

MDLIVE Mobile Platform

Architecture, Benefits and Opportunities

Background of the Current MDLIVE Platform

MDLIVE 3.0 for iOS and Android provide anytime access to board certified doctors and pediatricians. The current versions of these apps were developed as partially native, partially hybrid, which makes integration challenging for MDLIVE's business partners. Making simple changes to colors, icons, components, visibility and flows is more difficult than it should be. Additionally, the backend for these current mobile apps is not in parity with the web backend. The result is two different architectures requiring two different services layers.

It is MDLIVE's desire to create a best-of-class platform which provides more value to its partners with a larger ecosystem of services and features. To that end a new design was undertaken in the summer of 2016, which includes the redesign of both the iOS and Android MDLIVE apps. The new platform will support multiple app variants and multiple partners. The anticipated release of the new mobile platform is the first quarter of 2017.

New Design Philosophy and Decisions for the MDLIVE Mobile Platform

The Mobile Platform is a brand new design from the ground up. Not a single line of code was used from 3.0. The new design focused on improving the platform in four areas: business objectives, user experience, engineering and security.

From a business perspective, it was important to develop a solution that benefited MDLIVE's partners. The emphasis was on creating a system in which changes can be designed, prototyped and tested rapidly, to keep pace with a fast-moving industry. At the same time, there was also an emphasis placed on minimizing risk to both the code and to MDLIVE's partners.

It is also important that the new platform be better at providing feedback to MDLIVE and its partners. This applies to both tracking end-user behavior within the apps, as well as evaluating the success of new features and releases.

The new apps place a priority on workflows which anticipate end-user requests and screens which provide complete and obvious context. For low-tech users it is important that features be easily discoverable and that there be easy and obvious access to additional information and explanations. To achieve these ends, the new Android app implements, to the greatest degree possible, Material Design look and feel, while the iOS app stays true to the iOS UX standards.

The new app designs are purely native and modular. As a result, the apps achieve better performance in that they both minimize memory utilization and improve response time. Implementing internal caching at the API request level throughout the SDK minimizes the number of API requests, which requires less frequent connections to the backend. All of this adds up to less waiting time for the end user.

All of the modules are independent of each other, except for the core module. It contains base-level services such as API management and services related to user login and credentialing. None of the modules depend on any other module which means MDLIVE partners can choose to integrate only those modules which are pertinent to their business.

Module independence also means the system is less risky because it is impossible for one module to refer to the code in another module without a well-defined interface. Ultimately the new modular designs give greater flexibility and control of the finished product to the partners.

The audio/video platform is now based on WebRTC, with the end-to-end architecture in-house. That means there are no 3rd party downloads, components or plugins required. It also means the system is more secure, because the entire infrastructure is controlled by MDLIVE.

The Mobile Platform is very aggressive in protecting personal health information (PHI). Consequently, no PHI of any kind is stored on the device. Security is improved in other ways as well. If a user abandons the program, the session will time out and the user will have to re-enter their PIN to continue. The user will also have to revalidate to change their PIN, password or security questions.

The new designs were architected for generalized error handling. There is now a single error handling location throughout the apps, so improvements are more contained and straightforward.

System testing is of great importance. Extensive testing has been done across both code bases. Over a 1000 unit tests assure ongoing quality in the face of innovation and the incorporation of new features.

Back-end Architecture

The back-end, which is built using Ruby, and the open-source web framework Rails with an event driven architecture, is now the same for both mobile and the web.

The event driven architecture enables plugging in micro services without interfering with existing processes. It also allows for building out integrations without impacting the current production stack. This enables MDLIVE to realize the benefits of continuous deployment. And thanks to the event driven architecture, the ecosystem is not only highly scalable, but the average response time is under 100ms.

The new architecture uses JSON as the primary data exchange format between MDLIVE's application servers and client applications. JSON was chosen because it is compact and easy to read. MDLIVE's application servers run on CentOS release 6.8, while Nginx and Passenger enterprise are used for the web servers.

