Blockchain Architecture Design and Use Cases

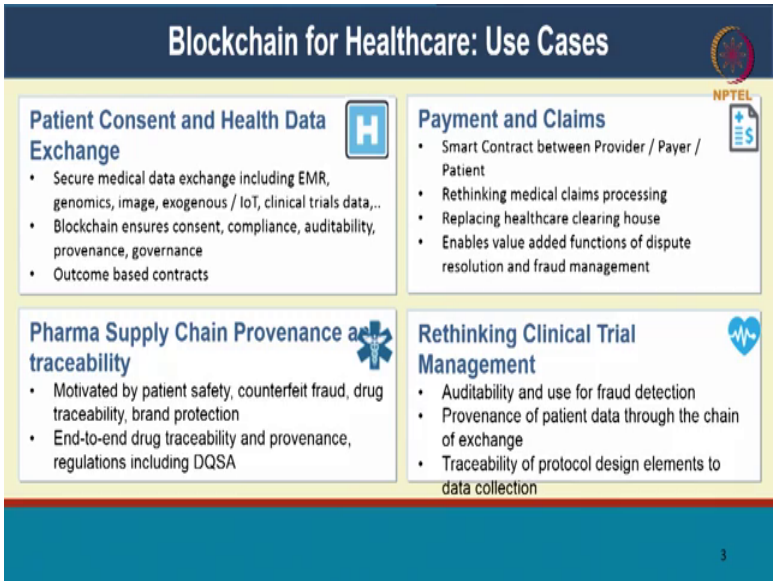
Prof. Sandip Chakraborty
Prof. Praveen Jayachandran
Department of Computer Science and Engineering
Indian Institute of Technology, Kharagpur

Lecture – 37
Blockchain in Other Industries

Hello, everyone and welcome back to our Blockchains course. We looked at two industries, we looked at financial services, we looked at supply chain use cases and Professor Sandeep will be talking about government and public sector use cases, but I just wanted to give you a little bit of a flavor on various other industries in which blockchain is being used today. It is just sample examples; I will not go to do too much detail.

So, the first industry you look at is healthcare. This is again a very blockchain is slighted to make a very big impact in the healthcare industry today.

(Refer Slide Time: 00:53)



So, some quick use cases in the healthcare space, right. One is patient consent and health data exchange. So, I will give you an example right. So, today let us say I am I have gone to a particular hospital that I usually go to, they have my medical history with them. So, it is great whenever I go in there I get there the any doctor I meet there in that hospital immediately has access to my medical history.

But, let us say I am travelling I am going to a different hospital it may be a different city now for god forbid this let us say an accident and I get into a emergency situation and I am rushed to a hospital there. Now, that other hospital has no idea who I am. They have no information about my medical past. There are this information as to whether I am diabetic or not, some of that kind of information is very critical and the kind of medicines you can prescribe to that to that person.

So, one of the use cases that is making waves of how blockchain can make an impact is a health data exchange. So, what if these hospitals can all talk to each other and are able to exchange information about the patient with each other. Of course, this is all private information, but has to be stored very securely and it also has to be it is private information about me as a patient, right. So, then it requires my consent or the consent of someone high authorize and only after they provide that consent can the data exchange happen, right.

So, that whole process of consent and data exchange can be something that can be captured on a blockchain and because this is all private information is highly secure and needs to be audited, blockchain provides that capability as well. So, later on the bank can prove that in fact, they did get the patients consent before exchanging the information and the patient can also have feel secure that their information regarded and they have the rights to disclose their information.

So, they can determine when and who they disclose that information to. So, that is again a very big use case that many people are looking at and there are people looking to put this out in production as well. So, the second kind of use cases around payments and claims. So, of course, healthcare is very closely related to healthcare insurance and of course, there is a very large amount of money that is involved. So, of course, when I go and get healthcare from a hospital, the hospital they expect me to pay for it and I am usually I am I am insured and so, the payment on at least a large portion of that payment will come from the insurance company directly. So, that again there is actually multiple parties in the ecosystem and fraud again is a big part of this. So, can we can we automate some of these claims processing and payments on blockchain and we can actually think about very new models and which insurance can be provided with some of this information coming on blockchain and some of that automation coming in.

