FOUNDATION OF DIGITAL BUSINESS

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Week 01

Lecture 04

Lecture 04 : Overview of Emerging Digital Technologies - Part 2

Good morning. Now I will take the second part of this overview of emerging digital technologies. We covered IoT, the Internet of Things, and in this session, I will talk about cloud and edge computing, blockchain technology, and discuss some of the pitfalls of artificial intelligence. I will be doing a large module on artificial intelligence separately in the third or fourth week, and then we will talk a about AI. I will not talk much about it here, except we can just highlight some of the disadvantages, problems, or challenges of AI. We have to be careful about many things when we talk about AI. Cloud and edge—I will explain what cloud really is.

Cloud is the use of comprehensive digital capabilities delivered by the internet for organizations to operate, innovate, and serve customers. It eliminates the need for organizations to host digital applications on their own servers. What it essentially means is that every company runs their operations in a digital data center. You have servers—if you know what a server is? Stacks of servers to store your data and, of course, do all your internet browsing, web browsing, emails—everything you need a server for, because you have to communicate with something

else outside your organization and, of course, to store all your digital data. That is one of the major requirements—the storage part. You need a data center. A data center means you have a separate air-conditioned room having racks with many servers and, system administrators maintaining the systems and the data, etc. Then sometimes the servers can crash—digital devices, electronic devices—they can crash. When the server crashes, then your business gets impacted. Whatever part of the business which was using that server stops.

To run your ERP for example, it has to run on a server because it has to record all the transactions happening and then it will generate lot of transaction data. You have to store the data somewhere. That is why the servers are quite critical to an organization today. All these IT outsourcing which you are seeing, the IT business like TCS, IBM or Accenture or Wipro, Infosys, Capgemini, HCL. You read about these and many hundreds and thousands, of the engineers today they pass out and then join these IT companies and what do they do most of them? They are doing application maintenance and development services.

Which means the global companies, the large companies, their data centers, big ones, obviously big companies, big data center like Nestle, General Motors, Coca-Cola, the banks, big banks, British Telecom, etc., the oil companies, Shell, British Petroleum, their entire IT systems are being supported and maintained by these people who are sitting in India ,through the internet. They are doing whatever change, some new thing, if something goes wrong, crashes, they are all servicing from here. The entire support staff are physically sitting in India and maintaining the servers located at the companies data centers. That is the outsourcing business that we are seeing around us.

Why they have done it? Obviously, to save cost, their salaries are very high and Indian employees are much cheaper, they are knowledgeable and thanks to internet, you can do it from anywhere. That physical constraint is not there, that I have to be near the machine or this is my server I have to sit next to the server that requirement is gone today again thanks to internet. This give another idea that if I have this virtual data center or I own a big data center, but I do not need all of it. I have got lot of spare capacity. which I can give it on rent to people who need?

To understand how it works, I will give you an example of a hotel. Suppose you have got a marriage party going on in your family and you are expecting 50 of your relatives/guests to come and stay for 2-3 days for the marriage function. You book 50 rooms in a hotel ? Or you book 100 rooms for 100 guests or may be 50 rooms for 100 guests. For 3 days you pay rent but you do not buy any house do you.

That is the difference between having your own data center and the cloud. Cloud gives it on rent and you can take it for 3 days, 2 days, 1 day whatever you want. Now, suppose suddenly day before the wedding 10 of your guests are unable to come for whatever reason like somebody is fallen sick or whatever urgent work has come. Out of 100, 10 will not come, for the 10 you had booked 5 rooms, now you do not need those 5 rooms.

You tell the hotel that you do not need 5 rooms. Instead of 100 y will need only 95 rooms. So, you will pay for 95 rooms.

The hotel has got a big order from you, you are very happy, and they will adjust. In another situation, apart from 100 suddenly 10 more people come and join. Initially they said they will not be able to come. You did not consider them, but now they said no we are free and we want to come. You need 5 more rooms and instead of 100 you now need another 105.

