Introduction to Information Security

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Lecture – 07

Rotation of duties means that the same person should not be involved in maintaining or doing some activity for long.

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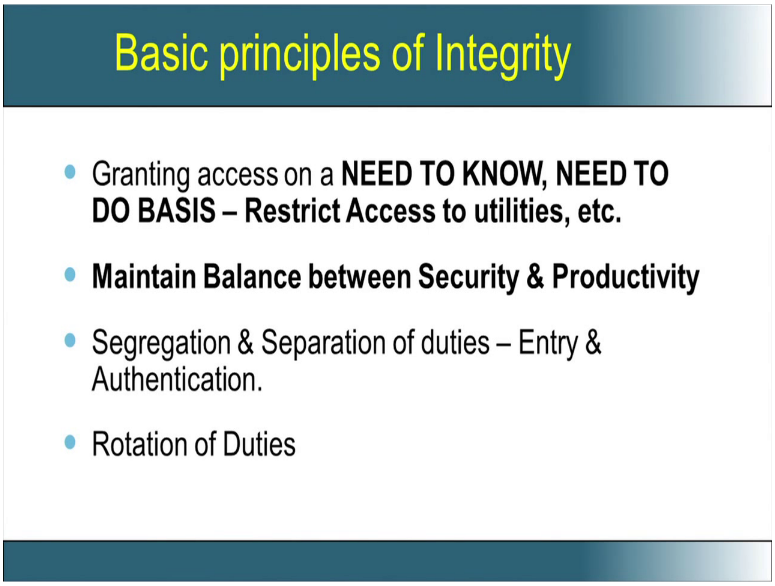

Basic principles of Integrity

- Granting access on a **NEED TO KNOW, NEED TO DO BASIS – Restrict Access to utilities, etc.**
- **Maintain Balance between Security & Productivity**
- Segregation & Separation of duties – Entry & Authentication.
- Rotation of Duties

This actually creates a good amount of redundancy within the system and at one point of time, if suppose I have a data and I don't know what the data is, no one in the organization knows what the data is except one person. Then, that person can essentially go and change the data in the way he wants, because no one can go and verify what that data means.

So, it is always important that many people come to know many things about many data, if that is not ensured then the organization will face the problem of what we call as, it is something like one fellow ownsthe data and nobody else knows about that data and so if, then he can go and change whatever format he wants and nobody can go and verify. So, rotation of duties ensure that this particular problem is addressed, it gives at least more than one people to have knowledge about every information asset that the company processes.

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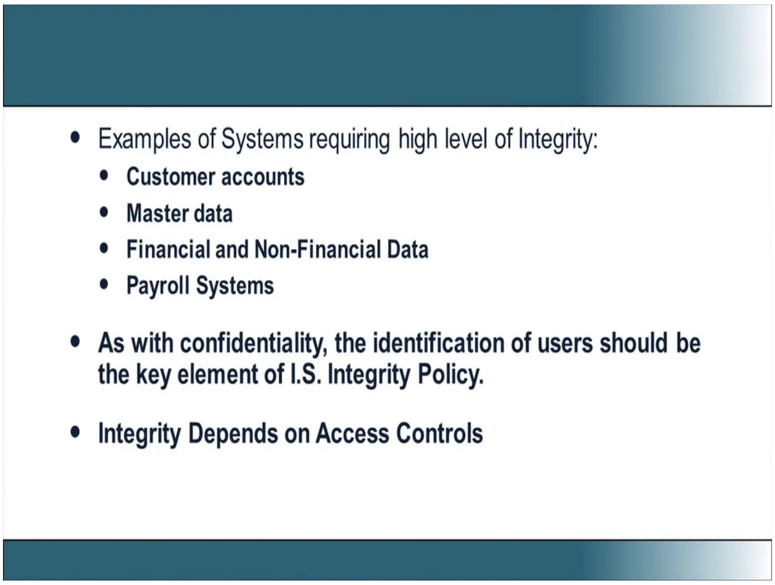

- Examples of Systems requiring high level of Integrity:
  - Customer accounts
  - Master data
  - Financial and Non-Financial Data
  - Payroll Systems
- As with confidentiality, the identification of users should be the key element of I.S. Integrity Policy.
- Integrity Depends on Access Controls

So, now let us look at some of the systems which require very high level of integrity. For example, the customer accounts is an information which needs to have high level of integrity. The master data, the financial and non financial data, the payroll systems all this needs to have very high level of integrity. As with confidentiality, the identification of users should be the key element of information security integrity policy. So, how do I go and ensure integrity, first thing is I need to identify the user.

So, how do we do this identification, again we have the process of identification, authentication and then we have what we call as the authorization, all that we did for the case of confidentiality needs to be done here. So, a user identifies himself through a login, then there is a password, then the authentication happens. Then, there is an authorization and based on this authorization, he can now go and do certain actions, do certain consistent actions on the data. So, what can an authenticated users do on different information assets inside the system, so that it is integrity will not be affected, it is basically dictated by the access controls. So, for us to ensure integrity, we need to have access controls. Now, we will look at different access controls that form that the basis of enforcing integrity.

