporated into the development and testing processes of qualified products; please contact DHS MAPS for more information.

6) Handle Data Appropriately

Using standard information exchange interoperability practices such as the National Information Exchange Model will provide first responders consistent interface to their data using their traditional terminology. If an app is intended to transmit public safety data to a PSAP, developers will need to disclose how the data will be routed and how the recipient is able to accept and use the data. Also, if the app is intended to handle private or sensitive data, be sure to research and follow all applicable federal, state, and local privacy laws and data sharing requirements (see ICS/NIMS as an example). It is important for the app to follow data storage, protection, and deletion (on device and/or on server) requirements. Determine which data must be encrypted and how that encryption will occur. Understanding interoperability practices, data requirements, and encryption requirements can seem overwhelming, however working closely with first responders and verifying data handling procedures will allow an app to be used more broadly.

7) Keep Accurate Records

Many first responder functions require that records kept during an event can be used as legally-defensible evidence afterwards. Records are also studied by command staff after the event to inform anticipatory planning and/or improve subsequent response efforts. Depending on the app's function, using automatic, tamper-resistant relevant tagging (such as device identification, timestamp, and/or geo-location) of locally captured information may be helpful, but the logs must also be protected, as they may contain private data and could be used to thwart subsequent response efforts. In addition, first responder procedures often require a chain of custody with regards to device access by keeping of log of users with time/date stamps.

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Top Recommendations for Performance

1) Code for "Regular" Performance, then Enhance

First responders will expect their apps to react in similar fashion to typical, commercial products. For instance, if there's an incoming call, it would be offered to the user to 'accept' or 'decline' and the app could resume after return. Standard performance of navigation features, such as a back and/or home button; quality of user interface; and consistency of icons/terms would all be assumed to be similar to commercially-available apps.

2) Minimize Battery Use

First responders do not typically have time to charge their device during an event, some of which last multiple days – so power management and finding ways to conserve battery life are imperative. For instance, piggybacking orientation (screen rotation) information pings with another activity can limit reloads. In addition, shutting off or coding a stand-by mode for any peripherals not in use, such as Bluetooth, camera, and global positioning system (GPS), can help conserve battery life.

3) Be Scalable

First responders have both day-to-day operations and emergency operations. These operations can involve a variety of actors. Even if the developer intends an app to be used by a limited user group, be aware that it may need to expand to a large number of active users without diminishing effectiveness for the user.

4) Adapt to Network Connectivity

First responders use both cellular and Wi-Fi networks and may switch between the two. Also, in emergency situations first responders are typically on networks suffering from congestion and apps may need to function without connectivity, pare back functionality to reflect connectivity, frequently resume operation after interruption, and/or request new access if service is too degraded. The app may be expected to operate in all environments (urban, rural, wilderness) and with communications infrastructure challenges, such as (1) no remaining infrastructure; (2) compromised or damaged infrastructure; and/or (3) within confined areas, such as subways, buildings, and underground garages.

5) Use Network Resources Wisely

First responders often multitask with their device on congested networks, which requires apps that optimize both device usage and network usage. Multiple apps using device resources can quickly interfere with each other and drain battery life. Guidance for feature management, caching, transmission control protocol (TCP) connection management and other optimization techniques can be found in commercially available documentation, such as the App Quality Alliance: Best Practices Guidelines at www.appqualityalliance.org. Using a diagnostic tool, such as AT&T's Application Resource Optimizer (open-source and available for free), can provide feedback on network interfacing inefficiencies in the app that slow response and drain device battery life. In addition, developers should be sure to keep file size to a minimum by choosing the correct image compression format and ensuring that the rendering of the graphics doesn't overwhelm app performance.

6) Stay on Task

Disruptions for the first responder can mean the difference between life and death, so keeping notifications to a minimum and avoiding distracting screen motion and advertising can improve the experience for the user. Reducing the scope of an app's function can often help the first responder react appropriately in a high-stress, disorderly environment.