The third use case they are on the pharma supply chain type. I think I briefly mentioned this in one of the earlier lectures, there was also video I had in the fun reading section. The pharma supply chain has a lot of traceability aspects as well as compliance aspects, right. So, there are very strict rules on how a pharmaceutical codes have to be transported across some of them maybe I have to be refrigerated and so on. So, there are compliance rules or and instructions business instructions on how to process these things across the supply chain and we want to be able to trace that.

Again, a big problem a very relevant to India as well is counterfeit. It is estimated about 25 percent of the drugs out there in the market today in India is actually counterfeit and that has a serious implication on safety as well. So, if your taking counterfeit drugs it can actually cause health issues for you so, you want to be avoiding some of those issues, right. So, patient safety is foremost and we want to avoid counterfeit drugs.

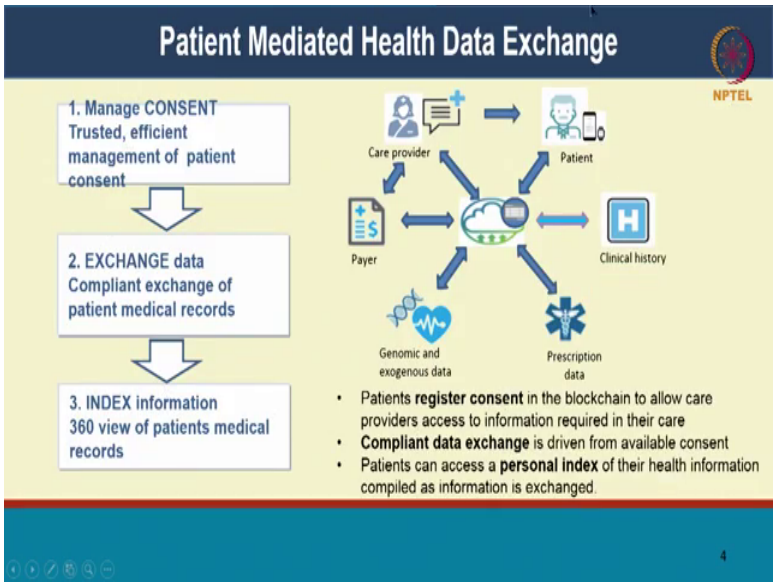
So, imagine if you can go to a pharmacy when you are buying that drug you can actually scan it and you can verify it across an entry in the blockchain where they actual pharmaceutical company that produced that good, as well as the company does is it something that transported that good both give you proof that they were indeed the ones who handled it and this they tell you how it actually came into be. So, you know that it was not counterfeit for instance. And, there are also regulations and bond. So, a regulatory authority can immediately have visibility to this, they can verify that the due processes is have been have been followed.

And, then there is a whole area around clinical trial management. So, today there is information there is getting exchanged between multiple entities on clinical trials. So, today if you think about it about pharmaceutical industry again if they look at maybe hundred different maybe molecules or whatever they use in a drugs maybe only one of those one of those hundred trials might actually be even they might even take it to the level of producing a drug.

Once they produce a drug maybe out of that one percent maybe 0.2 percent is might to actually be something that will get to a retail store. The remaining 0.8 might have side effects might have other issues they might not eventually make it to the retail store at all. So, all along the way from the time something is detected as having a medicinal property till the time a drug is reduced to being verified, validated and actually coming to a retail

store there is a lot of steps involved, a lot of management and documentation that that happens there and of course, fraud also and we will not to be able to track and trace this whole clinical trial process itself. So, that is again is a big use case in the healthcare industry.

(Refer Slide Time: 06:55)



So, this is the patient mediated health data exchange I briefly talked about in the in the previous slide. So, what are the steps involved you want to be managing consent from the patient. So, the patient is the one who has to come in and then maybe digitally sign of transaction and put it on blockchain saying I am authorizing this particular hospital to access my health records.