MySQL is used as the storage engine for all data. Redis is used to handle caching and locking of resources, while RabbitMQ is the message broker.

All applications are locked inside a VPN and access is limited to only external-facing applications. All communication happens over SSL and MDLIVE is in the process of achieving HiTrust certification.

Hosting has migrated to Microsoft Azure, which was motivated by an increased need for security, compliance and scalability.

New iOS Architecture

The MDLIVE Mobile Platform for iOS is a modular architecture. The result is an app which offers maximum flexibility and ease of use for MDLIVE's partners.

Modules are independent of each other, except the Core module. They are implemented as frameworks and are included using CocoaPods for dependency management. As can be seen in Figure 1 below, the system includes the Core module, Services, CoreUI, the standard MDLIVE modules, as well as any optional modules.

Logical Project Layout

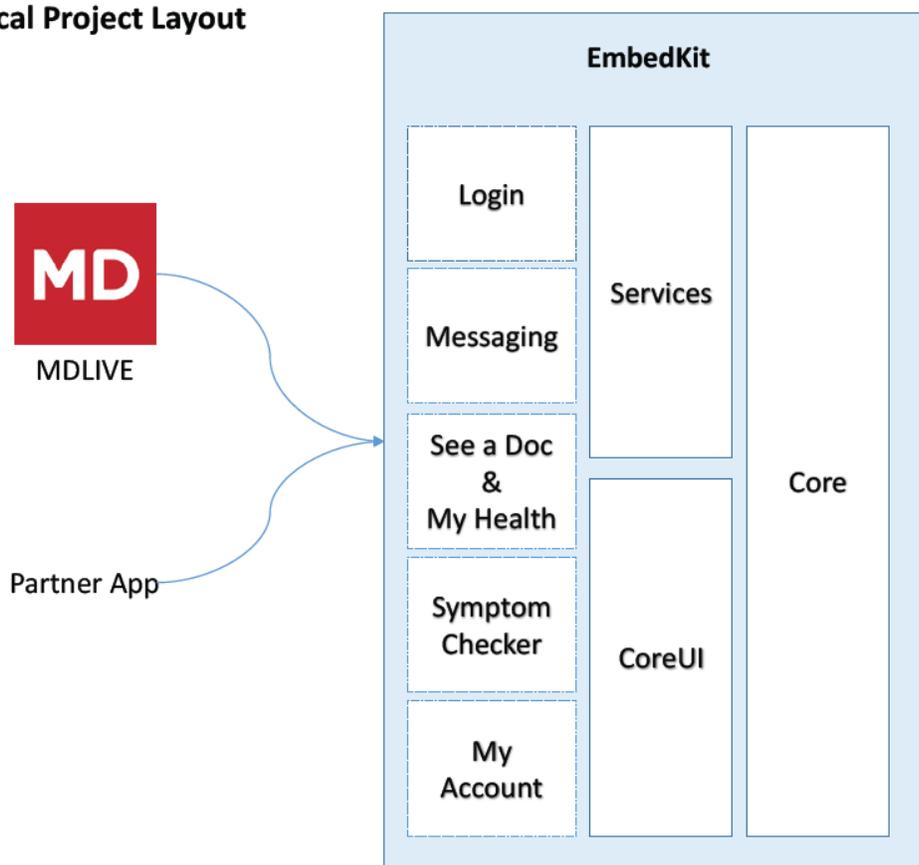


Figure 1

The Core module is required by all apps using at least one other module. To maintain module independence, each module provides its own repositories, services, UI interactions, business logic, etc. (except Login, which is tightly integrated with the Core module). From an architecture standpoint, the system is more than one module, both logically and physically.

All modules can be installed using CocoaPods. Using standard iOS install mechanisms simplifies the development process for MDLIVE's partners.