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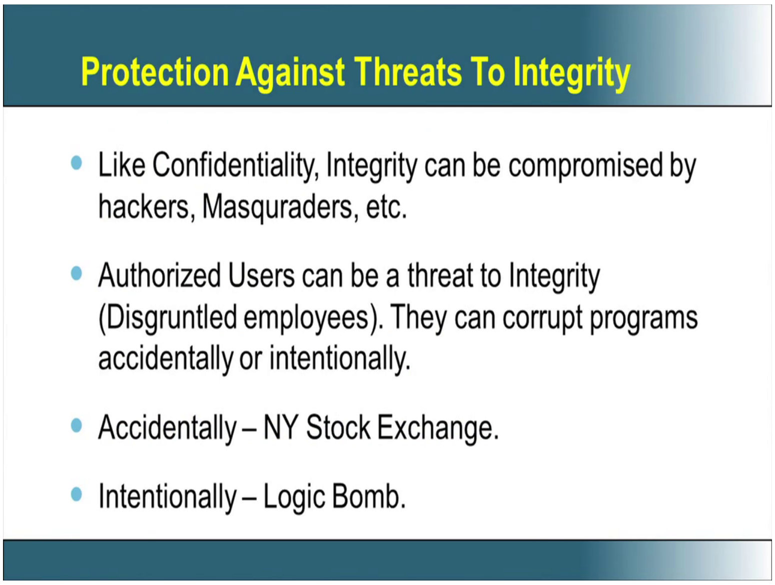

Protection Against Threats To Integrity

- Like Confidentiality, Integrity can be compromised by hackers, Masquraders, etc.
- Authorized Users can be a threat to Integrity (Disgruntled employees). They can corrupt programs accidentally or intentionally.
- Accidentally – NY Stock Exchange.
- Intentionally – Logic Bomb.

When we look at protection against threatsthreat to integrity of course, like confidentiality, integrity can be compromised by hackers, Masquraders, etcetera. The authorized users can also be a threat to integrity. For I, they can go and corrupt programs accidentally or intentionally and that could cause integrity issues. I can give you a very simple example. In many servers there are certain configuration parameters which are set a boot time. So, when the system boots it reads the parameters and based on the parameters the server does some action and that parameter remains same, till you reboot the system again.

For example, there is a parameter a and I set it to a value 2, when the system boots it will read the parameters value as 2 and it will continue working. When the system is working when I go and change the parameter value to 3, nothing will happen to the system. But, when you shut down the system and reboot the system that time it will read that value as 3 and start doing something different.

So, let us take this type of scenario Now many of these servers have some parameters, if you set it to 1, it will share memory across applications. That means, your memory utilization becomes very good. If you set it as 0 then it does not share memory and then if you have very high memory intensive programs, then the server will essentially crash. Now, let us have one disgruntled employee who is maintaining the data centre, on the day when he sent out just before leaving, since still he has the authorization, he can get just go and change this memory sharing parameter from 0 to 1 or 1 to 0. Nothing will happen immediately, because it is a boot time parameter. After 5 or 6 months when the system boots up, it will read this parameter as 0 and then what will happen, the system will crash, it starts crashing and it will be very difficult for somebody to come and find out, this was because of the parameter change.

So, what has happened there was essentially an integrity issue here, where a configuration parameter has changed its value intentionally. So, the threat to integrity can also be within the system, it is not necessarily outside the system. So, there are two well quoted examples about threats to integrity. An accidental event which actually caused a threat to integrity was the New York stock exchange issue, where in somebody accidentally try to sell a huge number of stocks and that went and crashed down the servers and it create an availability issue and an integrity issue, it was a very accidental thing.

Similarly, one intentional case study that is well reported and well articulated in many information security literatures is the logic bomb. There is an employee who wrote a software for a company in which he said in case I am dismissed he wanted to create havocin the company. So, what he did was that on 7th of every month, if the software does not see his name in the payroll list, then he said go and delete all the files in the server, so he wrote the software like this.

So, on one fine month he was fired, the next month when 7th came, the software did check if his name was there in the payroll, his name was not there in the payroll and so it went and deleted everything in the system. So, this is an attack on the integrity, it is an intentional attack and that originated from within the system. This is commonly quoted as the logic bomb.

So, to sum up what we have seen so far is the definition of confidentiality and potential threats to confidentiality and how we can maintain confidentiality and we are also looking at integrity, we have seen different issues of integrity and how we can try and maintain integrity.

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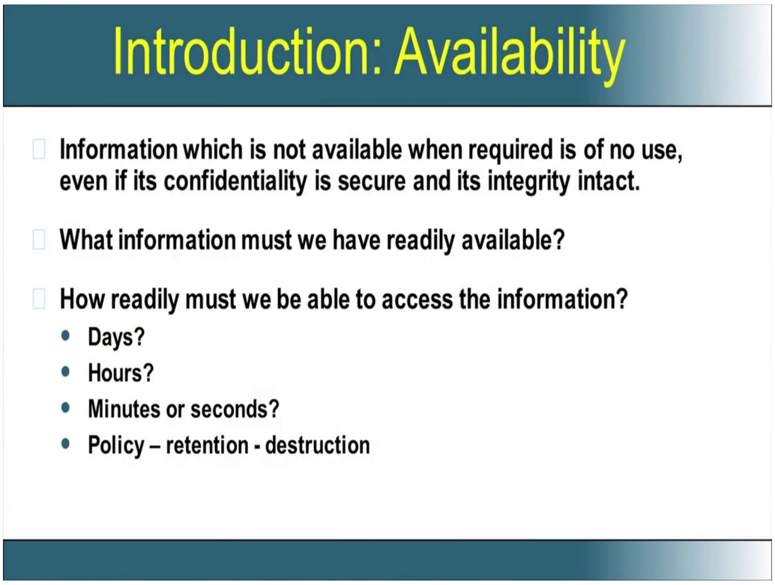

Introduction: Availability

- Information which is not available when required is of no use, even if its confidentiality is secure and its integrity intact.
- What information must we have readily available?
- How readily must we be able to access the information?
  - Days?
  - Hours?
  - Minutes or seconds?
  - Policy – retention - destruction

Now, we go to the third point of availability. What is availability? So, we would like to come with a good definition of this, that the information should be available means, it should be available to an authorized user and it should be available in the form that is needed by the user. The user wants to maintain some format, he needs some integrity, confidentiality, etcetera and so and this data should be made available within some fixed amount of time.