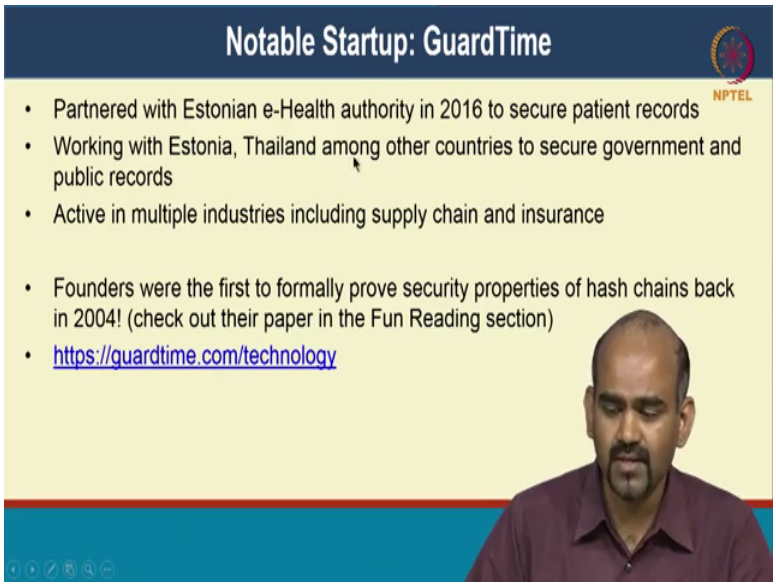
So, there is a consent that is placed on blockchain and there is an exchange of data there is compliant with the records. So, it is only that patients record that is getting shared from maybe hospital A and hospital B. I am using hospital in a genetic sense this could be any kind of health care provider, it could be other institutions as well and the patient will be able to have a 360 degree view as well as a hospital we can have a view of all the patients that they manage, right.

So, all of this can be provided and a similar use of this is for instance once this kind of healthcare information is associated with a blockchain it is also possible to use some of that information for clinical research again, right. For instance, let us say you are studying cancer patients right you are doing cancer research what we could do is actually

anonymize that information again you can provide that proof on blockchain that the data has been sufficiently anonymized, it can be aggregated and then can be used for research and again that audit log of how it was anonymized, aggregated, so that private information is not disclosed.

So, there you are not disclosing the fact that this record is actually mapped with this particular person real person in this world. So, if once you have anonymize that then it might be to use for a search and it happens today that this kind of medical information is used for a search after anonymization, but now blockchain can come in and provide the proof of such exchange.

(Refer Slide Time: 08:46)



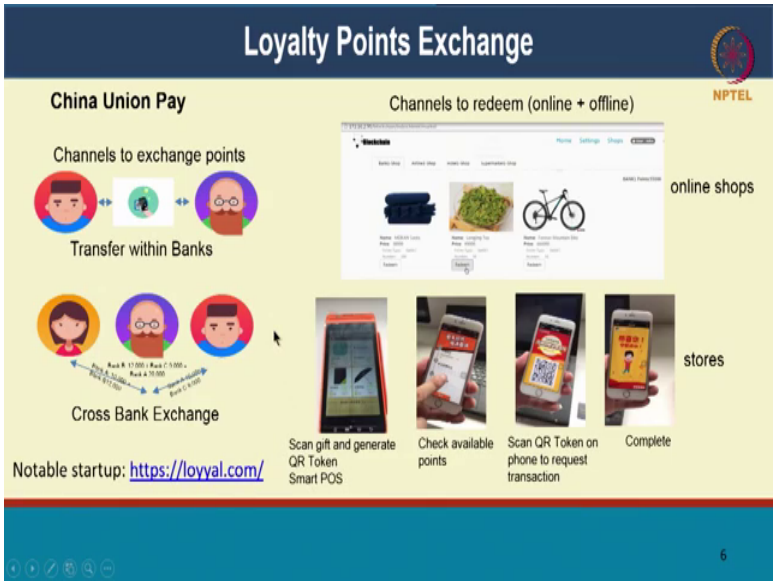
So, this is a very notable startup called guard time making waves they were doing a very good job in this space. So, they partnered with the Estonian e-health authority in 2016 to actually secure patient records in Estonia. Think about Estonia was very small country. It is actually not that hard for them to capture medical records on blockchain. The Estonia has also been in the forefront of leveraging blockchain for various use cases.

And, guard time actually worked with Estonia and Thailand among other countries as well. To secure government public records which also have a similar flavor to healthcare records, but maybe healthcare is a lot more stringent in terms of regulations, but you can imagine the same thing with government public records as well. So, they have done some good work in that space.