The primary security feature of the design is that no PHI information is stored locally. In addition, iOS standards are followed to maintain PHI and HIPAA compliance.

The design incorporates TouchID for fingerprint recognition. Any information which is stored on the device, such as fingerprints and passwords, is stored in the iOS secure enclave. The secure enclave is relatively new technology for protecting onboard data and is a step above iOS 8.

The new iOS design allows for greater app customization by MDLIVE partners. The architecture lets end developers inject their own analytics tracking mechanism throughout the whole architecture of the SDK. What would normally be captured in the Core app can now be captured by partner's own analytics tools. This leads to better tracking and knowledge of end-user behavior.

Because all the hybrid screens have been eliminated, iOS users will benefit from a more familiar look and feel. MDLIVE iOS 4.0 will feel more like an iPhone app.

New Android Architecture

MDLIVE Mobile Platform for Android is also a modular architecture. The design utilizes *reactive* programming (Rx) and *functional* programming. Reactive programming was chosen because the code base is more stable, it's more responsive and more resilient to component and network failure. Functional programming was chosen because it requires dramatically fewer lines of code. The result is a stable app which can be customized in a substantial way by MDLIVE's partners, while still leveraging the core code base.

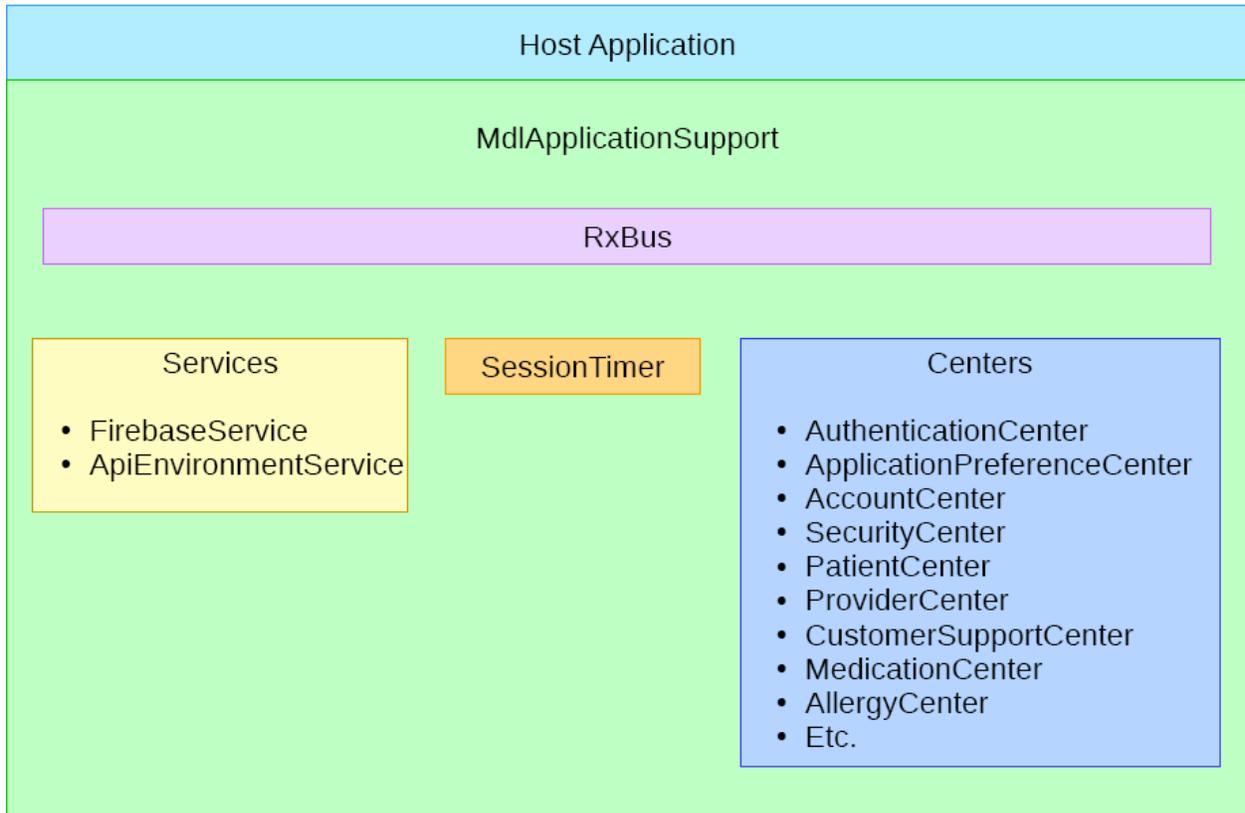


Figure 2

Partners wanting to customize an app on the Mobile Platform have two options: API services and customized injection.

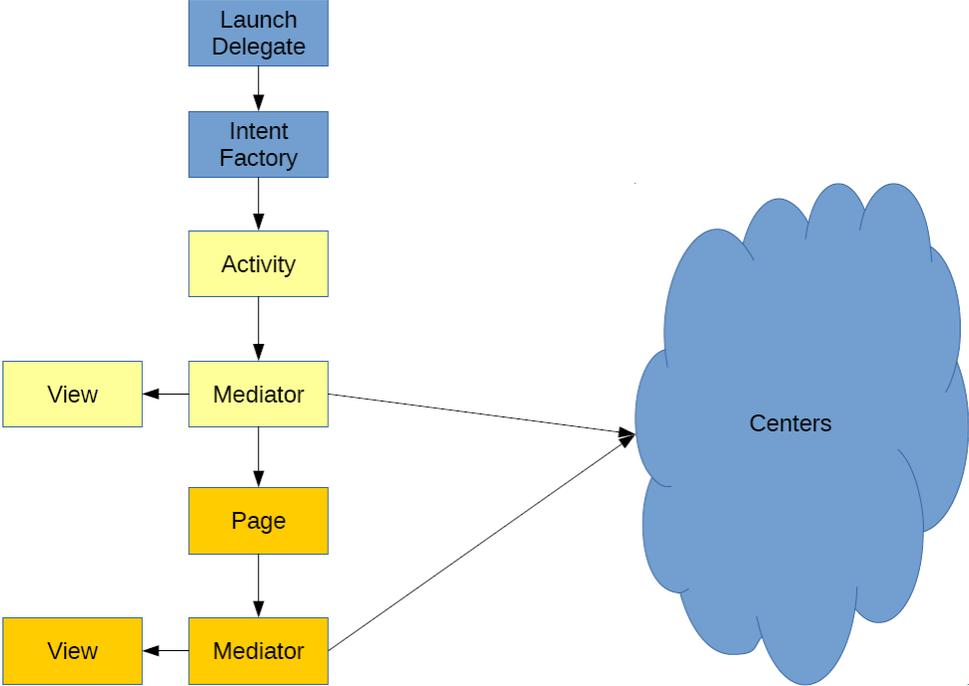


Figure 3

API services is for those wanting to access MDLIVE via the API. For this approach there is an API interface available. API services is based on the retrofit technology, which is pure java, so it can be used from any java client, not just Android. This is for APIs that go directly into the backend, so there are no screens, no business logic, etc.