7) If Provided the Opportunity, Test on a Representative Network with Realistic Scenarios

Understanding the environment and circumstances in which the app will be used will be key to experimenting with performance (such as finding the right combination of periodic transfer timing, piggybacking and batching for battery life), functionality (including operating correctly and/or handling a large number of active users), and security (such as authenticating users of different priority levels and/or encrypting data). Ideally, apps should undergo the functional, security, performance, and beta testing associated with a secure development lifecycle. For first responder apps, this may also include testing in a controlled environment with representative users demonstrating a scenario.

8) Think Outside of the Box

Rather than creating an app that is an expansion of the current mindset and tool functionality, employ device functionality to accomplish the task most effectively within requirements, even if it is much different than the way it has always been done. Interfacing with first responders on use scenarios and workflow design can help.

9) Remain Aware of Advancements in the Government Environment

Mobile devices upgrade operating systems, software development resources change, and programming languages evolve. Systems for government are no different, and keeping abreast of these changes is valuable. For instance, the Federal Government Digital Government Strategy encourages (1) enabling access to high-quality digital government information and services anywhere, anytime, on any device; (2) procuring and managing devices, applications, and data in smart, secure and affordable ways; and (3) unlocking the power of government data to spur innovation across our Nation and improve the quality of services for the American people. As advancements occur, such as the opening of new data/application programming interfaces (API) or the implementation of new security reference architectures, consult the Digital Government Strategy document and others to make sure apps are developed in a secure, interoperable fashion for optimal performance in the latest environment.

10) Seek the Most Accurate, Current Data

The government is in the process of making data more available to citizen developers. For instance, the Government Services Administration (GSA) has a collection of APIs, data feeds, and a code repository for developers. DHS Science & Technology is providing operational environment information through FirstResponder.gov, Data.gov, Safety.data.gov, and OpenFEMA are also informative resources during app development; please see "Further Resources" on the next page for links to these repositories.

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Further Resources

DHS OEC MAPS Program:
Office of Emergency Communications: DHS_MAPS@hq.dhs.gov

Digital Government Strategy
Learn more:
http://www.whitehouse.gov/sites/default/files/omb/egov/digital-government/digital-government.html

Data Sources & Educational Materials:
- FirstResponder.gov
- GSA Developer (gsa.gov/developer)
- Data.gov (and Safety.data.gov)
- OpenFEMA (www.fema.gov/openfema)

Mobile Application Development Best Practices/Guidelines:
- Mobile Gov Community of Practice Mobile User Experience Guidelines and Recommendations – www.digitalgov.gov/resources/mobile-user-experience-guidelines-and-recommendations/
- CWE/SANS Top 25 Programming Risks – www.sans.org/top25-software-errors/
- Open Web Application Security Project (OWASP) – www.owasp.org
- App Quality Alliance: Best Practices Guidelines – www.appqualityalliance.org
- GSMA Smarter Apps Guidelines– www.gsma.com
- AT&T ARO: Best Practice Deep Dives – developer.att.com
- Android: Android Open Source Project Tablet App Quality Checklist – developer.android.com
- Apple: Developer Best Practices and Human Interface Guidelines – developer.apple.com
- APCO: An online application community – www.appcomm.org

Further Resources (continued)

First Responder Sites:

General:
- National Incident Management System Handbook – www.fema.gov

EMS
- State Health Departments
- National Registry of Emergency Medical Technicians – www.nremt.org

Fire
- International Association of Fire Chiefs – www.iafc.org
- International Association of Fire Fighters – www.iaff.org
- National Fire Protection Association – www.nfpa.org

HAZMAT
- International Association of Fire Chiefs – www.iafc.org
- International Association of Fire Fighters – www.iaff.org
- Department of Transportation – phmsa.dot.gov/hazmat

Police
- Fraternal Order of Police – www.fop.net
- International Association of Chiefs of Police – www.theiacp.org
- Department of Justice Community Oriented Policing Services – www.cops.usdoj.gov

Search and Rescue
- National Association for Search and Rescue – www.nasar.org