Architectural considerations while developing Enterprise Mobile Applications

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Abstract- **T**oday's competitive environment is demanding employees to be productive on the way. Employees can work while at home, travelling or from on-site. Mobile devices are proving to be extremely helpful in increasing productivity of employees.

Enterprise Mobility is becoming an inevitable part of any organization and is playing crucial role in development of any organization. This paper is focused on discussing various aspects of Enterprise Mobile Application Development from an architectural perspective.

Index Terms- Enterprise Mobile Applications, Enterprise Mobility, Mobile Application Architecture, Go Mobile

I. INTRODUCTION

In the present era of mobile, deciding the mobility strategy is gaining a lot of attention for any organization. In a broader sense the mobile applications can be classified as:

1) B2C (Business to Consumer) Applications
2) B2B (Business to Business) Applications

A. Business to Business (B2B) Applications

Business to Business (B2B) applications mainly focusses on various interactions viz. transactions between the businesses. B2B applications also defines the communication and collaboration between the various business units. B2B applications also caters employee needs to connect/interact with each other across/within various business units to fulfil the business needs.

B. Business to Consumer (B2C) Applications

Business to Consumer (B2C) applications mainly falls into Retail Mobile Application domain. Retail is considered as a sale from a business to its end-user i.e. consumer. B2C applications are targeted towards creating virtual market place where business and consumer can exchange goods/services against the compensation.

Another classification of mobile applications is based on the type of services provided by the respective mobile application.
The mobile applications are classified as
1) Enterprise Mobile Applications
2) Consumer Mobile Applications

A. Enterprise Mobile Applications

Enterprise Mobile applications are designed for an organization and are focusing on addressing the business needs of an organization. The Enterprise mobile application may interact with the existing system to pull/push data to/from the system. The typical tasks carried out by Enterprise Mobile system can be procurements. Order processing, Viewing Reports, On-Site reporting, Real Time data gathering (may be data processing in some cases, though the processing of data can be limited by the processing power of mobile device). Within a particular organization, the Enterprise Mobile Applications can be used by various departments like: Sales, Marketing, Production, Higher Management, etc. The Enterprise Mobile Applications can be related with Enterprise Resource Planning (ERP), Business Intelligence (BI) and Customer Relation Management (CRM). Many organizations prefer to adapt suitable MEAP (Mobile Application Development Platform) to build mobile applications.

B. Consumer Mobile Applications

Consumer Mobile Applications are mainly focused on end customer. These types of applications mostly provided services based related with user location, Social Media, mobile commerce, etc. Generally these are the mobile applications which provides context-aware services. These apps mainly focused on user interests, likings, geo-graphical location, user intentions, user time zone, etc.

II. THE NEED OF ENTERPRISE MOBILE APPLICATIONS AND STEPS TO 'GO MOBILE" FOR ENTERPRISE

The mobile revolution which was started by Apple in 2007 after launching of iPhone has totally changed the face of mobile spectrum. It has generated the "Going Mobile" need for enterprise to be in and lead the competitive market. Mobile has proven to be very effective way for an Enterprise to extend its services to large amount of consumers. Every organization is striving to improve the way in which the services are delivered to employees and end customers. The main focus is on accelerating the employee productivity and enhancing the end-user experience. CIOs of companies are having mobility on their high priority list. Every Enterprise is looking for building their own presence in mobile spectrum.
The following are the steps for any organization willing to "Go Mobile"
1) Define Mobile Strategy
2) Develop mobile application Strategy

3) Development, Deployment and Management of mobile applications

A. Defining Mobile Strategy

A Mobile strategy is a plan devised in order to decide / create / improve mobile presence of any organization. A typical mobile strategy is based on some factors and answers to some of the below questions.

1) What are the problems faced by employees and end customers presently?
2) How "Going Mobile" can address their problems?
3) Which all sections of Enterprise needs mobility?
4) What are the applications needed in Business to Business (B2B) and Business to Consumer (B2C) categories?
5) What application strategy is needed for Business to Business (B2B) and Business to Consumer (B2C) applications?
6) Does Enterprise have backbone (mobile network infrastructure) in place for mobility support or Enterprise need to build mobile network infrastructure?
7) In case backbone is available, is that capable of serving mobile applications or Enterprise need some modifications to it?
8) Does the staff is literate enough to use mobile applications or Enterprise need to educate them?
9) If the training to staff is required, what will be the level of training is required?
10) What is the mobile usage index in the geographical areas where the end customer is based?
11) Does organization will provide mobile devices to the employees or organization is willing to follow BYOD (Bring Your Own Device) policy?
12) What MDM (Mobile Device Management) methodology Enterprise need to follow in order to maintain the security/authorization for Enterprise data?
13) Which all mobile platforms needs to be targeted?
14) How the application(s) are going to be distributed to the end user?