They are also active in many other industries including supply chain finance and insurance, ok. But, what is most interesting for me about guard time is the fact that the founders have got time at least some of the founders where the ones who actually proved way back in 2004, some of the security properties of hash states of how if you chain multiple transactions together. So, that the second transaction has the hash of the first that third has the hash of second that is a hash chain, right.

So, they actually were the first to mathematically prove some of the security properties of hash chains, back in 2004. So, you should look them up they have a very nice website and some simple explanation of their technology itself, right. So, it is a very cool startup in my opinion.

(Refer Slide Time: 10:16)



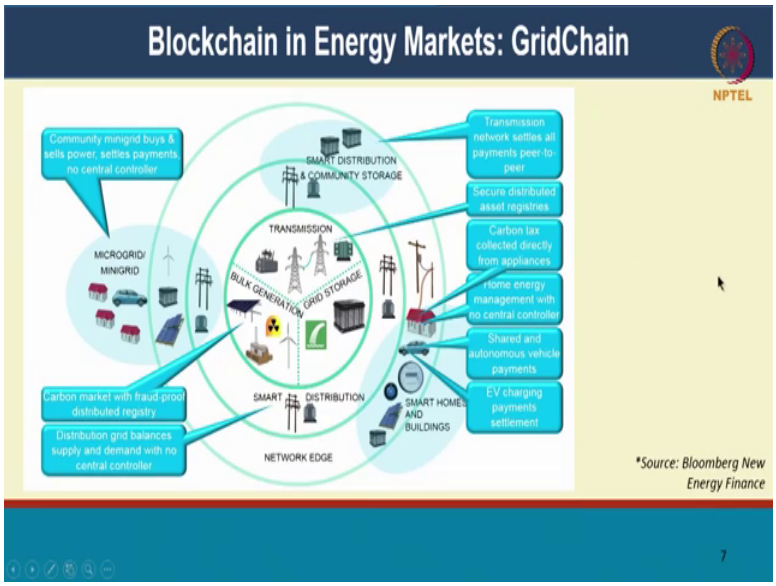
So, another use case which is also being very popular lots of startups in the space is loyalty point's exchange. So, think about this. So, this is again worth that we have done with china union pay, it is just it is this representation of many other people who have done a similar use case.

So, think of in today's world there is a large fraction of a promotional points or these reward points that never get utilized and that is actually wasted marketing first in some sense for the entity that is actually providing these reward points. But, what if we hired an ability to exchange reward points across multiple businesses? This could be for instance multiple banks coming together and they all have a mechanism by which I can

earn points in one bank, but actually the redeem it in another bank, that would be cool right?

So, they have this kind of a consortium of banks coming together on a blockchain platform, where end users can actually earn reward points or a loyalty points from any bank in this in this consortium and of course, I can redeem it for goods and services of any approved provider across all the all of these banks. So, this is just how a simple representations shows the kind of process and there is actually nice startup in the space are called loyal. So, they are also they are doing a lot of interesting work in the loyalty points exchange space, ok.

(Refer Slide Time: 11:42)



Yet another industry rates and the the intent of this is to show you the extent of reach of blockchain of how various industries are looking at blockchain for a variety of use cases of how blockchain can transform their use cases of their industry.

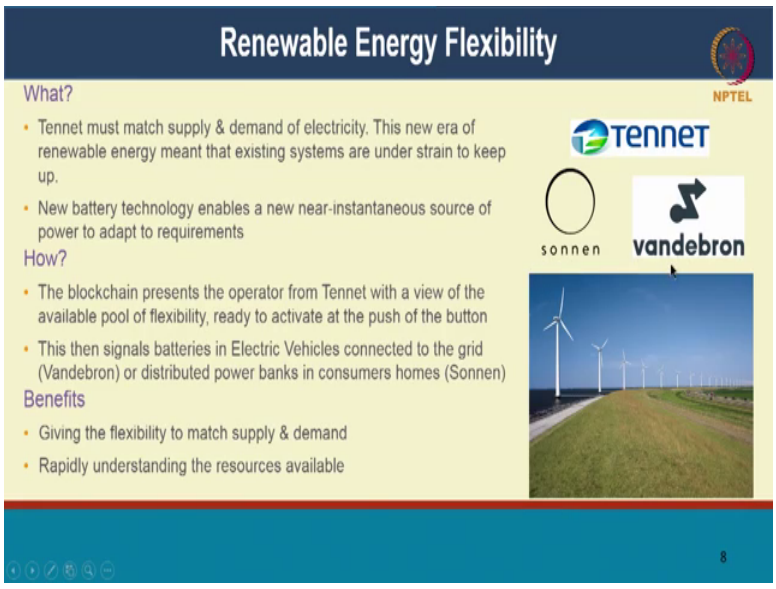
So, energy markets: so, think so, here let us say there is a there is a micro grid maybe this is solar, right. So, there may be homes, it could be small grids that are existing the roll all connected with each other in a small micro grid. So, these micro grids are actually emerging today India is also very big in the solar in solar space we are growing and the prime minister is there set has set a target for us it might be 2022.