You ask the hotel whether they have another 5 rooms. It is available and you take those extra rooms. What it means first is the capacity is changing on a day to day basis. and it is on demand. But if you buy your own server and make your own data center whatever you have bought is your capacity more or less whatever it is. Today suddenly year ending you have a huge volume of transaction and you need more capacity. However, the servers whatever you have that is your capacity. If you need more capacity, you cannot do anything because buying a server takes time as you just cannot go to a shop to buy a server and start using it.

But in a cloud situation, you go to the cloud provider, and tell him that for 2 days you need extra capacity. After 2 days that requirement is over and you release that capacity and you stop paying extra. This is how this model works. This is the beauty and reason why it is becoming popular, because I do not have a fixed capacity and I can get extra capacity on demand if I want today something more, I can get it today. It just takes 5 minutes or 10 minutes to login and book that extra capacity, pay the money and start using it . Response is fast and I can either get the extra capacity or release the capacity just like that you know as we talked in 2 or 3 minutes.

These are the features which has made cloud very popular. Firstly, it is an OPEX operating expense, not a Capital expense. You are not buying anything, not investing anything, just paying a rent. It is like the difference between buying a house, you have gone to work somewhere, Mumbai, you know that you will be there for one year or two years, you do not buy a house, you go and take rent. First thing is you take a rent, but later on if you think no, I will spend the next 30 years of my life here, then you probably think of buying something. As already explained, this is the most important criteria behind the success of cloud technology. Getting capacity on demand/ rent.

Greater speed and agility, to create value more quickly because the response in procurring is fast and you get your extra capacity fast. This speed and agility etc is

helping you to create the value for the customer, You cannot tell the customers, I have ordered for my extra server, it will take two months to come, please hold on for two months, then only I will give you my extra service which you wanted. Here in a cloud, you say fine, I will give you the service from tomorrow. Developers use cloud service to build and run custom applications.

Today as a developer, you can book a space in cloud and develop your apps, and hardly paying anything. Most of the apps will be free to get the APIs and you can always develop a product without buying any hardware that is the thing. To maintain infrastructure networks for companies of virtually all size specially large global companies are expensive and difficult. With cloud, you do not have to maintain anything.

The cloud service providers, they offer services such as analytics to handle and manipulate vast amount of data. These analytics and AI and all these things we are talking about today, it needs huge computational power, to run those statistical tools or engines. Now, where will you get that computation power from? You have to buy or go to the cloud service, to get it on rent.

Which is the better choice? Obviously, getting it on rent is a much better choice because you do not know whether it will succeed. You might fail, you might call off the project, you can stop, but once you buy something means it is your for good, you cannot get rid of it. Time to market decrease because now you do not have wait time for anything. You just get the cloud the service which you want at a very short notice ,not even days you can get it in few hours. Your time to market obviously is much less because you are not waiting for anything.

Feeding innovation to deliver better products and services across the world. Hence, everything you can see the speed, time to market, etc. reduces by a great extent. It is all because of that I can get that capacity almost instantaneously. No other technology can provide you such flexibility, and such advantage and that is the reason why cloud is becoming popular.

There could be some negative things like data security. If you talk about data security or the cloud service providers can exploit you once you are hooked on to a cloud you cannot change. There are pluses and minuses, but the advantages are huge, and so large that they just outnumber your disadvantages. Now what are the various types of cloud which we have? It is called infrastructure as a service. Always it will be AAS (as a service).

Now that first letter can be anything, it can be I for infrastructure, P for platform, S for software, B for business process. Sometimes we write XAAS means anything as a service. That is the principle of "as a service". For the cloud everything is "as a service", as you do not buy anything just pay monthly rent. Infrastructure as service for example, Amazon, AWS, Microsoft, Azure, Google cloud they provide you the infrastructure you want to store many terabytes of data store.

You want to put some software there, install your software there and run your business. You basically want a hardware server, you get it already that is infrastructure as a service. Now, what is platform as a service? Now, these are like AWS, Elastic Beanstalk, Google App Engine or Microsoft Azure. These also work as platform-as-a-service in the sense, they will provide you other software and APIs , which you can use to develop your own software.