B. Development/Refinement of mobile network infrastructure

Any organization may or may not have the existing enterprise system (which may provide web/desktop interface). In case of existing system, organization need to think on extending the same system for mobile applications. It need to build interface for mobile applications to interact with.

In case of absence of such system, the organization need to build it in order to support mobile applications.

C. Develop mobile application strategy

A Mobile application strategy is a plan devised in order to build effective mobile applications.
This plan should be in line with the organization's mobile strategy. It should cover the various goals to be achieved through the mobile applications. It should address the network and security constraints of the organization. Mobile Application Strategy should help to decide the platform and architecture. It should also help to decide the development methodology for the applications.

D. Development, Deployment and Management of mobile applications

Finally organization needs to develop the applications. Once development and testing is carried out, organization need to deploy the application. The deployment is highly driven by the platform selection of application. The Business to Business (B2B) applications can be distributed through Enterprise licensing model which ensures that the application is available only to the specific users (for instance Employees). For Business to Consumer (B2C) applications, organization may prefer to distribute the application through application distribution platforms which are typically provided and operated by respective platform owner. Below are some of the application distribution platforms:

1) App Store – iOS
2) Google Play - Android
3) Windows Phone Store – Windows Phone
4) BlackBerry App World – BlackBerry

The organization also needs to make sure effective management of these apps. B2B applications can be managed by leveraging one of the available Mobile Device Management (MDM) solutions.

III. IMPORTANCE OF SOUND MOBILE APPLICATION ARCHITECTURE

Application Architecture is the design process and its outcome is structured approach which will fulfil the business, functional and technical requirements of application. Mobile Application Architecture encompasses the set of significant decisions about the organization of a mobile application.
Developing an architecture involves:

1) Selection of the various structural elements within application and their interfaces by which a system is composed.
2) Architecture specifies the behavior as specified in collaborations among those elements.

The Architecture is related with decomposition of the system into various components or modules or various subsystems.
Architecture defines:

1) Component interfaces – Component interface is related with capabilities of component i.e. what a component can do. Interface extends the details about what a component will do when one tries to consume the component.
2) Communication among components – Architecture details out the various communication channels which can be consumed when one component consume/provide services from/to other component.
3) Dependencies – Architecture lists out the dependencies related with functionality or consumption of any component.

A. Importance of Architecture

A sound mobile application architecture always leads to the successful application delivery. The good software architecture is very important to the success of the project/application because:

1) Good architecture always aims for higher quality keeping the cost low.

2) Optimizations can be carried out in better, efficient and easy way.
3) It promotes the better code reusability in turn leads to faster software development.
4) Good architecture ensures the scalability, performance, modifiability and maintainability of the application.

The below sections list outs the various advantages of architecture to various stake holders of the system.

B. Advantages of good software architecture for end-users

1) Performance – The performance of application plays an important role in mobile applications. Mobile users expects quick response from the application specifically compared to desktop/web applications. If the application is taking long time to retrieve or display the details, there is a high possibility that the users would not like the application and they might stop using the application. A mobile application architecture should ensure to meet the performance expectations of the users.
2) Availability – Good Architecture should ensure the availability of the application. Availability is one of the important requirement of Enterprise Mobile Application. Availability refers to the virtue of the application to be available to server when user needs it. If user is in need of using the application and it is not available at that time may lead the user to move away from using the application.
3) Usability – Usability plays an important role specifically in case of the mobile applications especially considering the small amount of screen real estate availability. The architecture should be built to ensure the usability requirements of the application.
4) Security – In Enterprises, data is of the prime importance and Security of the data is one of the major non-functional requirement of the application. The good architecture should always be robust enough to address the security concerns of the Enterprise and it should be in compliance with the organization's security policies.

C. Advantages of good software architecture for developers

1) Maintainability – Considering the requirement change due to change in environment, market, demand, Enterprise Policies, always there is a need of maintenance for the Enterprise Mobile Applications. A Good Mobile Application Architecture ensures the high maintainability of the mobile application. It reduces the efforts and complexity of the change implementation which is in favor of the developers.
2) Reusability – Reusability always leads to faster application development and structured development approach. Good Architecture always considers the reusability aspect during design of components and interfaces.
3) Portability – Portability is the ability of the system to react to the environmental changes. In case of Enterprise Mobile applications, the change in environment may be frequent considering the technology, market, demand changes. These changes may result in change in servers, database, etc. The good Mobile Application Architecture ensures the system to be portable enough to respond to these changes keeping the impact of change at minimal level.