So, all these things are involved when we try to define what is availability? So, the information which is not available, when required is of no use. Even if you say I have got the highest degree of confidentiality and integrity, this information is of no use. So, the question now comes what are the information that must be made readily available.

So, that forms one of the important ingredients of your security policy, what is said that I should make it available and how readily I should make it available, should it be in days, hours, minutes or seconds. How much time should I maintain the data, should I backup the data, when can I destruct the data, all these things come as a part of yourinformation security policy.

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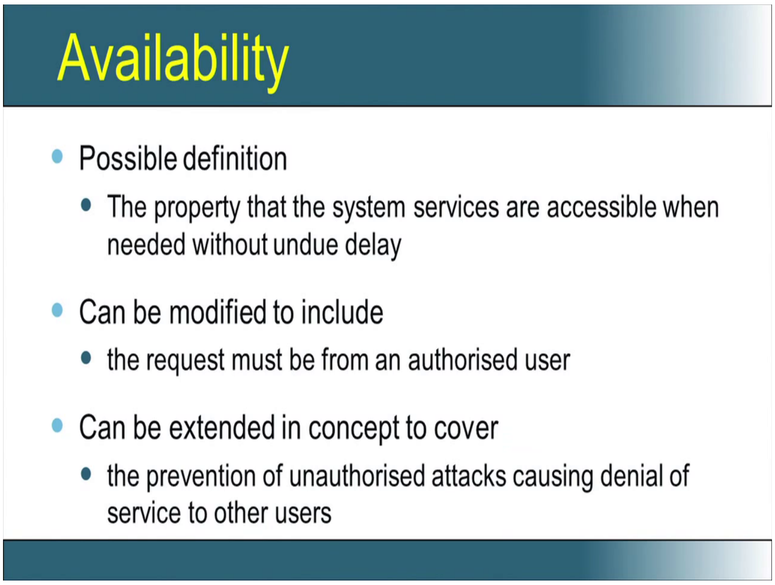

Availability

- Possible definition
  - The property that the system services are accessible when needed without undue delay
- Can be modified to include
  - the request must be from an authorised user
- Can be extended in concept to cover
  - the prevention of unauthorised attacks causing denial of service to other users

So, with this as a background we will go and start defining availability. So, availability as you see is the property that the system services areaccessible when needed without undue delay. As said what is data that should be available, first data is the system services, first information I said is the system services, they should be accessible when needed without undue delay. And with some more of what we saw in the previous slide, we can say that the system services when it is requested by an authorized user should be available without undue delay. And we can also go and add say the second facet of this definition, where we need to prevent unauthorized attacks causing denial of services to other users. So, availability means for an authorized user, the system services the information assets should be accessible when needed without undue delay and prevention of unauthorized attacks which can cause denial of service to other users.

So, we have been using this word denial of services, what you mean by a denial of service. For example, I have several computers within a office which are connected through a network. Now, when one computer wants to talk to another computer, it is start using the network. Note that this network is a shared resource, if I am going to increase that traffic on a network, traffic means the amount of data transmitted on the network, beyond some threshold then what would happen, the network will choke and because of this choking what will happen, a computer A cannot talk to computer B, this means that there is an availability issue and this is a security issue, because we are not giving the availability of this.

Now, how can I create the traffic, there can be another system within the local area network who starts sending arbitrary packets on the network which will go and choke the switch, the network equipment. And so, the network equipment will be very busy handling these packets which are coming from this unauthorized source. And so the amount of attention that network device can give for the communication between computer A and computer B essentially decreases. So, the response time between computer A and computer B, the response of computer B as perceived by computer A and the response of computer A as perceived by computer B will not be as per the expectation and this is actually called denial of service. The denial of service with respect to your particular system is completely external to the system, but it can stop this system from communicating to the neighbouring systems and do an activity. So, this is one example of a denial of service. We will talk about many examples of denial of service as we proceed through this lecture.

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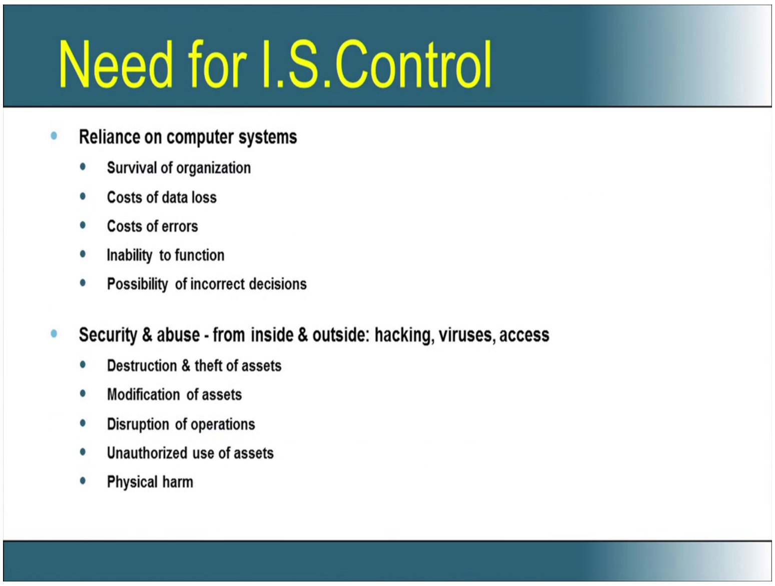

Need for I.S.Control

- Reliance on computer systems
  - Survival of organization
  - Costs of data loss
  - Costs of errors
  - Inability to function
  - Possibility of incorrect decisions
- Security & abuse - from inside & outside: hacking, viruses, access
  - Destruction & theft of assets
  - Modification of assets
  - Disruption of operations
  - Unauthorized use of assets
  - Physical harm

Now, what we need is we need to get this confidentiality, integrity and availability in the system and how do we get this, we need to impose some control and this is called information security control. For need to ensure confidentiality, integrity and availability I need to put certain control mechanisms inside the system which will basically ensure this. Why do we need this control? This control becomes extremely important, because we are using computers today for survival of many organizations.