So, there is these micro grids which have a need to match supply and demand again between producers of power with consumers of power. Then maybe some of these excess power might get distributed across and there is a smart distribution phase. So, there may be transmitters and so on, that are involved here and then there is a core grid along with storage in and bulk generation. So, this might be coming from thermal power plants and it is connected to that.

So, this whole ecosystem consists of smart grids, smart homes with maybe smart meters that are involved for instrumenting it might be buildings as well, office spaces, distributed distribution sector and storage, right. So, all of these are import and what do you want to do is intelligently match supply and demand. So, and once we match supply and demand we also want to have a payment go through automatically.

So, what people are looking to do is in some sense assetize the energy units. So, each time if I am producing let us say 10 units of energy, I will get 10 tokens crypto tokens potentially back from the from this market, from this ecosystem and I can exchange that crypto tokens for money likewise if someone wants to purchase power they will have to first purchase crypto tokens and then they can actually exchange those crypto tokens for actually energy assets, right. So, so, that kind of a whole marketplace is coming into being

(Refer Slide Time: 14:15)

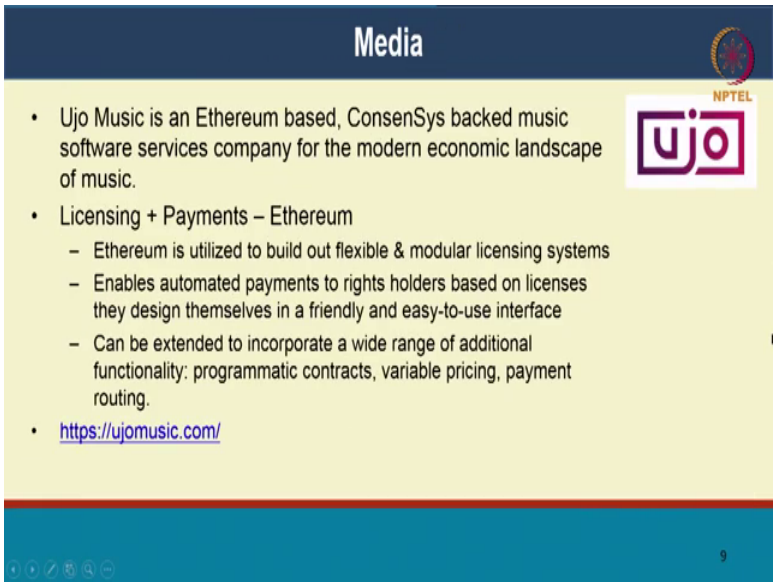


There is a startup called tenet they are working with a couple of utility companies and they are called core goal is exactly this. They are matching supply and demand of electricity and they are actually doing this for renewable energy. So, they have a these some of these utilities they are working with have wind farms where they are producing energy and they have battery technology which enables you to temporarily store energy for a certain period of time and allows you to instantaneously adapt the requirements needed.

So, basically it is it is managing supply and demand flex. So, these if your supply is in excess you would store that temporarily and then solve future demand and they also have a bunch of electric vehicles connected to this ecosystem and then these electric vehicles you can determine when to charge these electric vehicles based on maybe whenever there is excess supply, right ok.

So, this whole flexibility of matching supply and demand you know almost near real time basis on blockchain is what this company is trying to do right. So, again they are looking at cost benefits and real time visibility into supply and demand has their core use case.

