Information Security 3
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Module 45
Basics of Networking
An Introduction

Over the next few set of modules, we will be basically introducing to you the fundamentals of networking, computer networking specifically, and then take you into the world of network security. So as was discussed earlier, the set of modules that is actually following this will give you a basic introduction of what exactly is computer networking all about, we will try to actually introduce you to the jargons in a networking domain as well as take you into the world of network security so that when in our subsequent modules when you actually go into really working hands on or different kinds of network security products, you get an idea about what exactly that we are talking of.

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So what exactly is an internet, so if you look at it basically from a the components point of view it strictly a mechanism by which I have a different kinds of devices connected and the number of devices here could be running into many millions together where I have something called as a host, so you will find people referring to as host or as an end system, but essentially they both mean one and the same. The host or the end systems will actually be running the applications

what we refer to as a network application so for example you typically be running a browser, you would be typically running a email, client software and so on or you typically be running a web server depending on what kind of an application that you are trying to start off with. Now the host or the end systems will run the different kinds of network applications that will be required for data to be exchange from one system to another system and that essentially what networking is all about, now how is this data going to be exchange from one system to another system you will have people refer to it as what is called as communication link, so the communication link here could be either based on a fiber or a copper or a radio, satellite, so many different typed of physical transmission medium that is available.

So there are different types of communication links that are actually available so the communication link medium could be either a fiber cable it could be a copper cable it could be radio it could be a satellite and so on and so forth, now how do we really differentiate between what kind of communication link will be typically suited for a specific requirement, it would be dependent on what is the the rate the transmission rate that your network application would typically require.

 So that will, we dependent on what is a network application that is running, so depending on the network application the rate by which the data needs to be transferred will be expected to be from a particular from a starting from a particular range to a particular range and that is basically the transmission rate is basically what is refer to as the the bandwidth for example at our homes we would be we would've actually got our provider telling us that he will be able to offer at offer like a 2mbps line or a 4mbps line or a 16mbps line so forth.

So this mbps that is the mega bits per second is basically what is refer to a transmission rate or a bandwidth right, so when you talk of the internet from the individual components perspective you have the host or the end systems in which you typically have the network applications running so some common examples the network applications could be or email application could be or browser application could be a web server application and so on and so forth.

And these network applications are going to be actually exchanging the data between the two end systems over what is commonly refer to as communication link and these communication links could either be links based on fiber optic or could be based on copper or a radio and

likewise we have different kinds of physical media on which I could really try to transfer for the data across at the lowest physical level and then we also introduce the concept of bandwidth which essentially means what is the total capacity or the transmission rate which you typically like to have available for a data to begetting transferred from one mission to another end system.

So apart from that we also have something called as routers, these router devices as we would have actually heard, enquired a few scenarios before, these router devices are the once that are responsible for forwarding the packets from the source mission to the destination mission, right?

So if my data traffic has to go for example from Chennai to Mumbai I would need to have the packets which are originating from my system whether it be a pc or a laptop whatever it is, a sort of forwarded all the way to the destination system in Mumbai and who is going to be responsible for forwarding these packets those devices are what is refer to as a router devices in my network path.

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So if you look at this particular diagram, you have different kinds of icons if you see here, so the reason for actually giving you this different kinds of icons is to differentiate and thereby easily communicate to the end user of what are the different components that are there in a typical network topology, so what do we mean by network topology is basically a network diagram which be used to illustrate the kind of connectivity, the kind of systems that are there in the

network so that we could have a very quick and cute look about however entire network is actually structured, so if you really see this particular icon, this is an icon that is used typically to show that I have a router device in this portion of my network topology right and then if you see these kind of icons, these icons are actually used to show that these are typically the host or the end systems in which we discussed were we will be running our network applications and all the lines that you see here are the ones that we refer to as the communication links, so essentially if you see for example this could be a sore system which is actually connected over a modem.

So the the telephone icon that you really see here is to denote that I have a modem here it could be typically an adsl kind of a modem which is very commonly used nowadays in the, in any kind of a a basic computer network and the kind of systems that is actually connected here would essentially mean that these systems will be running a network applications and the network application that is actually running on this system will be wanting to communicate with the network application that is actually running for example on this system right and that's basically where we are talking of really, the communication links coming into play over multiple routers devices on the path which will basically forwarding the packets from the source all the way to reach the final destination system wherever the packet is supposed to be reaching.