If the computers don't exist, if the computers are compromised, the organizations cannot survive and if I do not have proper information control I will have data loss and the loss of data is very, very costly. I would have errors again the cost for these errors should be extremely high. And I may not be there could be a denial of service I cannot even function and because of this wrong data as I mentioned earlier, the data is used for making business decisions and if I go and corrupt the data, then I could possibly make incorrect decisions which can hamper the growth of the organization.

If I don't have control, then what will happen is there could be an abuse from both inside the system and outside the system through things like hacking, viruses, unauthorized accesses, etcetera. And the moment my system is abused, now all my information asset either can be destructed or they can be stolen, they could be modified, my operations can be disrupted, I could have unauthorized use of my assets and I can also have physical harm, the system can get burnt.

So, all these things can basically go and it is a potential threat to the survival of the organization. Because, now we are talking of more and more reilance on computer systems, information security based control becomes inevitable, we have to have such type of controls and these controls in place, we can basically talk of confidentiality, integrity and availability as our security goals. Now, we will go and look at what are all the controls.

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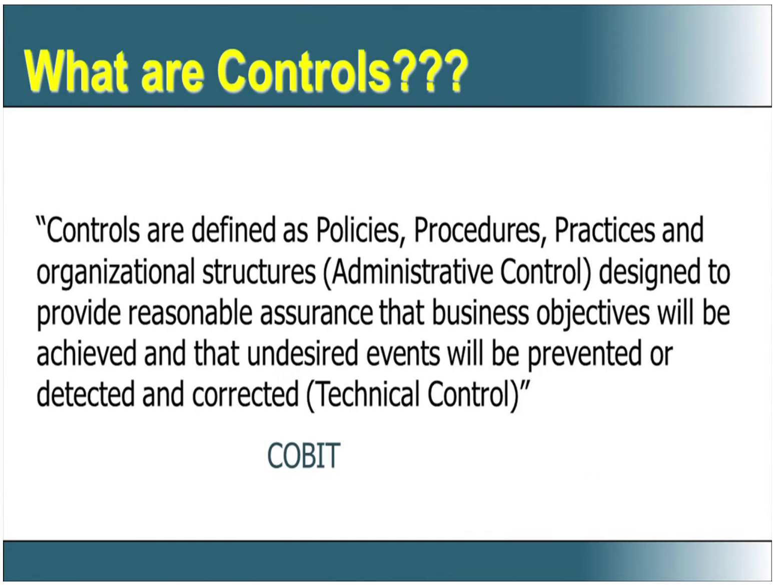

What are Controls???

"Controls are defined as Policies, Procedures, Practices and organizational structures (Administrative Control) designed to provide reasonable assurance that business objectives will be achieved and that undesired events will be prevented or detected and corrected (Technical Control)"

COBIT

So, control is of two types, one is dictated by the administration, another is technical. Now, COBIT actually an organization, COBIT is a standard, it comes out with the definition of control. Controls are actually defined as policies, information security policies, procedures that implement these policies, practices that comes out due to the procedures and the different organizational structures that are in place to maintain this policies, procedures and practices.

So, controls are defined as these policies, procedures, practices and organizational structures which are designed to provide reasonable assurance that the business objectives will be achieved and that undesired events will be prevented or detected and corrected.

So, the policies, procedures, practices and organizational structures form the part of the administrative control and once those things are in place now to ensure that no undesired events, undesired in the sense events that are prohibited by the policy that are not stated in the policy, that are not part of any procedures or practice, thus type of undesired events will be either prevented or if it happens, it should be detected and subsequently corrected.

The technical control takes care of stopping these undesired events, while the administrative control defines what are desired events and what are undesired events. So, control when we look at from the broad perspective is a combination of administrative and technical control. We will now talk more about this control as we proceed.

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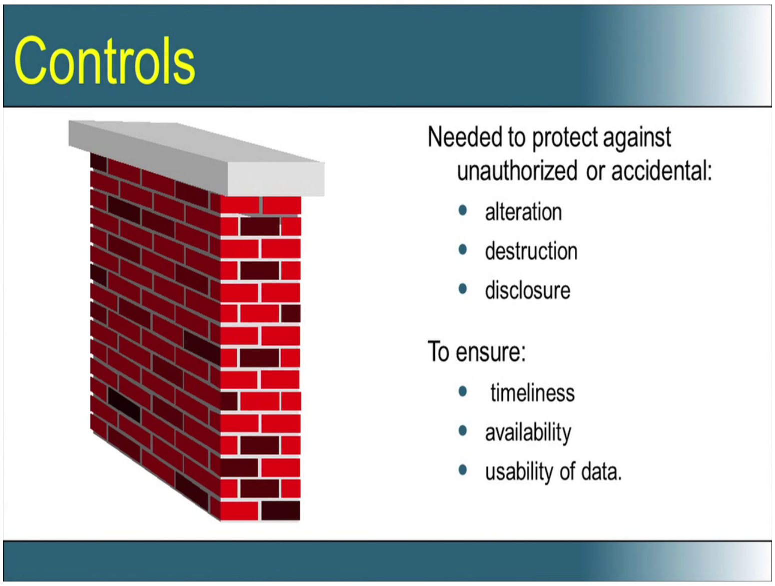

Controls

Needed to protect against unauthorized or accidental:

- alteration
- destruction
- disclosure

To ensure:

- timeliness
- availability
- usability of data.

Now, what do we want to control, what is the goal of control? The goal of control is to maintain the CIA. Now, let us look at the negation of this, it is to protect the system from what we call as DAD, C is confidentiality, the opposite of confidentiality is disclosure, I is integrity, the opposite of integrity is alteration, D is availability the opposite of availability is destruction. So, I need control to maintain CIA, it is essentially to mean I need controls to protect the system from disclosure, alteration and destruction.