4) Testability – The Enterprise application needs to undergo rigorous testing processes in order to ensure the consistency of the application under various conditions. This raises a need to rigorous testing of each component/module of the system. Good Mobile Application Architecture ensures that the each component is separately testable.

IV. ARCHITECTURAL CONSIDERATIONS

Building an architecture for mobile application involves a lot of considerations. A wrong decision taken by ignoring / misunderstanding any of these considerations will lead to product failure which in turn result in loss of organization. The various architectural considerations for Enterprise mobile applications are listed below.

A. Platform Selection

Any organization willing to "Go Mobile" need to decide the mobile platforms to be supported. The selected platform may be iOS, Android, Windows Phone, BlackBerry, etc. Some organizations may opt to support multiple platforms.

B. Development Approach

Depending upon the types of platforms to be supported, the development approach could be Native, HTML5 or Hybrid. These approaches are briefly discussed below.

1) Native – Native mobile application development approach is specific to a given mobile platform and it uses the development tools and language that the respective platform supports. For example, Native Android development is carried out using JAVA language.
2) HTML5 – This approach uses standard web technologies, typically HTML5, JavaScript and CSS. The application developed using HTML5 runs in browsers of the devices.
3) Hybrid – This approach uses the HTML5/JavaScript approach in combination of power of the native platform by wrapping a Web application inside the native container and leveraging the bridge available to interact with device native features.

B. Client Type

The application strategy helps to decide the type of client needed. The mobile application can be designed to be a Rich client, thin client or rich internet client.
1) Rich client – The Mobile Application will designed as a rich client when it requires to carry out local processing and likely to operate in an occasionally connected scenario. Generally a rich client applications are more complex to maintain.
2) Thin client – If Mobile application strategy denotes that the application will be governed by server processing and will always be fully connected, then the architect should suggest and design a thin client.
3) Rich Internet Client (RIA) - If there is a need of a rich user interface, not much access required to local resources, portability to other platforms is of high priority, the architecture should built for a rich internet client.

C. Device Type and Capabilities

The selection of devices to be supported by the application is an important decision for an Enterprise. When choosing which device types to support, below factor plays an important role:

1) Screen Size – The fragmentation in Android devices in terms of various screen sizes has considerable impact on the decision to decide the supported devices.
2) Resolution (DPI) – Considering this is important factor majorly when it comes to support Rich User Interface.
3) CPU Performance Characteristics – CPU performance is very important specifically for Rich Client mobile applications.
4) Memory and Storage Space – Some mobile application may require high amount of processing which may demand high RAM whereas some mobile applications may demand larger storage space to store the application data. Enterprise need to consider these factors while deciding on the devices to be supported.
5) Native Feature Support – Some applications may require usage of native features like Accelerometer, GPS, Camera, etc. The selected devices should be capable of supporting these features.
6) Battery Life – The device battery life plays an important role in some of the mobile apps. The architecture should make sure the less consumption of battery. The battery intensive application features should be architect in such a way to reduce the battery consumption. Wireless connections like GPS, Backlighting are the examples of features which demands more battery.

D. Security Requirements

In most of the Enterprise Mobile Applications, data security is at most priority. The application architecture should be robust enough to secure the data accessed/consumed by the application. The architecture of Enterprise Mobile Application should be in sync with organization's security ecosystem. Any data stored on the device (in-memory or persistent) should be encrypted to ensure security. The organization may opt for Mobile Device Management (MDM) tool to impose security constraints on the application. The application architecture should be able to accommodate any interface to such Mobile Device Management tools.

E. Internationalization

An Enterprise may have its business across different geographies and languages. Supporting multiple language is an important consideration for Enterprise Mobile Applications. The architecture should have provision to support internationalization in an elegant way. The architecture should support addition of new languages seamlessly.

F. Internet Absence/Presence

There can be a requirement of an Enterprise where the application is expected to work in the absence of internet or in case of less internet connectivity available. The Enterprise Mobile Application Architecture should consider these scenarios and the application should be capable of storing and securing all the data which is needed by the application locally in case of no internet scenario. The application should also take care of securing the local data. Mobile applications should also cater to scenarios when a network/internet connection is intermittent. The Architecture should support state management in such cases.

G. Authentication

Most of the Enterprise Mobile Applications need users to authentic themselves before using the application. Architecting an effective authentication strategy is important for the Enterprise. This is crucial consideration for the reliability and security of the mobile application. There can be some challenges in implementation as:

1) Mobile operating system unlike desktop operating systems are built to be single-user system and does not provide user profile and security support beyond just a password (textual or pattern).
2) The application strategy should also focus on the scenario where users are trying to authenticate in absence of internet.

H. Authorization

An Enterprise can have different users holding different positions willing to use the mobile application. In such cases some of the application features may/may not be available to some user groups. This is something known as role-based access. The Mobile Application Architecture should be capable enough to switch on/off the access to particular user based on the access rights defined.