So here you see I could also have a physical link that could possibly be running over a some kind of a satellite link as well, so this kind of topology diagram in which we will typically have all our devices so whether it be a end system or whether it be a router device or whether it be a communication link all of them captured, and this network topology is what is typically used by a network administrator when he is actually designing the original design of the entire network of how it is going to be structured right. So whenever somebody gives you a network topology the different kinds of icons that is used here as I was just mentioning is will be useful for us to identify where each type of devices located for us to quickly come to an understanding of how the whole network is really structured.

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So there could be different types of internet appliances so you could really have a IP picture frame, you could really have a very small embedded web server that is typically running on all kinds of very mini devices in today's world, you could also have for example a very fancy a bread toaster which could enabled over an IP network for it to be even remotely monitored and then of course we have IP phones today which is actually become pretty common now as compare to having a normal voice phone for so many different reasons in terms of manageability, in terms of lesser cost and so on and so forth.

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What's the Internet: "nuts and bolts" view

- *protocols* control sending, receiving of msgs
  - e.g., TCP, IP, HTTP, FTP, PPP
- *Internet: "network of networks"*
  - loosely hierarchical
  - public Internet versus private intranet
- Internet standards
  - RFC: Request for comments
  - IETF: Internet Engineering Task Force
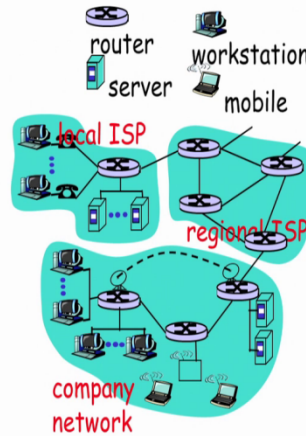
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Now coming down to the communication between the different type of devices that we talked off, there are something called as a protocol which will actually be used for communication, so what exactly is a protocol it's, protocol is basically a a language that two different devices in my network will use to communicate with each other, right?

So if I basically try to give a very simplistic name an example be for example are using let's say an English language for communicating between two of us and unless and until the other person with whom we are communicating also understands the same language it's going to be very difficult for two people to communicate, likewise the protocol in the internet world, in the internet terminology is is a kind of a language that is typically used by human beings but the two different devices in my network which is actually trying to communicate between each other should really be talking with the same protocol on both the devices for the entire communication to be successful.

So if I basically have to explain protocol, protocol is basically a set of messages through which I will be controlling the communication between two different devices or end systems in my network right, so I will be able to control, I will be able to the data transfer so when I say control, I essentially mean trying to set up a communication path and also trying to closed on a communication path once the data transfer is completed right.

So what exactly is a protocol so protocol is basically a mechanism which is actually used by two different systems in my network and essentially they should actually be trying to follow the same protocol so that they will be able to successfully communicate and exchange their data which is essentially the whole purpose of actually having a network in place, so there are different types of protocols in fact network is all about a protocol and again when we say protocol, protocol is all about jargons, so you have different kinds of acronyms, we will actually be slowly introducing you to different types of different acronyms that you need to be comfortable with if you are basically going to be working in the domain of networking.

So you could basically be referred as like a TCP protocol, it could be IP protocol HTPP FTP PPP and so on and so forth and there are in numerable numbers of protocols that are there in the networking domain as of today. So the protocol is something that is actually going to be used for example between the communication from this end end system to let's say this end system, right?

So among the protocol that is actually listed here, one example protocol that could be used is http when this end system wants to communicate to this particular end system right, so for example ip is another protocol that could actually be used for communicating for example from this router device to this particular router device, right?

So we will actually see the different kinds of protocols that are used very commonly just to ensure that we actually have some basic understanding and foundation for getting a clear idea about what are the most common protocols, where are they used and why should they be really used for the communication to be effective, right?

So in terms of the structure internet could actually be define as sort of a network of networks it's a very loosely hierarchical in the sense I don't have a very well established strict hierarchy mechanism for the communication to be established, but I have a certain amount of hierarchy in place because I could really structure my entire network into something as what is called as subnets right,

So I could have a local ISP for example controlling this part of my entire network topology and I could really have a regional ISP who is a sort of at a higher level as compare to a local ISP. So ISP here stands for internet service provider, right?

