

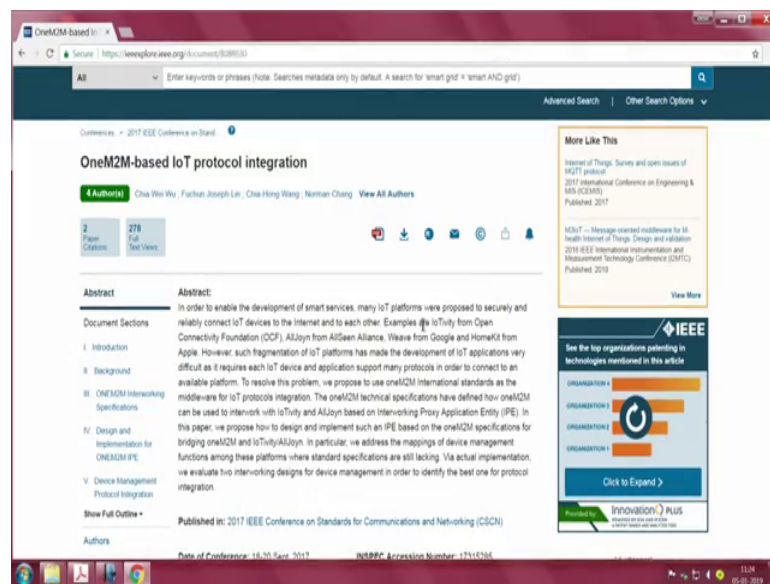
Advanced IoT Applications
Dr. T V Prabhakar
Department of Electronic Systems Engineering
Indian Institute of Science, Bangalore

Lecture - 41
First Responders – Application – Part 1

So, that is a nice SDP therefore, is a nice you know framework. The software defines the parameter for adding devices into the system. See the thing is that if you want, so here we have said that devices are of different layer link layer technologies right; you have Bluetooth, you have Wi-Fi, you have you know all kinds of very specific protocols which have to inter work under a framework and provide security for you.

This is not going to be easy and they have been efforts many years and trying to provide a sort of an IoT platform for despair a devices to get connected and yet you know share data across this different type of technologies.

(Refer Slide Time: 01:26)



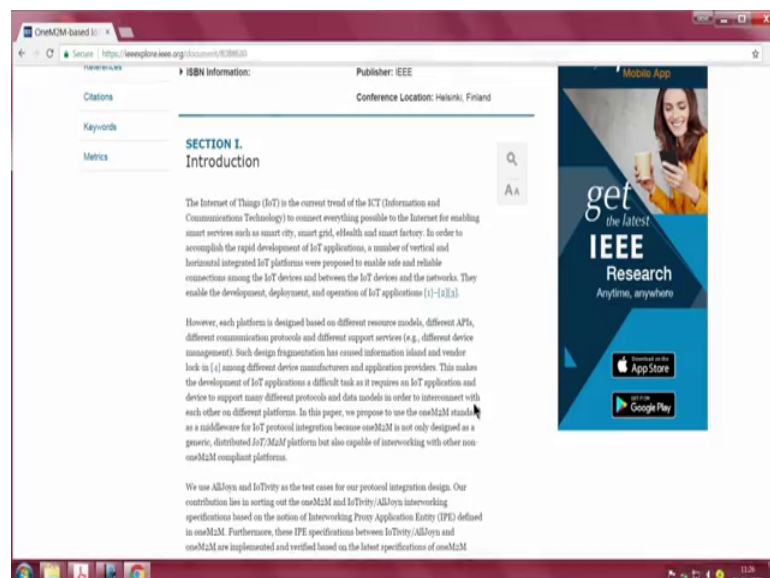
For example, there was this technology which was called IoTivity. As you can see here there was a protocol called let me just expand the just put this pointer here for you. There was this IoTivity from open connectivity foundation. Then there was AllJoyn from AllSeen, Weave from Google and HomeKit from Apple; all of them where all fragmentations. If you have to ask Weave to talk to something IoTivity based platform, it would not be possible unless you install both ok. So, this is not going to work if you are

talking about a first responder network. The first responder simply comes near the building, the device should get automatically authenticated and security keys have to be established and the SDP host and you know requesting and accepting hosts have to be identified. IPV 6 is exposed. You get data directly and start streaming and looking and look at what is happening in live, that is what our goal is. So, it is not going to work if you have these desperate technologies. Therefore, that paper also talks about a important I would say protocol integration called one to OneM2M IoT protocol integration.

Therefore, if you go in to first responder networks, you have to solve this problem of understanding OneM2M based IoT protocol and look at that framework and see how these desperate devices can all connect between them and therefore, all these protocols which are all fragmented the stuff would really not be a proper solution.