So, the control can also be defined in this form, so I need control to prevent or protect a system from disclosure, alteration and destruction and to ensure that any services is available within a prescribe time limit and the data is in a usable format or the information is in the usable format. So, this is how I can define the role of control in a information security framework.

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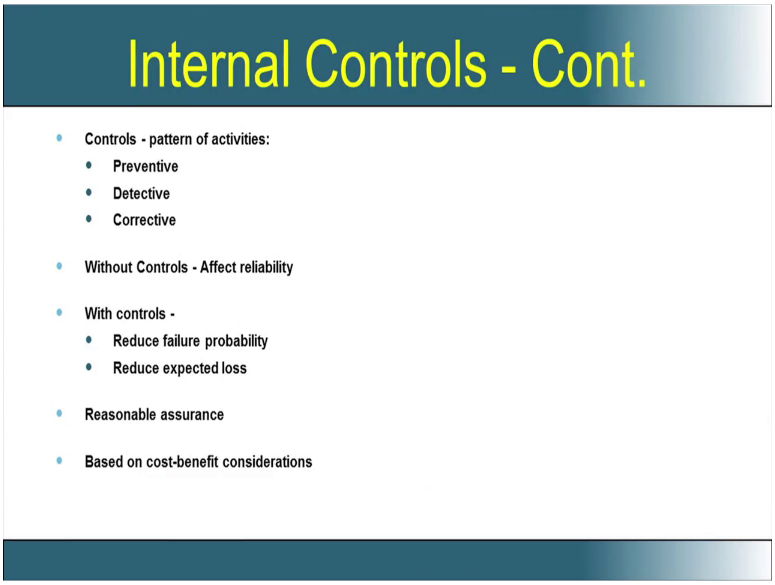

Internal Controls - Cont.

- Controls - pattern of activities:
  - Preventive
  - Detective
  - Corrective
- Without Controls - Affect reliability
- With controls -
  - Reduce failure probability
  - Reduce expected loss
- Reasonable assurance
- Based on cost-benefit considerations

Now, what are the different types of controls? The first one is an internal control. So, the internal control is basically can be classified into three preventive control, detective control, corrective control. And these controls are based on some pattern of activities. One very interesting example of an internal control is the antivirus that you install inside the system.

It prevents malware from entering the system, if there is a file with a malware, it goes and detects and removes that malware from that file and that removal is actually a corrective action. So, an antivirus thus prevents malware, it detects the presents of malware and removes that malware essentially as a corrective control. So, if I do not have this antivirus, then my reliability certainly affected and because of...

So, but with this control, certainly my, I can reduce the failure probability, I can reduce my expected loss. Failure in the sense what could a virus do, a virus can also crash your system. So, with these type of internal controls I could get reasonable assurance about the CIA of my system. But of course, all these internal controls come with the cost benefit consideration. Cost benefit is very, very important here.

Suppose, I look at a particular organization in which there is one vulnerability which may happen once in a year and to avoid this vulnerability, there is a software which say cost 1 million rupees. Now, if this is projected to the management saying buy this software which will stop you from this vulnerability and that will cost you 1 million rupees. On the other hand, the management can go and look at what will be the cost of this vulnerability to the bank.

Maybe it is a vulnerability which is not going to seriously hamper, the trust that the people have on that the bank, it is not seriously hampering the image of that bank and that vulnerability may cost is some 20,000 rupees. So, effectively the management will say I will sell out this 20,000 rupees I will not go and buy the 1 million rupees software and that is the most intelligent decision, the management can take.

So, this is one very interesting thing which software when does need to keep in mind, when they propose a security a product which is going to ensure some amount of security, they should also take into account what would be the cost if that vulnerability exists and it damages whatever it can do and that is what essentially I mean by this term cost benefit consideration.

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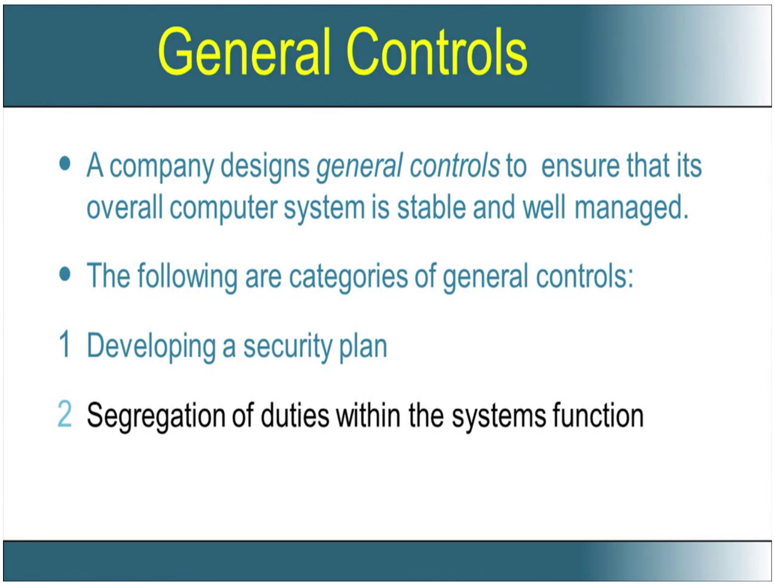

General Controls

- A company designs *general controls* to ensure that its overall computer system is stable and well managed.
- The following are categories of general controls:

1 Developing a security plan

2 Segregation of duties within the systems function

Now, we will go and look out before we go into specifics of administrative and technical controls, we will now go and look at general controls. Why do we need general control?

The computer system should be stable from a security point of view, from a CIA point of view. So, what is one the first general control is to develop a security plan.

