Topic: Architecting Solutions for the Mobiles:

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Speaker Bio: **www.cse.iitk.ac.in/users/tvp/**

Speaker's Introduction: https://www.youtube.com/watch?v=FUXzO1qc9ug

Summary:

Have you considered the power that "missed call" brings to a mobile application developer? Missed call is not a service used just by individuals trying to save calling charges. It is used by corporates and banks. It has already started to eliminate huge call center costs.

Every mobile device, when connected to backend, offers the potential to deliver a wide range of services. Some examples are discussed in this talk. A lot more can be thought of and there is practically no limit. In this talk, the speaker starts with an abstraction and proceeds to architect solutions using mobiles that make use of device features (such as camera, SIM card and sensors) and back-end functionalities available with services providers. A mobile solutions architect is a highly paid professional. In this talk, the speaker shows how a learner here can also think up solutions and architect them.

Narration:

This is a slightly abstract presentation as to how we cut a solution to a problem using the mobile eco-system (Slide 1). I have drawn solutions in three layers. I will describe each of them one by one. We will then see how all these things come together.

The bottommost layer (note the red marking to the right) is the device layer, talking about the instrument we have in our hand. (This is a smartphone or a feature-phone)

For example, this device will have a touch screen or a keypad. It will have sensors- for example, the geo-positioning system (GPS), a light sensor, a gyroscope (to sense device orientation). It has a camera and a microphone. It will have a SIM card which will identify a phone number.

It will have storage which is independent or part of SIM card or both sometimes. And then it has a radio. By radio, I mean a communication device by which it allows a user to make phone calls or connect to WiFi. Given this kind of hardware on the phone, what can I do with it?

I can send and receive phone calls. I can also connect. By connect, I mean the data transmission abilities of the phone. I can store information locally.

I can sense various things. I can sense the environment. You can of course exchange audio/video. You can hear, speak and record.

Given what this device can do, we can construct a toolkit. I have an image of a Swiss Army Knife to represent what is possible in the middle layer. We can construct various kinds of things. For want of a term, I call it “Connect”.

What are the capabilities?

We can do the geo-location. By this, I mean we can figure out where the phone is at any point of time. We can do identity (ID) management, given that the phone has a SIM card with a number associated with it. And the user has some properties. We can combine all these to do some ID management. Let us look at these tools that are possible with devices we have today.

(Slide 2)

First is geo-location which allows to locate where the mobile is. It uses signals from three satellites. It is based on triangulation. Sometimes, it can also locate using cell phone towers. The resolution you get from cell phone towers is less compared to what you get from satellites which are able to locate you close to a few meters accuracy. Geo-location is one of the most powerful applications or tools that a mobile device allows us.

(Slide 3)

Next is what I call ID management. I have some examples. To start with, every phone or device has a SIM card. There is a telephone number associated with it. Given this phone number, we can do lots of interesting things. What do I do when a user complains of loss of password? User now wants a new or alternative password. It may be somebody even a false user masquerading to get access to somebody else’s email account. So one simple way for the user is to inform them, when opening new email accounts, what his/her cell number is. So when you ask for a password, it will send a key to registered phone number. If you are the real user (you are using the same number), then you will receive the key. You can enter that information and get access to the system.

There is another way to provide ID- SIM card coupled with a national ID number. One can then add a password to say that the combination of this national ID number, SIM card number and password constitute the ID of an individual. We can then deploy more sophisticated services, like micro-finance and banking, like it happens with m-Pesa. There are ways to use mobiles to ensure that a person seeking certain banking services is indeed eligible. This use case goes like this: let us say I am at a computer and I log into my banking using a web interface. What then the system does is to pop up a message asking me to call a particular landline number. The user is expected to give a missed call to that number in just two minutes. The system then knows/verifies that this bank account, being accessed online now, is registered with this cell number. System can compare with its database to verify if the calling number is the same or not. That is how you can provide an additional layer of security. These are simple examples of how you can manage your ID using a mobile device. ID management is a powerful technique. There

are many loopholes and they are getting better, with biometrics and fingerprints in newer versions of phones. All said and done, ID management is extremely crucial and there is huge scope for progress.

(Slide 4) The next tool kit mobiles provide is to sense the ambience. An example: there is an ambient light sensor. What it does is to detect if the device is operating in very bright or low light. Why do we need this? If the device is operating in bright light, the screen has to be bright or its visibility will drop. If in a dark place, screen intensity can come down. It will help in two ways: it will reduce battery consumption. My eyes will hurt less because I am not looking at a bright screen. Ambient light sensors are useful in this fashion.

Another very interesting sensor: if I take my phone close to my ears, some key may be touched or pressed. For example, it may be muted. If the phone recognizes that it is close to my face, it can then turn off the screen from being touched or getting active.

Most smartphones have accelerometers. They can sense if the phone has moved too quickly. This can be used, for example, for the care of the elderly. If the person has fallen with the phone, you can infer that from the phone, and the lack of movement thereafter. There is a pattern to every fall. Then you can trigger an SOS or SMS, or send a call to a person giving care. Rotation of the phone is easy to sense- heavily used in game playing.

Essentially what we are saying is that if you can sense what is happening to your phone, you can build interesting applications around that. This is another powerful tool that mobile devices provide.

(Slide 5)

When you connect this phone to a back end, more interesting things start happening. What do I mean by back end? A phone connects to a telephone exchange or to a WiFi connection. Once connected, I can make a phone call. I can also put in a lot of new services. I have added a lot of functionality at the back end, apart from simple telephone call switching.

Interactive Voice Response (IVR), as they call it. I can provide a menu of items which the computer will play. Users can interact in a variety of ways. Simplest is to press buttons. IVR is one way to provide services, and is a tool.