So, I am just trying to put you on path to look at OneM2M technical specifications that have been defined how OneM2M can be used to inter work with several of these existing technologies already; IoTivity or AllJoyn and so on. So, there lot of interworking proxies and all of that and essentially if you get this platform you know OneM2M based IoT protocol integration if you understand it well and you install this platform.

(Refer Slide Time: 03:39)



Then, whatever we are discussing really will be a reality to this complete system. I have some open thoughts on this first responder networks. Also from what I have been seeing and feeling a little depressed in the current days all over the country, we see some issues

and I am sure you will be able to connect to what I am saying and several of you may even have unknowingly you know got into this into this problem. Think about you are going on in a busy road, either on a two-wheeler or an in a your car or your private transport or public transport; you suddenly see that a person x or y has met with an accident and he or she is bleeding ok.

And what you do? If you are a human which we are we all are and human and we have concern for our community and all that. First thing we do is we get off, take that person, find an immediate closest hospital and take that person and admit that person to the hospital right. This is what we should be doing and this is what was happening for several years and there are so many good Samaritans out there who actually even today do this. But equally disturbing are also several pictures that we have seen on different social media and all that.

Where, people take out their phones and start shooting that incident right. Whatever is happening live, instead of going and rescuing the person; they are taking their camera and then shooting through their mobile phone. They are actually shooting that that incident. Now let us not go in to what is ethical, unethical, non-ethical and all that because that is a controversy which I do not want to rake up at this stage. But I want to bring in technology here just think about a situation that irrespective of who is shooting, if this video is available to first responders server. Because when you shoot you have your video and you have your Jio location which is available, exact location because you are standing right then and there and all the background that you can see that if it is a flyover, you know it is a flyover and all that with all that.

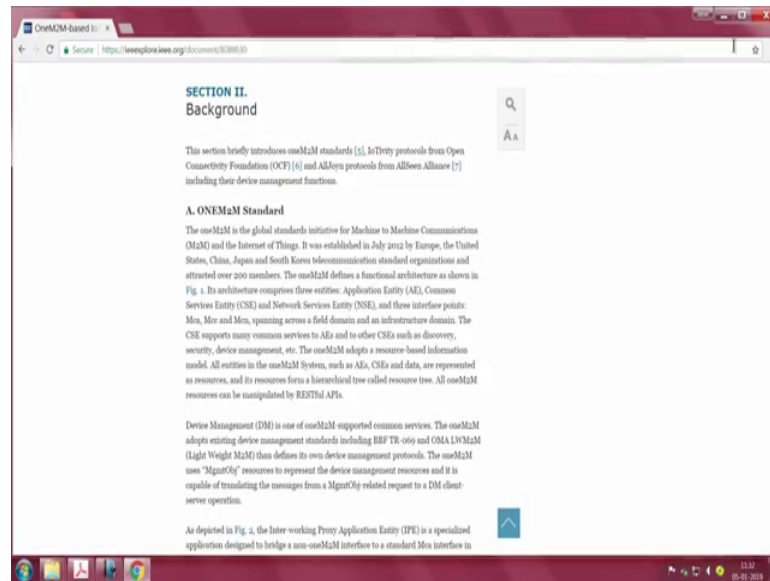
The network of first responders if it goes connects to a 101 services or it connects to ambulances, it connects to hospitals, it connects to all the nearby systems; then, you will have everything in place. Maybe if you are not able to do, the people who are supposed to rescue should at least come to that spot in quick time right. At least that can happen and since it is can this video is now getting screen to the nearest hospital or hospitals in a let us say a boundary of in a diameter of about 1 kilometre, hospitals there can be ready to because they see the pictures, they can be ready to provide the first aid and depending on the kind of injury that the person is involved in.

The roads can be freed, the signals can be given green; the ambulances can come, the police can come and whoever are there can come and actually rescue the rescue this system. But if you want to do all of this, it is nice right; it is great. Why would a picture taken from my phone actually be believed by the first responder right that is where the problem is. So, many times you may have a technology which is ready, but many times you cannot use the technology because the supporting infrastructure, the support security requirements and support infrastructure is not ready mature enough for the for the such a system to get enabled.

Therefore, if our phones have to transmit data video data of a scene, there is no reason why the first responder should believe that it is coming from an authentic source. Why should I mean it is like the usual you know phone calls that are made to say that certain object is placed here and object is replace there which can kill people and all that so lot of these things be here and you know they are all hoaxes right. So, why should this not be a hoax video? Why can why cannot it be a hoax video?

Most often 99 percent, it is not a hoax video, but it is those 1 percent people who can create more confusion and furore among you know all the community that really we have to read out. And all these mechanisms are for those 1 percent set of a hoax videos that are not even 1 percent; perhaps its 1 fraction of a 1 percent which essentially will have to take care. Therefore, you need a framework security framework for providing all this support.