I. Caching

Here Caching refers to storing data locally for the application in case of instant access needed especially in "no internet" scenarios.

The mobile application architecture should not enforce storing of unnecessary data on a device and it is especially not good when device has limited resources. Caching decisions are highly driven by the frequency of data change. For example, in case of storing master data like list of cities, the data change frequency might be very low. But in case of stock market data, the data changing frequency is very high and there is always a risk of cached data getting stale. In this case relying on cached data may not work as expected.

The caching of Enterprise data always comes with a security concern. Storing of sensitive data in persistent/in-memory without encryption is a security breach.

J. Synchronization

In case of mobile applications, Synchronization may refer to syncing the local data with Enterprise server. In case of Enterprise application, data synchronization will often involve sensitive data. The security of synchronization data over the air is required. The mobile application architecture should suggest elegant ways to handle connection interruptions graciously during synchronization. This can be achieved by abandoning the operation or by allowing it to restart on connection availability.

K. Logging

Logging refers to the process of storing some information on device for later use. Logged data can be used to troubleshoot the application issues or to judge the application behavior. The log synchronization between the mobile logs and the server logs provide audit capabilities on the server.

The mobile application should have some provision to pass on the logged data to server in order to analyze the same. For logging, application architecture should consider the limited memory on mobile devices and accordable demand limited logging.

L. Architecture Type - Layered

The layered architecture is suggested to be the best for Enterprise Mobile Applications. The layered approach improves the reusability and maintainability of the application. The layered approach leverage the concept of layers to maximize separation of concerns.

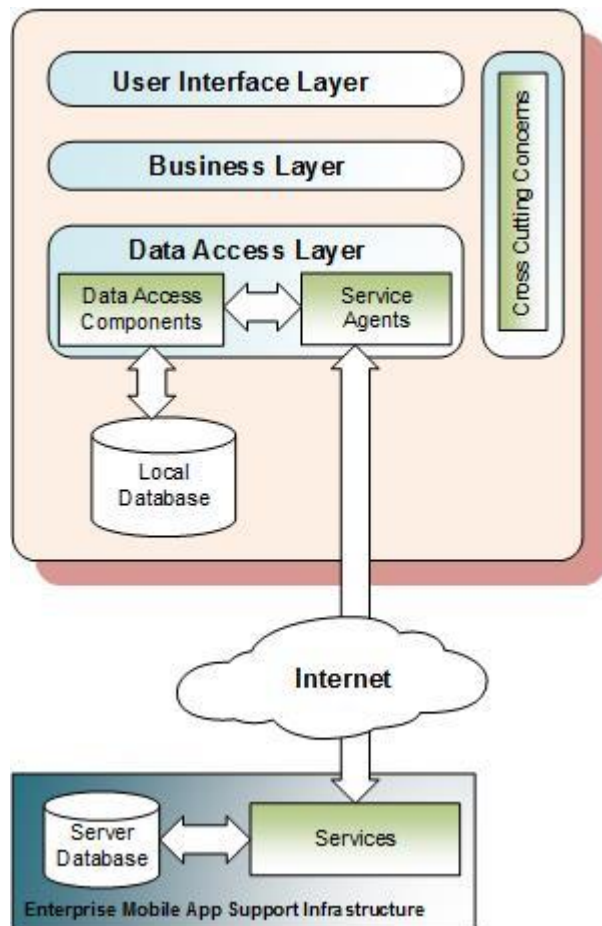The typical Enterprise Mobile Architecture looks like:

Figure 1: Typical Enterprise Mobile Application Architecture

i. User Interface Layer

It is also known as Presentation Layer. Presentation layer presents the application user interface to the user and it also accepts the inputs from the user.

ii. Presentation Layer

Presentation layer presents the application user interface to the user and it also accepts the inputs from the user.

iii. Business Layer

Business layer holds the business components, various business entities and it governs the business workflows.

iv. Data Access Layer

The main function of Data Access Layer is to abstract the data access from the rest of the application. This layer ensures to retrieve the data from local data source or Enterprise server depending on the business needs.

v. Cross Cutting Concerns

Cross cutting concerns are generally the application non-functional requirements which spread across the layers. Some of the Cross Cutting concerns are Security, Authorization, Caching, Logging, etc.

V. FINDINGS

Architecting Enterprise Mobile solution is one of the most important step for any organization willing to "Go Mobile". The Architectural concerns should be very well addressed during the initial phase of the application development. Any discrepancy in mobile application architecture can be very costly to fix for the organization. There are many strategy related and technical decisions are involved in arriving at an Enterprise Mobile Application Architecture.

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