Suppose, you are developing an app and you need lot of APIs, you need Google map, you need some GPS systems whatever. All of these things are available from the Platform provider. You can just simply drag and drop these. In that platform they are providing all of these tools like Android for example. Android will provide you all the Android tools on a Google platform in the Google App Engine and there I go I take on rent and I start building my app

and whatever Android features are available. It is available to me either free or may be I have to pay some price for getting those features. Same with iOS - Apple, for example. Same thing for Apple they have got a huge platform iOS. You go there and develop apps. These are the two biggest platform provider service Apple's iOS and Google's Android and you can develop your apps for whichever system OS.

Software-as-a-service is like all these gmails, github, dropbox, MS Office. These are all basically softwares, available for use , either free or on payment. These softwares are hosted in some cloud. Where, you do not know, but you are using gmail and you do not pay anything as it is free. Software has to be hosted in many servers somewhere and Google is doing it. Similarly, business-process-as-a-service, which is basically business applications like, online payments, loans and order and account management, payroll, purchasing etc. is another cloud based service. Salesforce.com for example, is a very popular customer relationship management tool. The product is hosted on a cloud and can only be used on a rental

mode as Business Process as a Service. If you want to run a campaign for example, for your team advertising campaign , you can go to Salesforce.com site and book that campaign thing for a duration depending on their their pricing model and pay for the services. They will give you that cloud facility for whatever time you want and you run your campaign on that and you get your output results whatever it is. There are many such software for payroll or purchase operation processing by companies. You can do your purchase management entirely through a business process on a rental basis.

You can pay may be say per user and you have say 4 purchase person in your organization. You need 4 licenses and may be you are paying 1000 or 2000 rupees per month as rent and these 4 people can do all the purchase job on the cloud using that, business-process-as-a -service andcreating purchase orders, tenders, floating tenders, whatever. If you do not have any ERP or other purchasing software in your organization, you can use it on a cloud on a rental basis. Now, there is something called cloud, and there is something called edge computing.

Edge—or fog, it is al called fog or edge—means it is closer. The cloud, you do not know where it is, but the edge has to be somewhere very close to you. Why edge is required is that it gives you a very fast response. Many healthcare applications or self-driving car using visualization, hazardous industries etc.—many such applications cannot afford to have latency, in the sense you need the reaction very fast. As an example, if you take an autonomous car, which is moving on the road and it sees an object. The radar detects an object, needs to get quick response from the server to slow down or brake. The communication between that radar-sensitive object and the instruction coming back, and the identity of the object ,should happen within a fraction of a second; otherwise, accidents can happen.

If your network is slow or takes time, then whatever the quality of your car may be—accidents will happen. That is where we need to think of edge computing, where that portion of the cloud should be closer along the road or the highway, such that response comes in the shortest possible time and , that latency can be minimized. Another example is, say, in an operation theatre, remote operations, robotic surgery are being conducted. The sensor information has to come to the screen fast, and the surgeon could be remote. Suppose you are doing rural medicine.

Doing an operation somewhere in a rural area or giving a suggestion, etc, and the doctors or surgeons are away in a remote city. There again, the time between the sensor sensing

something and the doctor getting it and giving advice also has to be very short, or the surgeon taking some robotic action has to be short. These are cases where we talk about something called edge computing, which is nothing but a cloud—the only thing is, it is much smaller and closer to your field of operation. The majority of the final data storage will be in the main cloud where it can go, but the temporary immediate activity can be handled by this device called edge computing computing. Why edge computing? Actually, I have already discussed that latency can be a reason for failure. Latency means the time it takes for healthcare, financial transactions, stock markets—for example,

they take decision very fast based on whatever information or data is coming. The stock market people have to react very fast, and then there's the driverless car, which I told you about, and some applications that require significant bandwidth. The surveillance systems, for example, for security purposes with cameras, etc. That huge amount of data has to go, and something has to be detected very fast. Security in a border line, or in a campus or housing society, etc. In all these things, you need a very fast response and the ability to handle a large volume of data.