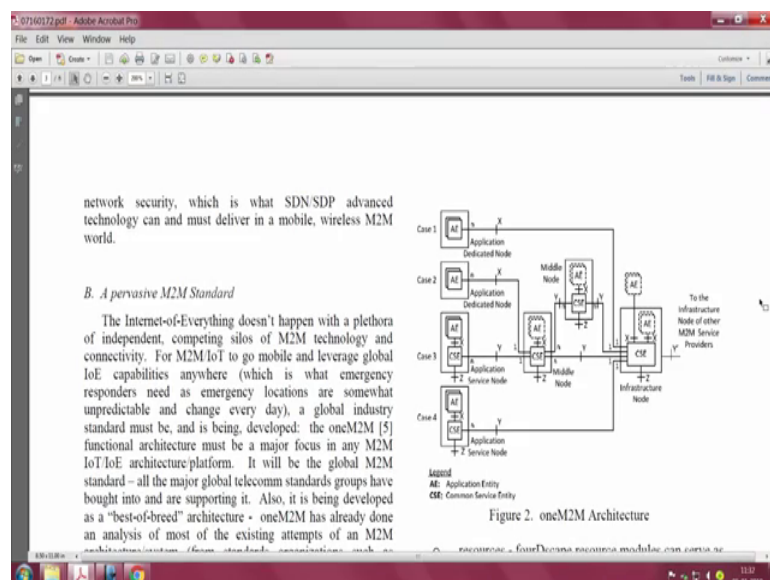
(Refer Slide Time: 08:58)



And this M2M OneM2M based IoT protocol integration will perhaps provide some for kind of support in trying to provide you that that framework under which your own mobile device could be trusted well.

So, I will not like to deviate the topic.

(Refer Slide Time: 09:09)



So, let us go back and look at what actually happened.

So, if you look at quickly to say that the OneM2M protocols standard talks about AE's which are Application Entities and CSE's Common Service Entities and that framework is something quite mature, I mean it is coming up.

(Refer Side Time: 09:30)

connectivity. For M2M IoT to go mobile and leverage global IoT capabilities anywhere (which is what emergency responders need as emergency locations are somewhat unpredictable and change every day), a global industry standard must be, and is being, developed: the oneM2M [5] functional architecture must be a major focus in any M2M IoT/IoE architecture platform. It will be the global M2M standard – all the major global telecom standards groups have bought into and are supporting it. Also, it is being developed as a “best-of-breed” architecture - oneM2M has already done an analysis of most of the existing attempts of an M2M architecture/system (from standards organizations such as ATIS, ETSI, TTA, 3GPP, as documented in their Architecture Analysis Technical Report) and are using that knowledge, plus evaluation of numerous M2M use cases in various vertical markets, as the basis for the oneM2M architecture protocol being developed. oneM2M focuses “on the Service Layer aspects and takes an Underlying Network-independent view of the end-to-end services. The Underlying Network is used for the transport of data and potentially for other services.” [6] What this means is that oneM2M will work on any network transport architecture, which is exactly what we need for globally addressable M2M devices to connect over heterogeneous end-to-end networks. [oneM2M achieves this with a layered services approach, specifically utilizing underlying Network Services Entity(s)]. oneM2M is clearly

Case 3
Application Service Node
Middle Node
Infrastructure Node
CSE

Case 4
Application Service Node
CSE

Legend
AE: Application Entity
CSE: Common Service Entity

Figure 2. oneM2M Architecture

- resources - fourDscape resource modules can serve as oneM2M “Application Service Nodes”, interfacing to a multitude of mobile devices, wrapping them to appear as compatible M2M devices.
- engines - fourDscape engines coordinate between 4D resources and 4D servers, and can serve as oneM2M “Middle Nodes” or M2M gateways.
- servers - fourDscape servers coordinate the data feeds to/from 4D resources engines and fourDscape browsers, which would serve as oneM2M “Infrastructure Nodes”.
- browsers - fourDscape browsers are the user interface to all 4D portal functionality generated from 4D resources engines servers, and would be the user-accessible M2M applications in a oneM2M architecture.
- fourDscape is already an IP addressable, networked

And therefore, the SBP part will actually fit in into this framework as well.