(Refer Slide Time: 15:35)



In the media; so, in the media industry again there is a lot of active work going on about leveraging blockchain for the media industry. So, today artists let us say I am independent band or it could be let us say I am a producer, a music producer. When I

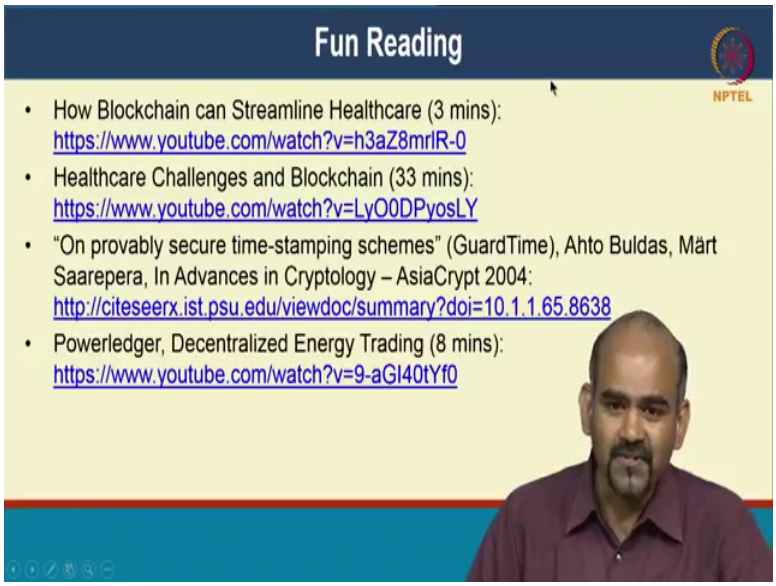
serve my content I might be hosting it on let us say YouTube, I am going to take the YouTube just as an example. Today, I am fully trusting YouTube to tell me how many people viewed my video or audio and based on that YouTube will give me on a pay per view basis right. So, each time I my video is viewed I get a certain amount of money. So, now I am dependent on YouTube to tell me exactly how many times my video was viewed and there is a lot of instances where producers artists have complained that they are not getting a fair share for that content.

So, this interesting startup Ujo Music what they are doing is they are they are based on Ethereum it is a platform we have not discussed Ethereum yet, we will talk about Ethereum later in this course. But, they based on Ethereum and it is backed by what they are doing is they are bringing licensing and payments on to a blockchain platform. So, think of it as the content producer will place their music or maybe a hash of that music on a blockchain and say I am making this content available for people to view. The block chain will track how many times people viewed the content and based on how many times people viewed the content you the in the producers can get paid for it, right.

So, this may this ensures that there is fairness across the ecosystem, no one party is going to cheat the other of their view. The buyer of the music gets exactly original content. So, they can verify that this content was actually prepared by this legitimate producer. The producer has a benefit that they get exactly for how many times they get paid for exactly how many times this video was viewed and there may be a facilitator or a market provider who is going to be providing the infrastructure and the service is listing of the videos. They provide the infrastructure to be able to actually stream the videos from the producer to the consumer, right.

So, this whole ecosystem can be again trapped on blockchain and we can ensure fairness and we can ensure automated payments and so on, right. That is it is a very interesting startup looking at blockchain in the in the media industry.

(Refer Slide Time: 18:13)



So, just some fun reading for this course for this lecture hm. So, one on How Blockchain can Streamline Healthcare. So, just 3 minutes. But, if you are looking for a more detailed view of how blockchain can impact the healthcare industry, this is the 33 minute version of the video as well, so, longer video. So, this the next one here is the actually the paper the guard times what is now guard time their paper back in 2004, which talks about how some of the security properties of hash chains and how they can keep data secure. So, this is a fairly rigorous paper to read that would give you give you that word of cautions.

So, I would recommend this if you are probably pursuing a PhD in security perhaps then it might be a useful read hm. I have to admit that I only understand this from a very conceptual level right. So, I do not understand the math. So, I have myself not gone through this in detail, but if you are pursuing a PhD in cryptography or in security I would encourage you to read this paper, alright. There is another interesting startup called Powerledger which is again doing Decentralized Energy Trading, they have a nice video on YouTube this 8 minutes you can take a look at what they are there doing in their energy space.

With that thank you that concludes few set of lectures we had on various use cases of blockchain for variety of industries and I hope I was able to give you a flavor of how the blockchain has a very far reaching impact on various industries.

Thank you.