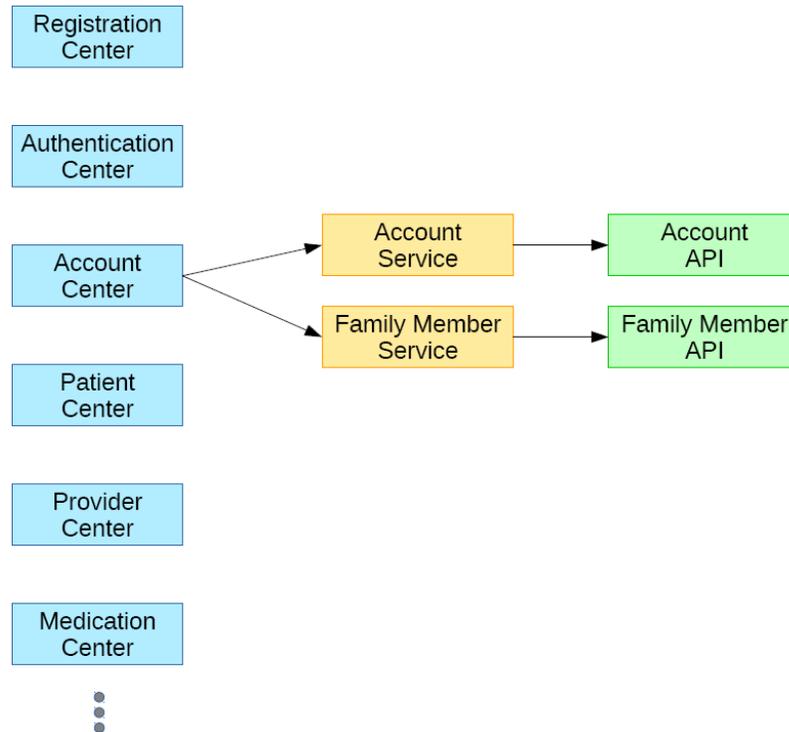


Figure 4

The other option, customized injection, is for injecting the entire MDLIVE application into the partner's own application for complete customization.

Customized injection offers two customization roadmaps. The first is for those wanting to take the existing MDLIVE app and customize it for their organization. This requires the use of Android Studio and Dagger 2.0 for dependency injection and reconfiguring constants (like phone numbers).

The second roadmap available for customized injection offers three levels of customization, which is handled by MDLIVE. All three levels are based on the same code base and use the MDLIVE library. The three levels of customization are:

- Level 1: changes to colors, fonts, text and images
- Level 2: changes to the layout of activities
- Level 3: changes to application flow

Android users will have a better user experience relative to error handling and data validation. There is much greater clarity around what data is required and whether the data is valid, even

before it's submitted to the backend. There is also clear, on-screen articulation as to which fields are filled in correctly. When it comes to errors there will be no more guessing.

Android users will also benefit from deep linking. A link embedded in a web page can be made to link directly into any approved target within the application. With such capability, a user can make a doctor's appointment from a webpage, go directly into Find a Provider and authenticate during entry.

Benefits of the New Architecture

Both MDLIVE's partners and end-users will reap the benefits of the new design.

End users should experience extended battery life and improved throughput. They will also benefit from a more intuitive UX and more efficient workflows. And their PHI will remain safe at all times and under all circumstances.

It is MDLIVE's partners who will really experience the benefits of module independence. Because of the clear separation of responsibility between the modules, product maintenance and development is streamlined. Existing modules can be upgraded and patched independently. New modules can be developed without impacting existing modules. And changes to the core code base poses little risk to partner's code. In a similar fashion, any changes to partner's code poses little risk to MDLIVE's core code base.

Because MDLIVE chose to go pure native for both iOS and Android, each app will have the best possible code base. The apps will perform faster and with a higher degree of reliability. And each app will have greater and more tightly integrated access to all of the phone's devices and capabilities.

It's not just the technology though. MDLIVE's partners will also benefit from increased business opportunities. The flexible and robust SDKs offer more and better "white label" options for partners to brand the MDLIVE app as their own.

Summary

The MDLIVE Mobile Platform for iOS and Android are brand new, fully native designs based on a modular architecture. The result is a product which makes integration easier, while offering greater design flexibility and a more stable product.

The new platform, available for release in the first quarter of 2017, offer extensive benefits to both MDLIVE's partners and end users. From protecting PHI to an improved user experience, there is no doubt this best-of-class platform will be the industry gold standard going forward for 24/7 on-demand access to medical care.