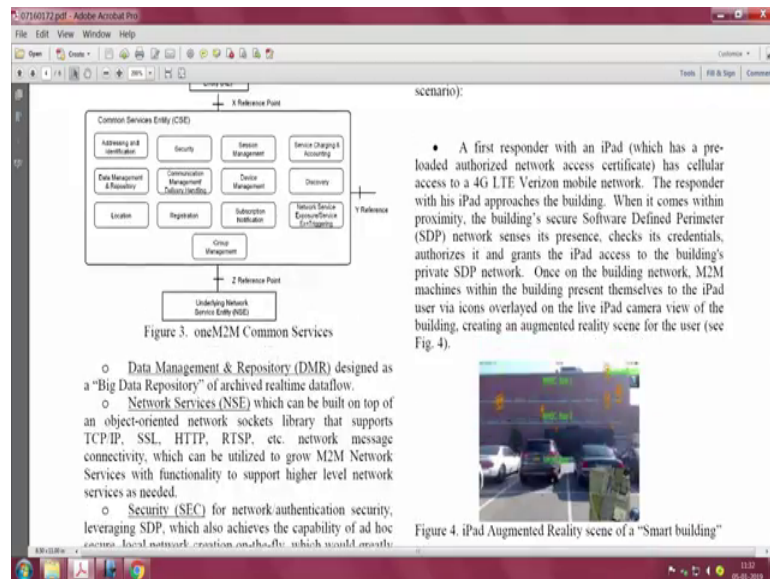
(Refer Side Time: 09:36)

underlying Network Services Entity(s)]. oneM2M is clearly the best reference architecture – any M2M solution not addressing and leveraging oneM2M would likely have a very short half-life with sparse pockets of deployment, which is certainly not the goal of the IoT. And with SDP providing the ability to deploy perimeter functionality where needed in order to isolate services from unsecured networks, SDP technology can protect and secure M2M nodes and services in an ad-hoc emergency M2M network – exactly what we need.

Our current research/analysis has also shown that Balfour Technologies’ existing, mature fourDscape software technology/architecture has a number of conceptual similarities to both oneM2M and SDP. This means that existing, commercial fourDscape can serve as the basis for an M2M SDP system architecture that can be operational now, and also continue to evolve into a comprehensive, compliant, commercial M2M IoT/IoE system for the foreseeable future.

- fourDscape is a layered architecture of networked components, similar to the oneM2M reference architecture. As is evident in the brief descriptions below, there is a very straightforward mapping between our existing fourDscape networked components and oneM2M defined components (see Fig. 2). It is not a big stretch to see how the existing fourDscape architecture could quickly support a oneM2M system structure.
- fourDscape is already an IP addressable, networked system of scalable components, which are already deployed and operational as a cloud-based system. This makes it ready to support both SDP and oneM2M in real-world M2M IoT/IoE deployments.
- fourDscape utilizes RESTful (http/CRUD/URI) TCP/IP, over heterogeneous net transport layers, which makes it both network independent/agnostic and capable of CRUD/URI accessible resources (like oneM2M).
- M2M Common Services Functions (CSF) – An M2M IoT/IoE platform like fourDscape will implement features identified as M2M Common Services (see Fig. 3 below), in a oneM2M Common Services Entity (CSE) package, such as:
 - Addressing & Identification (AID) of physical and logical resources in an M2M environment.
 - Discovery (DIS) of all available M2M nodes.
 - Registration (REG) of all authorized M2M nodes, which can also leverage the SDP authentication workflow, providing a quite secure ad-hoc M2M network.
 - Location (LOC), utilizing geo-data feeds identifying realtime locations of assets (such as vehicles) and/or devices (such as sensors, smartphones, etc.).

(Refer Side Time: 09:38)

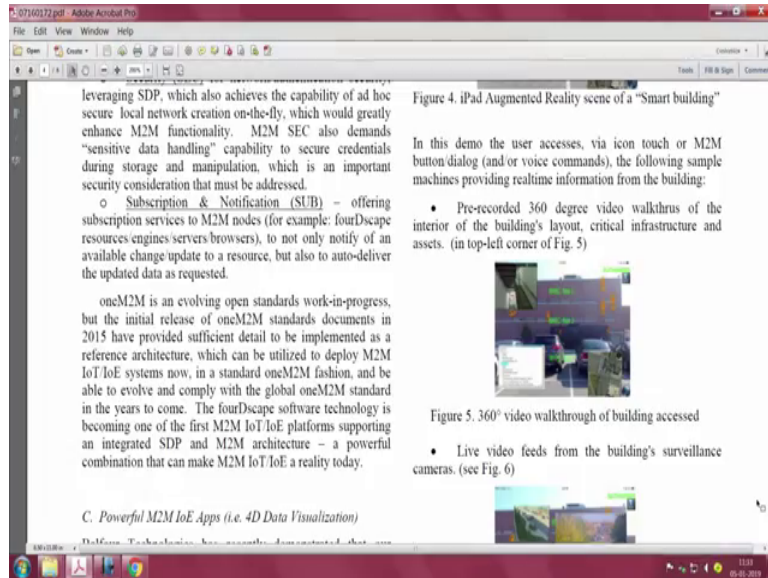


So, it is not without deviating too much. Let us look at some pictures and how actually things have happened look at this picture ok.