These are the scenarios where edge computing works much better, and cloud computing would be very risky. Because of the time factor—latency. Some applications of edge computing: the oil and gas remote monitoring offshore platform. This is a very risky venture—something can happen, like fire, etc. at any time. It has to detect very fast any leakage of gas, etc, and then the supporting action should also happen very fast. It cannot wait for a long time for the fire extinguishers to kick in.

Traffic management—I already talked a little bit about it. Similarly, grid edge control and analytics—see these huge solar farms. They are uploading the electricity to the grid, and this grid management is very critical because the frequency of the power supplied—if it goes wrong, the grids can crash. That quality of power which is going out has to be continuously monitored, and through analytics, there is a feedback loop that corrective actions can be taken immediately without delay; otherwise, the whole grid can collapse because of mething like that. We have also talked about autonomous vehicles.

Now, the next topic is blockchain. I am sure many of you have heard something called blockchain. What is blockchain? To keep it simple, it is a record-keeping technology designed to make it impossible to hack the system or forge the data stored, thereby making it secure and immutable. That is why people are talking about blockchain.

The technology is not very simple and al needs a lot of computational power, but the advantages are that it is very secure and immutable. People in financial transactions are finding it very attractive. We call this a distributed ledger technology. It is a digital system of recording transactions and related data in multiple places at the same time. Each computer in a blockchain network maintains a copy of the ledger to prevent a single point of failure, and all copies are updated and validated simultaneously.

If I maintain my data in one computer, it can fail or someone can break it, but if it is stored in many computers in the network, then it becomes very difficult for anyone or everything to fail at the same time. You are building a lot of kind of backup, instead of data in rows and columns and tables here the technology isit stores data in blocks. We will not get into the software part or IT part then we will go into a different direction altogether. Our idea is how the technology is used not how it is built.

And digitally changed together using hash algorithm. The hash algorithm is another software IT technology where something can be coded into a fixed number of characters and then they can be compared or added etc. Again these all help to build data security. It is a decentralized database managed by computers belonging to a peer to peer network instead of a central single computer like in traditional systems. If you consider a bank - banks have a central computer.

Now, if you apply for a loan for example, the people sitting in the bank will access your information that there is in bank data statistics and then decide to give you or not give you the loan. The whole thing they are doing it in conjunction with their central computer system. Here it will be a different story because there is no central authority like a bank to decide whether you will get a loan or not. That is the distributed ledger, several nodes or several computers your application gets accessed and approved by someone you do not know, but they are all part of that cohort. Once it is approved by everybody there is a consensus that all of them agree yes this person can be given a loan the loan will be given.

There is no individual point of decision making. The decision is taken by a group of people and in a consensus mode everybody has to agree then only the loan will be sanctioned. How it works? It works like a multi-step process and authorized participant inputs a transaction which must be authenticated by the technology. Your application was inputted by an authorized person however, and then it has to authenticated by that

technology. The action creates a block that represents that specific transaction data like you want a loan.

This states that a loan has to be given to a person x, y, z or whatever. Then this block is sent again to a computer network to every computer node in the network that request for the block, software entity. Then the authorized nodes, pick up the block will verify the transaction and add the block to the existing blockchain. The nodes in the public blockchain networks are referred to as miners. They are paid for this task, often in a process called proof of work. There are people who are known as miners, they are computer hacks, and they will work and try to solve. They will have a problem to solve and once they get an answer, they can solve the problem. They are authenticating the transaction and that is how it gets recorded to the chain.

I mean all of them do it, they go on adding in their output to as a block and becomes a kind of a chain. No outside or no other individual can break that chain, because once it is in the block-chain you cannot break it. It can not be reverse or changed. , because you cannot change it, because mebody has authenticated it, it is foolproof, fail proof kind of thing. It consists of two types of records individual transactions and the blocks. The first block consists of a header and data and then timestamp etc. and you help to create an alphanumeric string called a "hash". Now this will become bit more technical matter.