What do you mean by a security plan? A security plan says the complete organizational structure of the system, who is responsible for what, how do you identify an user, how do you authenticate the user, how do you authorize the different resources, the access of different resources to an user, how do you permit a user into a building, everything. Right from physical security to hardware security to secure the person, the process, the technology everything, people, the process and technology, everything has to be covered in your information security plan.

It is not just about making a hardware and a software and executing certain applications on that, it is all about a comprehensive plan of how a data centre is to be operated, that is what we call as a developing a security plan. The next important function is segregation of duties within the systems function. We have added a small discussion about that earlier and we will have a much more larger discussion about this as we proceed in this lecture.

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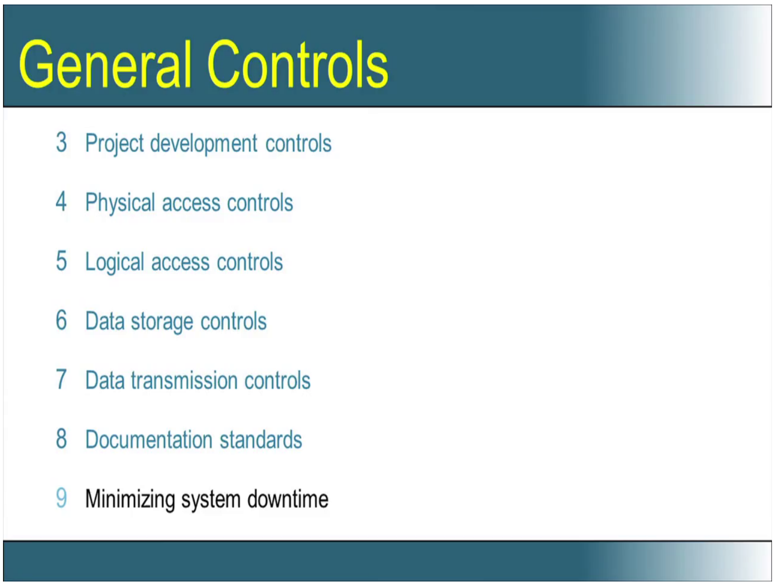

General Controls

3 Project development controls

4 Physical access controls

5 Logical access controls

6 Data storage controls

7 Data transmission controls

8 Documentation standards

9 Minimizing system downtime

The third is project development controls. What do you mean by project development controls? Let us take a case study of one project namely say know your customer, let us I am trying to look at KYC using Aadhaar cards. So, when Aadhaar as a project was conceived, what is the security issue involved in making a project development plan? What is the control that I need to have when I am developing a project document?

So, one thing that we could say that when we trying to make Aadhaar cards, all personal information about a person is collected. For example, finger print, iris, date of birth and many, many things that are needed. Finger prints of all five fingers sometimes, these are all taken at the time when we register for Aadhaar. So, one of the most important thing that the project development document of Aadhaar should address is whether this information is confidentially stored in some place.

Whether, the integrity of this information is maintained, because if imagine somebody stealing your finger print, it could have catastrophic effects. So, this is just an example of what it means to have what are the security issues when you actually develop a project document. Now, let us go and look at the next thing is physical access controls, the very, very important and we will discuss about that in the next slide.

Then, there are logical access controls, data storage controls where a data should be stored, how it is should be stored, how many times it should be backed up, etcetera, who should store it, who has the access to read it, who has the access to write on it, who has the access to manipulate it. The next important thing is data transmission control, how do I transfer the data from one system to another am I using a virtual private network, am I using a Sam, am I using a nas and when I use this what is the security, that during this transfer nothing gets tampered.

Then the most important thing are the, documentation standards. Documentation is very, very important. Because, documentation basically tells you the different details about the different assets., If an information about an asset is missing and it is known again, we go back is known only to one person, then he can go and change it in whichever way he wants and that is the origination of fraud. So, it is very, very important let every detail is documented, so that it becomes independent of an individual. And tt also makes auditors who come, who are independent, who can come there and they can go and look at these standards and look at these documents and from that infer, what type of information asset is available and what is the value of these information assets and many more attributes of the information assets. So, that they could go and audit and certify that a particular asset is indeed satisfying the CIA property.

So, documentation is very very important and many organizations do not have very strict documentation of their processes. The next thing about general control is that we would like to minimize system down time and that is very, very important because a down time is against availability, it is just one of the important goals of security.

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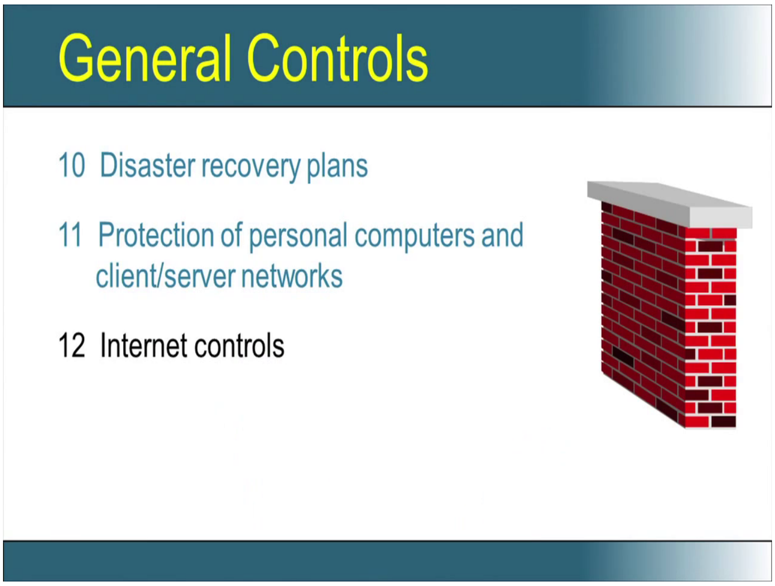

General Controls

10 Disaster recovery plans

11 Protection of personal computers and client/server networks

12 Internet controls

Then, there are disaster recovery plans, when there is a disaster, how do we move securely to the disaster recovery centre. When there is a migration of task from one place to another, how can it happen in a secure fashion, so that all the processes are available, all the data are transferred and no data, all information assets are transferred and none of this information suffered from an integrity issue or an confidentiality issue and it is made available to the user within a minimum amount of time. So, this is the major challenge when you arrive at disaster recovery plans.