Here, is a picture of a iPad Augmented Reality scene of a "Smart building". Here I will read out this it is very useful; it is nice to see how it works. A first responder with an iPad which has a preloaded authorised network access certificate has cellular access to a 4G LTE Verizon mobile network. The responder with is iPad approaches the building. When it comes within proximity, the building secure SDP, network sensors its presence, checks its credentials, authorises it and grants the iPad access to the buildings private SDP network.

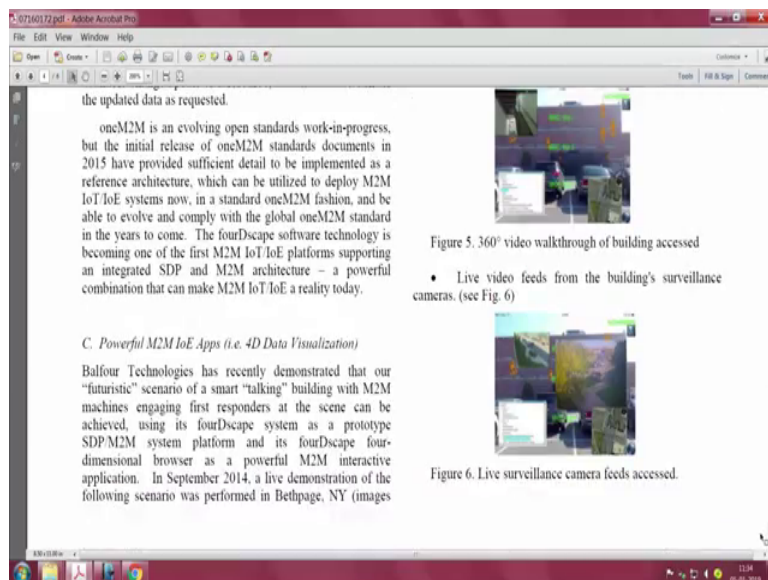
Once on the building network M2M machines within the building present themselves to the iPad via you know via iPad user via icons over laid on the live iPad camera view of the building creating an augmented reality scene for the user. What a fantastic way that a first responder is getting access to lot of information inside the building which is his primary purpose being to rescue people inside them.

(Refer Side Time: 10:50)



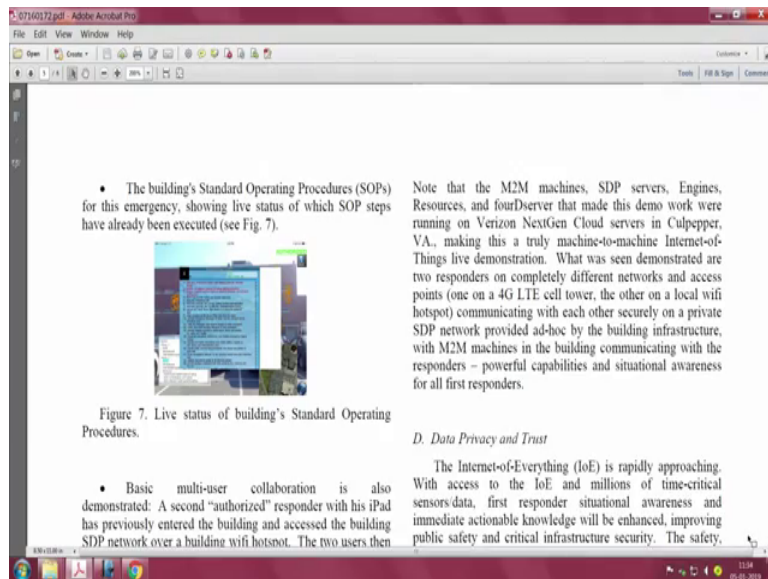
So, that demo is available you know and he gets into it and then he has a located right. Pre-recorded 360 degree video walkthroughs of the interior of the building is also made available to him and the he can also have a look at those pictures.

(Refer Side Time: 11:03)



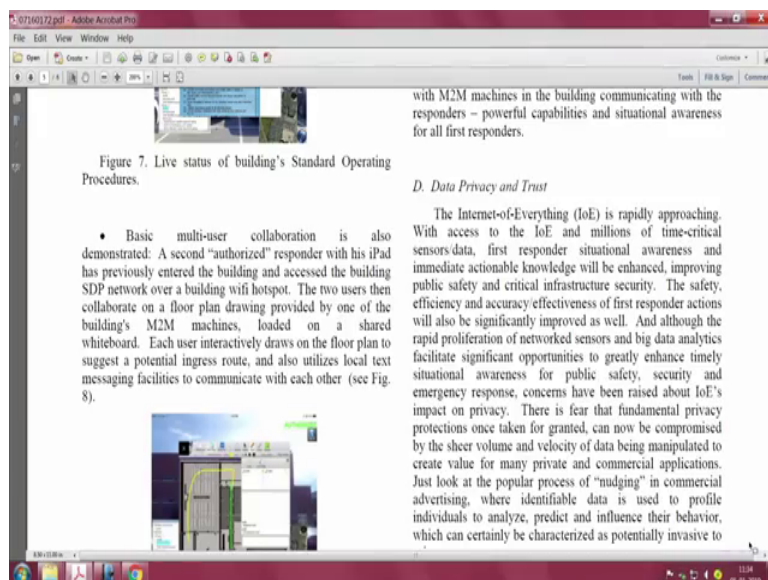
Live video feeds of the building surveillance cameras can feed information to him or her and so that the rescue operations become extremely smooth.