Speech recognition: if the bandwidth is good between the phone and the back end, say 3G or WiFi, the user can speak into the phone. Not just type via keypad. The user can talk. Today we can even talk about continuous speech recognition. GoogleNow or Siri (apple) are wonderful examples of what is possible. You can also do call-blasting; that is you can broadcast a message to a large group of people. All this is premised on having some functionality at the back end.

Mobile phone connected a back end allows one to do all these things to go into our solutions space.

(Slide 6)

Missed call: this is one of the smartest inventions of the common man, I'd say. You cannot help smiling when you talk about this.

It is said that telco's close revenue of the order of 20-30% because of missed calls. Because of missed calls, customers who would have completed the call, paid for it, are getting a service without having to pay for it. It is so well researched, there's even a Wikipedia article on it.

(Slide 7)

Missed calls are not because people don't want to spend money. We use this feature because it is easy to use. They are powerful mechanisms to communicate certain things.

If I have reached my destination, missed call is the easiest way to tell my people. Or, I want you to call me back because I don't know if you are free or not. I'm ready to talk so I give a missed call. You will call me back. I may be using a pre-paid phone with little money. I give you a missed call so you can call me back. What is interesting is that companies are using missed calls in a big way to save call-center charges and telephone bills. How do they do this? Earlier in this unit, I gave an example from banking: a user is authenticated based on missed call to a landline. Another simple yet powerful example: already rolled out by many banks. Let us say, I want to know the balance in my account: all that I do is to give a missed call. Inquiry for balance is one of the most popular queries from customers. A large percentage of banking transactions are from the customer to figure out the balance so s/he knows how much to spend. This is easy to implement. There's a registered cell number for every customer in the database. So, if a missed call comes from that number, send the account balance figure. You can register two numbers. If a missed call comes from the other number, the bank can send you a statement of accounts by, say email. That's going one step further. You have thus done away with a call center. All those infrastructure and operating costs have been saved by placing a small system there. Missed calls have moved into the corporate domain.

Here's another interesting example: There are cinemas which will give you a list of movies running and seats available for the next show. Most popular are: son/daughter reaches the college and places a missed call – taken as same as 'I've got there safe'. We have these services in the Ag domain. There are people who gather commodity process in a particular day. You give them a missed call and they will send you current prices.

So missed calls is a powerful tool. You can use this while cutting a solution for your problem.

(Slide 7)

Then we have what I would call *Design Patterns*. One is called "content caching". Mobiles often move into areas where connectivity can be poor. Let's say I'm reading a document. Since connectivity is poor, I won't have continuous access to material sitting on the server. Simple thing: cache it on local server. Mobile has an SD card. You can keep the current version of the document in the local store. There may be changes in the document at server. Or, you may make changes in your local copy. Synchronisation

will occur whenever connectivity is good – opportunistic synching. Content caching is a tool you can use whenever you have a large user base that is not continually connected to whatever service you are offering.

Next one is called sandbox: It is slightly more technical. Sometimes you develop a smartphone app which may inadvertently be doing unintended things without realizing it. So what phones do is to execute this in a sandbox. Sandbox: this is a wooden or cement box inside which a child will play. They will not get hurt. Outside the box it may not be safe. All the programs executed in mobiles are executed inside a sandbox, so that they do not harm or spy on other applications in the environment. This is a design pattern that is powerful and actually used.

(Slide 8)

Then we have what are called adaptive applications. What are these? They change their behavior dynamically. For example, they function based on your location. Let's say you are walking from place to place and you have entered a room. You have marked somewhere in your phone that this is the meeting room. You would want your phone to be silent during the meeting. Since you have registered that location, the profile can automatically change to a meeting profile, and not ring loudly when you go there. That's a simple example of an adaptive app. Another easy one: You have turned on WiFi, but now you are driving. You would want WiFi to be turned off. What the system can do is to detect that you're moving rapidly from your sensors, and turn the WiFi off. A simpler one: I'm listening to music, and receive a call. Music is then paused. It allows me to complete the phone call, and resumes where left off. Similarly with games. These are all examples of how apps adapt to an external event.

(Slide 9)

What does all this mean? Let us see Slide 1. I have the devices; they have some capabilities. Using them, I've constructed some tools. These are: ID management, speech recognition, missed calls; and when connected to server, send call blasts. So I have a set of tools. Given I have these tools, what do I do? I can use these to construct solutions. This (top of Slide 1) is my problem space, and I will use the tools I have. If I have to drive a nail into the wall, I'll use a hammer. Or, to place a screw, I'll use a screwdriver. Or will use a drilling machine to drill a hole. So there are various jobs and there are various tools. What we have in the middle layer is the Swiss army knife of a mobile app developer.

Let us see how these available tools can be used to solve a real-world problem.

You have heard the vKVK application which is a call blast service to farmers, giving them advisories and alters. How does it work? It managers the ID of users who have registered their phone numbers. It then uses the call blast tool. So, this too(call blast) and ID together – ID mgmt here is non-critical since no security issue is involved – make vKVK possible. Looking at Digital Mandi, a demo later in this course, where the farmers can ask for the process of a commodity. It does that by speech recognition. If you know/use GoogleNow, it can tell you, for example, how far is Delhi from where I am. It uses geo-location – knows where the device is currently. It recognizes your voice. It is connected to a server so it can do

some computation and search to let you know. Bank Access works on “missed call” and ID mgmt using SIM.

Given any problem, you need to use some of these tools to deliver what the customer wants.

Homework:

Each one of you is working on a problem of your interest. See which of these tools can work for you. Try to imagine the problem from the high level. Example: to do publicity, I need ID mgmt. and a call blast.

Note that the abstractions we talked about may not be complete! Towards the end of this course, let us come up with a comprehensive set which can help a developer deploy it for development purposes.