The last, but not the least is the protection of personal computers and client slash server networks, it is very, very important. Because, many organizations that used this IT as a client server model and these clients and servers should be protected. Even as I said in the introductory talk, even if one client gets affected it can starts sending spuriouspackets on the network and it can clogthe entire network essentially leading to what we call as the denial of service.

So, general controls are 11 which I could list here and all these general controls aim at providing us the necessary security goal. The next one is a most specific type of control which we call as internet controls. This is basically connecting the systems that the information assets that you have to the external world and there most stronger firewalls and policies should be in place, so, that unauthorized access to a information assets is prevented. So, this is basically this comes under the topic of network security which will be dealing in module 4 of this information security course phase one.

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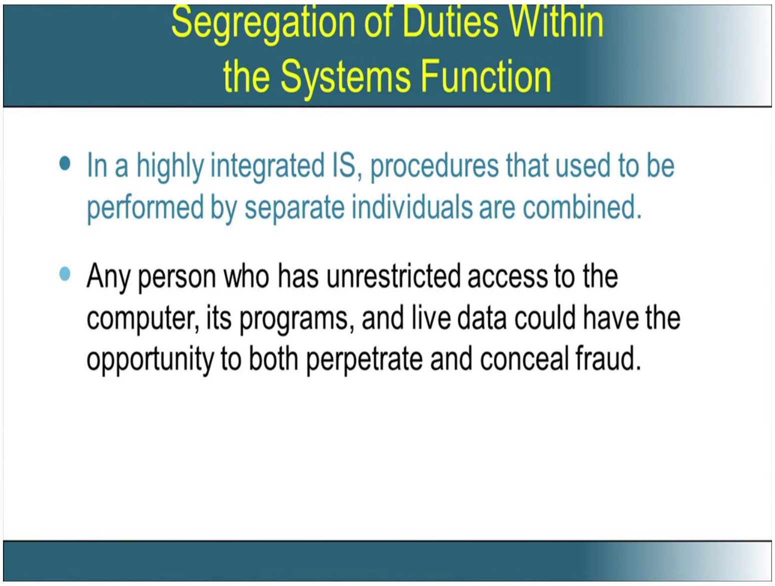

Segregation of Duties Within the Systems Function

- In a highly integrated IS, procedures that used to be performed by separate individuals are combined.
- Any person who has unrestricted access to the computer, its programs, and live data could have the opportunity to both perpetrate and conceal fraud.

Now, with this understanding of the general controls, let us look at one of the most important administrative control which is segregation of duties. Please note that as I have been mentioning, any person who has unrestricted access to the computer, its programs and live data could have the opportunity to both perpetrate and conceal fraud. Please note those two words, perpetrate and conceal.

So, and that has the big implication on segregation of duties. In any environment, secure environment including banking, every operation will have a maker and a checker and the maker and checker need to be different. If the maker and checker are the same that is what we mean by one fellow perpetrating and concealing fraud, the maker can do a malicious action on a data and he can go and conceal, because he is only checking the authenticity.

For example, let us take a banking institution. So, a officer has to create a loan for a customer and a manager has to clear this loan or authorized this loan. Suppose, the officer has the managers password, he will login as a officer and he will create or make the loan proposal and he will login as a manager and clear the proposal and this loan proposal may not be with all proper documentation, but since the manager has cleared this loan proposal can go through.

So, this is essentially a fraud, because the loan should not be given, but the loan is given by using some false documents and the person who created at this the officer who created the loan, who propose the loan, since he is a maker and the checker was a manager. But, since he knew the checkers password, he was able to go and do his action and basically see that this fraud happens. So, by knowing the managers password, this officer has essentially become a manager from a systems perspective. So, the maker and checker became the same and when the maker and checker becomes the same, then certainly this fraud can start happening and it will also be concealed.

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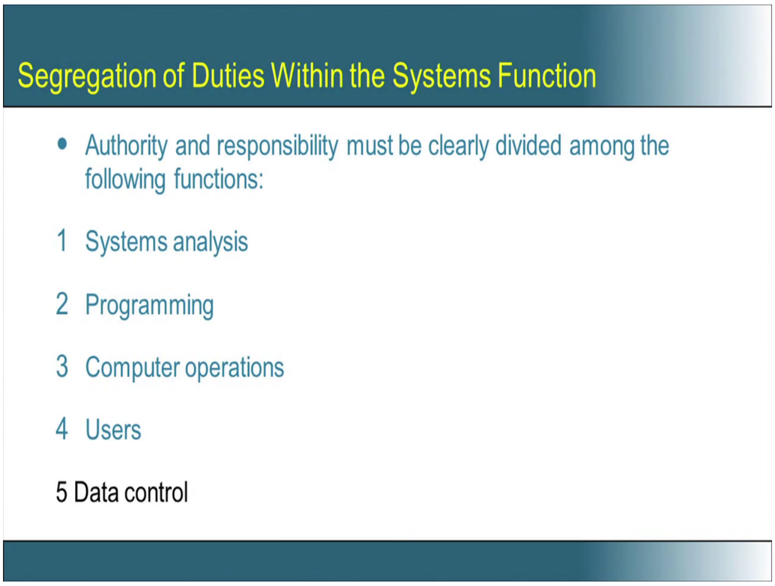

Segregation of Duties Within the Systems Function

- Authority and responsibility must be clearly divided among the following functions:

1 Systems analysis

2 Programming

3 Computer operations

4 Users

5 Data control

So, what are all the different responsibilities when you make a system? There will be a team who is doing a system analysis, there will be a team who is doing the programming, who will make the software, then there will be a team who will be doing the operations maintaining the data centre, ensuring all the applications are in place, ensuring the network is proper, ensuring that all the latest updates of the softwares are done.