(Refer Side Time: 11:09)



Safe operating procedures for buildings live status of which SOP steps have already been executed is also shown so that some of the inmates who are there in the building trap they are have actually executed these SOP's. How much of them have been met is prior information to first responders to you know assessed help in you know rescuing inmates inside.

(Refer Side Time: 11:34)

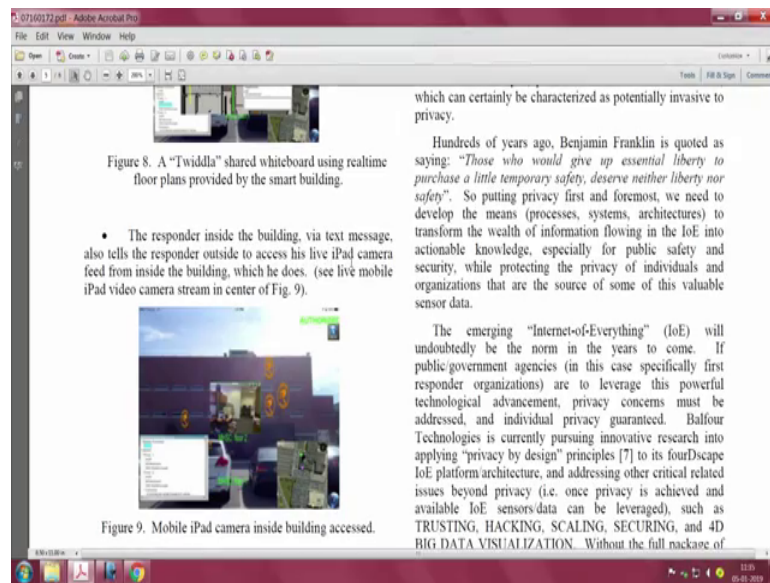


So, there is also possibility that just by not a single iPad connectivity, but basic multiuser collaboration also another thing that can be demonstrated. A single authorise responder with his iPad had as previously entered the building and access the SDP network over a building Wi-Fi hotspot. Now, you can do it with two users that can collaborate on a floor

plan, drawing provided by one of the buildings M2M machine loaded on a shared whiteboard.

So, essentially you are looking at both the users are looking at that whiteboard. Each user interactively draws on the floor map to suggest a potential ingress route and also utilizes local text messaging facilities to communicate with each other. So, that is another thing that you can do.

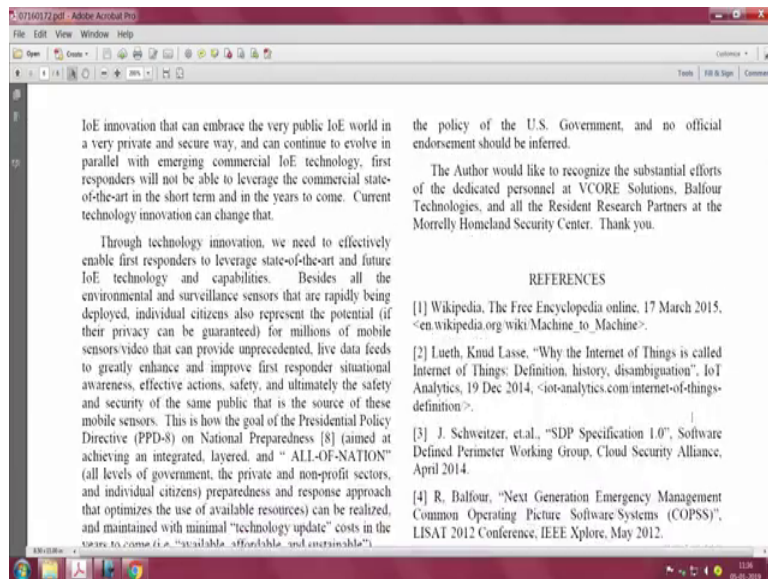
(Refer Side Time: 12:33)



The another thing that you can do is so these are what is happening between first responders, you can use text messages to tell the responder outside to access his live iPad camera feed from inside the building which he does. The responder inside the building via text message also tells the responder outside to access his live iPad camera feed and to see what is actually happening. So, you could share information of this nature.