I want to stop here do not go into the technical part as it might be confusing. Once the first Hash is created each subsequent block in the ledger uses that previous blocks hash, to calculate its own hash. If you are interested you can do further study on what is this "hash" technology and how it works, but I will not talk much about it because it will become very technical. One example here given is something called a use case of a smart contract. Smart contract means I have a contract with somebody to supply something, using blockchain technology. Once the material is

tracked through IoT devices, it is shipped. We know that what quantity of material is reaching and when. When it comes to the factory ,and it is received through IoT, the database comes to know that yes material has reached. Because I have a smart contract with this supplier that is I have a trust with that supplier. As material is received, I know that the quality will be alright, it will be acceptable and the quantity is also acceptable. The payment will get released automatically.

Invoice verification happens automatically. These are all done through that blockchain technology that trust is built and the vendor also knows that as my material will reach,

my payment will get released. The company's banker will get an instruction to release the money to the vendor's banker. All of these transactions are happening without any human intervention. This is one of the use case for the technology is coming into play, blockchain technology in combination with the smart contract where you can automate the entire vendor payment process. For the vendor it is a very big advantage that there is no delay, as the material arrives the vendor gets the money.

Obviously, he will try to maintain the trust otherwise, it the right material, right quantity is not given and found later , then the trust gets broken and the contract will get cancelled. The technology started from cryptocurrency, I am sure all of you have heard - bitcoin. This cryptocurrency's basic technology is blockchain technology. The technology used is exactly similar, and that is how blockchain was first used to develop Bitcoin-cryptocurrency. Logistics companies use blockchain to track and trace goods as they move through the supply chain.This is the example I gave you about this vendor sending the material;

it is tracked because the IoT devices will keep sending the information, which will get verified and become part of the block, adding to the chain. The entire information is part of a blockchain and available to anybody for review later, but you cannot otherwise change it; it is all automatically done through processing of algorithms. There is no human intervention. The legal community and entertainment industry are using blockchain as a basis for smart contracts for transferring and protecting intellectual property rights in the music industry, where people often use music without paying. It protects all artists, of their paintings being forged.

Many are finding applications where blockchain technology can be used to prevent making copies or creating false things, etc. But again, as I said, it is not yet very popular in the sense that it needs a lot of computational power and is not cheap. Running, maintaining, and developing blockchain technical use cases also needs a lot of investment and operating costs. Many companies or industries are exploring applications for a secure and cost-effective way to create and manage a distributed database and maintain records for digital transactions. The last topic I will talk a little bit about the dangers of AI because we will not talk about AI now but later.

Like automation is putting us all out of work; we will be working for robots. Loss of human control over our lives, robots that surpass humans in strength, speed, agility, endurance, decision-making, and intelligence. Killer robots, militarization of robots with

AI. Example drones with facial recognition, now these drones etc. has become very popular Last few days or couple of weeks

, all of us we know what is this killer robots, militarization of robots with AI is talking about where most of us getting our news and then everybody knows everything that drones are watching you. These things are used for remote fighting which happened between India and Pakistan. Incidentally without crossing borders from nearby place you can use drones to do whatever you want to do. These are where these technologies are finding lot of use may not be a good example because we do not want these to be used for damaging things or killing people. But that is where are the dangers of AI. I want to just give you a brief idea of the dangers of AI.

And if you go through this chart you can see that every industry is reinventing technology. All underpinned by cloud and AI technology. This is what every industry like supply chain operations , energy and utilities giving dynamic billing or putting sensors for safety and then dynamic billing smart meters nowadays many houses we have electrical meters or smart meters. All of these things are taking the help of cloud and sometimes may be al AI technology for their transformation.

It is their digital transformation. The business drivers why we need this transformation are coming from the financial, operational and technological reasons. With that, the last slide, of course, will be the same as the references. We come to the end of part 2. We will continue with the remaining in part 3.

Thank you very much.