So, they are maintaining the computer centre, they are maintaining the hardware, the software, the AMCs, etcetera. Then, there are users, these users can be outside the organization namely the customers and in the case of say the banking institutions, they can be the staffs, who are at the branches, the branch staff are at the branches and then there are people who are entrusted with the responsibility of data control, so who are responsible for the data.

We actually talked one in the previous lecture about the owner of the data, the custodian of the data and the user of the data. Now, we are talking about the owner, who actually basically controls this data and the custodian of the data. So, now if all these file let us say the user and the data control person are the same, then it essentially means that I go and create, I as an user enters a wrong entry and I login as a data control person and just pass that entry.

So, here the maker and checker essentially becomes the same and when the maker and checker essentially becomes the same, then the fraud can happen. So, at least in an organization there should be at least 5 classes of people, the first class of people looking at analysing the system, who is architecting the system etcetera basically a decision making body, another who actually implement software, another would develop and implement a software, another looking at the maintenance of the software and hardware, then there are the users and then there are auditors who look at controlling of data, who looks at logs, who looks at different transactions and certify on a day today basis that nothing is going wrong.

So, just to tell you that it is very important that different people perform these functions, so allowing a person to perform two or more of them will expose the company to the possibility of a fraud. So, there can be some small organizations where they say I can't have 5 different classes of people.

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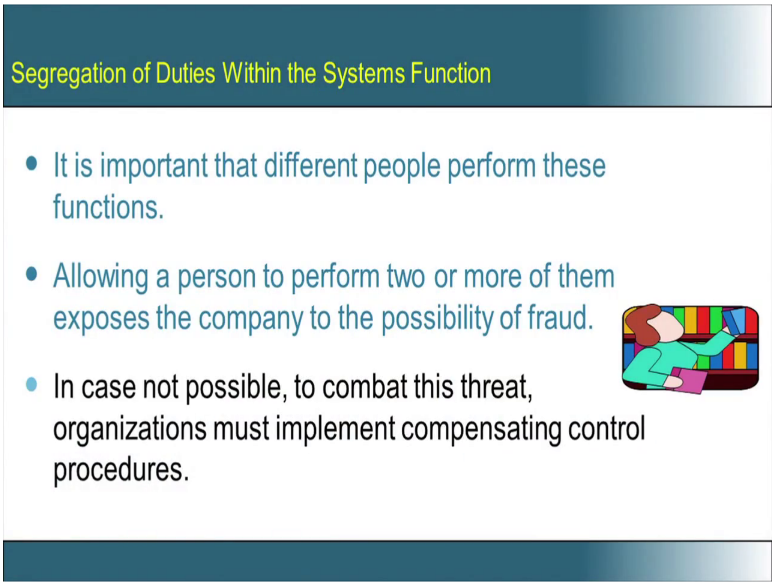

Segregation of Duties Within the Systems Function

- It is important that different people perform these functions.
- Allowing a person to perform two or more of them exposes the company to the possibility of fraud.
- In case not possible, to combat this threat, organizations must implement compensating control procedures.

So, in that case to combat this threat, the organization can have say one or two people. So, there can be some things were the maker and checker would be the same. When the maker and checker becomes the same, then the organization must implement compensating control procedures., what is the compensating control procedures, so you go and look at the logs of the maker and checker. There is one person who is making and checking, his entire activity should be monitored and if there is a notion of a fraud that should be immediately highlighted and that is what we mean by compensating control procedures.

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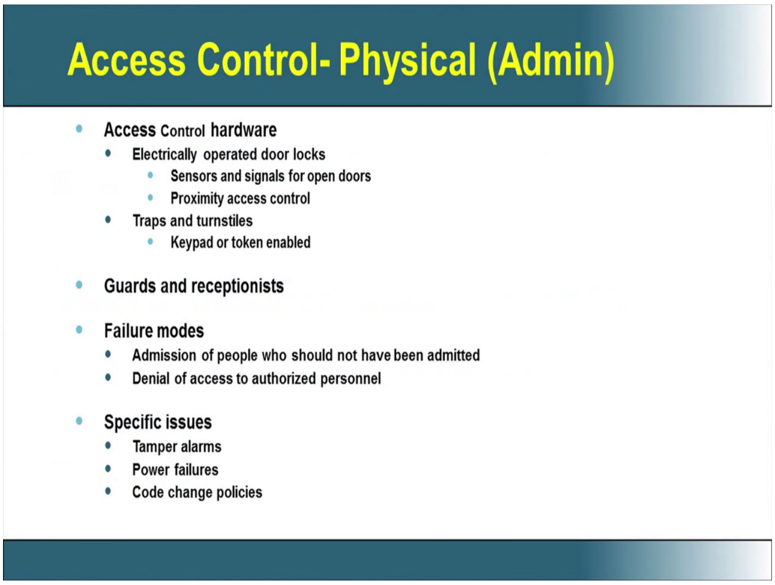

Access Control- Physical (Admin)

- Access Control hardware
  - Electrically operated door locks
    - Sensors and signals for open doors
    - Proximity access control
  - Traps and turnstiles
    - Keypad or token enabled
- Guards and receptionists
- Failure modes
  - Admission of people who should not have been admitted
  - Denial of access to authorized personnel
- Specific issues
  - Tamper alarms
  - Power failures
  - Code change policies

So, what we have look at so for is about the general access control and the administrative access control. Now, we will go and look at more types of access controls in the next session.

Student: ((Refer Time: 39:37))