So, all of this essentially means that technology could be used in extremely effective manner to and first responder networks in essentially is a platform to try out several of these M2M technologies in a very secure manner such that you know you meet your objectives. There are always problems of privacy and those that is also discussed in this issue.

(Refer Side Time: 13:39)



I mentioned to you also about the problem of live videos that we upload and those issues will have to be there. Sometimes the person who is fallen there may not want to be video graph for some reason right. So, that so without asking some ones permission, we are also doing it. So, they may be some privacy concerns; fight for instance forget about bleeding and blood loss and all that there may be some issues of people do not want to be you know video graph for some reason and that is right to their privacy.

So, you know access to this kind of video data is not is an incorrect way of doing it. So, lot of privacy concerns are there. We have to go bear everything in mind before we provide good solutions. This is one part of what first responders and SDP and OneM2M protocol framework and all that is all about. But another exciting thing that is happening to all of us, if you look around are new rules are coming up on use of flying machines for rescue search and rescue operations right.

Drones have invaded our lives and drones perhaps are the way by which several services will be made available to us. Amazon recently said that they will deliver several items using the drone technology right. Pizzas for instance can be delivered from a pizza outlet to one's home and then you know you could essentially pick it up in quick time. All of this means it is just not about pizzas, it could also be about medicines. In the first responder framework, it could be medicines. It could be drugs which have to be brought in. It could be blood samples that have to be taken to hospitals from a disaster site.

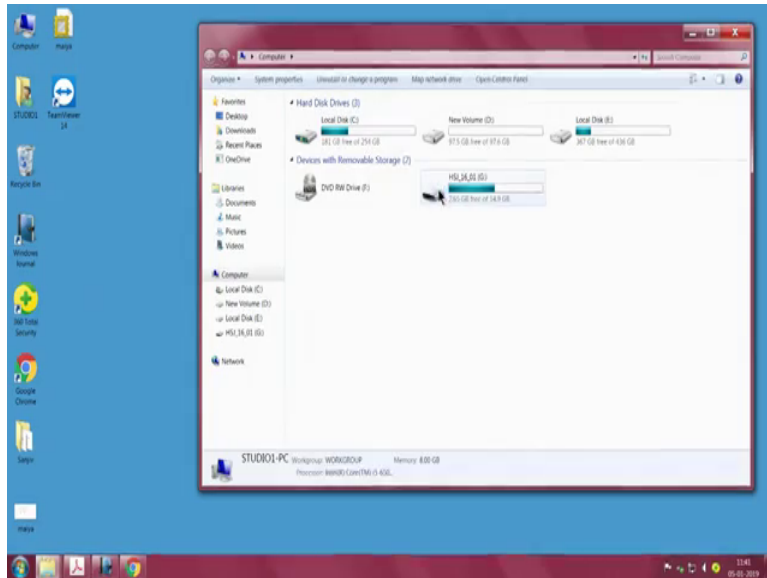
Suppose you want to prepare the hospitals on several on planning of blood requirements and all that, you may want to mark take off the samples put it on a quick you know a slide and then, put it inside a storage device and send it via the drone back to these hospitals which essentially means you will need accurate landing of these drones and accurate landing on either side and in between are this problems of you know drones not been able to you know having limited life for a flight time for typically 20 minutes to half an hour is what on full charge of a battery a drone can actually fly and pay load is an issue.

Different sizes of drones are available to take care of the payloads, but it is also useful to know what kind of technologies will be required if you want to support accurate landing of these drones ok.

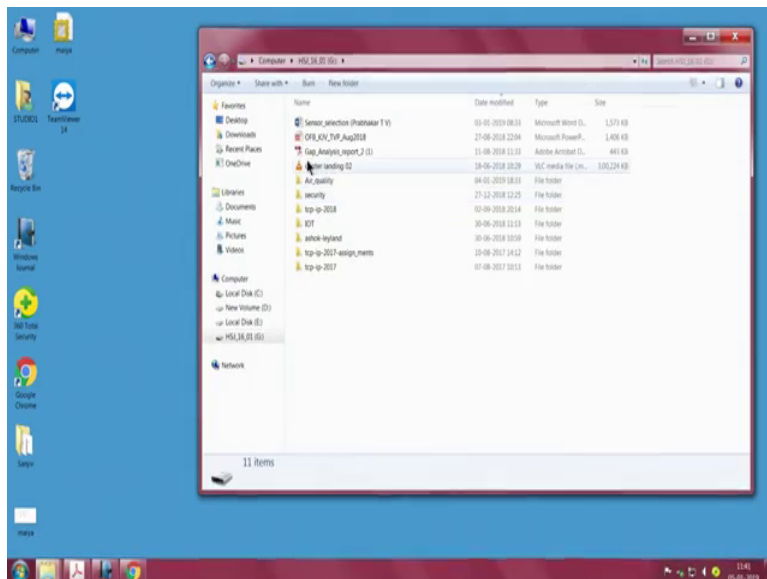
So, again it comes in the purview of first responders because it depends on how you look at it right. Why do you want a drone to land accurately? It could be for delivery of inside, could also be delivery of medicines. It could be to take items from that disaster site. So, this pizza delivery is a peculiar thing right. If your localisation algorithm is not so accurate or you yours ends up with lot of falls you know you know very grossly it falls away from where it should be landing; then, your pizza could actually get delivered to your neighbour right. So, that is something that might happen.

So, it has to do lot of thing. So, accurate landing is a very important requirement. Also as I said this charging of drones is an issue and you need to ensure that these are charge quickly before they can move on and you know provide services to all these first responder applications. Let us look at one video which essentially will drive you to understand what exactly is being done as part of this drone landing system.

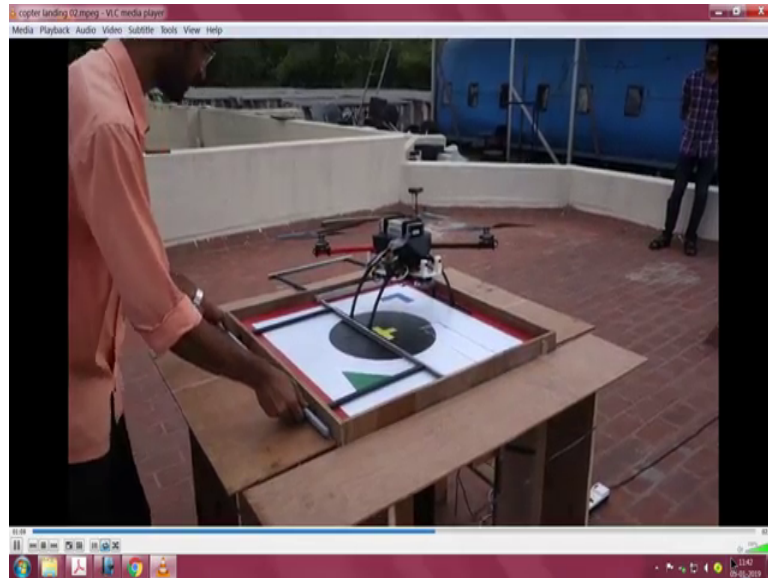
(Refer Side Time: 18:02)



(Refer Side Time: 18:04)



(Refer Side Time: 18:07)



I will play this video and I will cut off the audio. You can see now that there is a drone which has taken off and my student Vishnu has goes hands off. So, he has left it. Now the drone is on its own; its it has to land accurately somewhere. So, it moves and then now it is time for the drone to land either to drop something or to get charged by itself. So, it keeps you know looking for a location where there is a charging pad or a landing pad. So, you see that is the landing pad. It slowly descends down the landing pad. Please note that I am not landing on floor, I am actually landing on a platform. So, that is a lot more harder.

So, it comes down, it identifies, it looks for some marker, it identifies some markers; slowly it comes down and then it realises comes to some depth, comes to some height and then looks at those marker and then lands there. There you can see. It has landed now and then my student is has built this application for charging the drone in a wireless manner. So, there is this cay standard charger. So, he is at the moment using mechanical systems to toque the drone which can easily be automated and then, you can see that that the charging coils are mounted below will now come up and there will be a wireless charging system between the transmit of the coils in the receiver coils.

Essentially providing you support power for charging the charging the drone and after that after charging or in this case it is charging, it could be also delivery of items. Picking up items from the system, it takes that those items and then, goes up flies up and then there is a person there my student at the moment has not perfect at the art of making ensuring that it takes off all by itself. The take off itself is done manually you know by

that remote unit with using at elementary link, but then that can also be done very quickly and then you can see that it can take off by itself.

Where in this demo that we have shown you that this is a nice application which can allow you to use it in several scenarios including first responders right. So, let us see this once again. You see that there is a marker platform. There is a circle there. There is a plus mark and essentially you will have to use some sort of neural net application to do this object real time object detection and then, use those object detection algorithm to actually accurately land the drone right.

Now what exactly goes behind this technology is interesting. Because it is indeed not easy at all to do that that activity you may argue that why do you want to do wireless charging? Can it not be a docker; doch based wired charging as you can have contact pins? And then you can charge well that is another way of charging. We will not going to the detail, but what is important is it lands on a platform and it can do several things on that platform. To give you an understanding of what the complexity of that system is will be is an important thing.