So in that way I could have it in terms of an hierarchy but there is no strict structuring to it right and then we could also have something called as a public internet, was this a private intranet so public internet would essentially means something that is accessible from the internet across the world, whereas when I say it is a private intranet, it is something which will actually be accessible only within a specific network, so for example your organization network could be an intranet so your intranet site your file server that you possibly be using for storing the different kinds of project data, all this will be typically forming getting placed under my company network which will be getting classified as the intranet network, right?

So if I really want to have a mission accessible from a remote machine in my network then I will typically call it as a part of my public internet work, whereas if I need to have part of my mission available only within my private network that to will be referred to as a private intranet right. So there are different type of standards that are there especially for the different types of protocols, so you'll have a IETF which is basically the standardization body for all the internet working protocols IETF basically stands for Internet Engineering task force.

So each protocol actually has a standard document called as an RFC, so RFC stands for request for comments and if you really go to the site www.ietf.org you will find in that particular site lot of RFC documents and each RFC document will typically be referring to the standard the protocol standard for a particular protocol, so likewise you would typically have lot of RFC documents because as I was just mentioning there are many many protocols that are used typically the network although as far as very common usages of protocol are concerned there are only a handful of them, that we will need to be familiar with.

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What's the Internet: a service view

❑ communication *infrastructure* enables distributed applications:
  ❖ Web, email, games, e-commerce, file sharing
❑ communication services provided to apps:
  ❖ Connectionless unreliable
  ❖ connection-oriented reliable
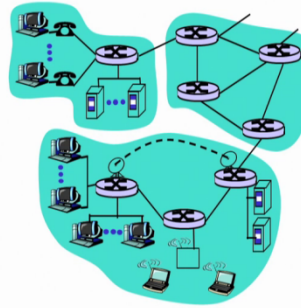
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So in terms of the services point of view the previous slide we looked at the the definition of an internet from a from the point of view of the individual components but in terms of these services that are being offered, you could typically classify it based on the kind of application that you are running, so as we would know different types of applications, network applications are possible over an internet so it could be a web application, it could be a email application, it could be a e commerce application for example we access on Amazon or flip kart or any of those kind of e portals right, or it could be a simple file sharing application like my drop box, so I could really have any kind of application that I would need to access over the network which is basically what my internet is going to provide to me as a service, right?

And then with respect to the communication services that are provided to the network applications so you typically have it either as a connectionless under liable service or a connection oriented reliable service. So we will be seeing what exactly is a connectionless under liable service and what exactly is a connection oriented reliable service.
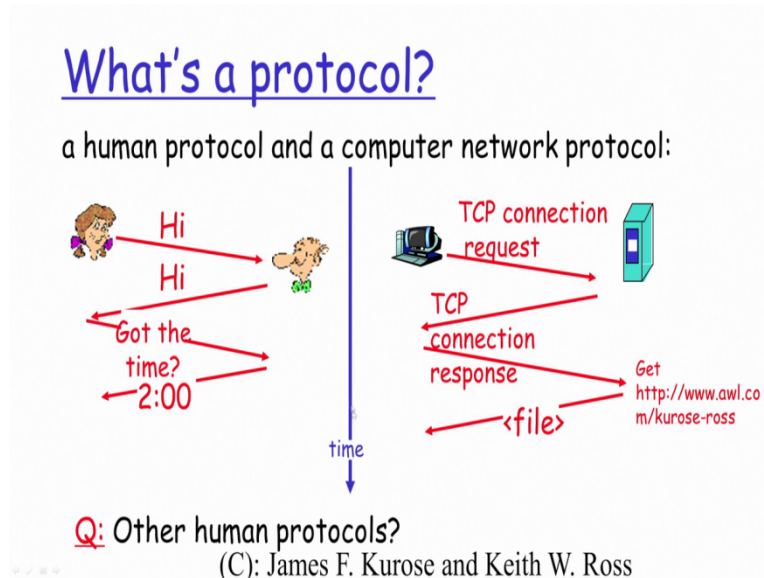
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What's a protocol?

human protocols:
- ❏ "what's the time?"
- ❏ "I have a question"
- ❏ introductions

... specific msgs sent

... specific actions taken when msgs received, or other events

network protocols:
- ❏ machines rather than humans
- ❏ all communication activity in Internet governed by protocols

protocols define format, order of msgs sent and received among network entities, and actions taken on msg transmission, receipt

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So I was just actually giving an example of how you would typically have a human protocol was this a network protocol, so all network protocols are actually governed by standards in IETF group as I was just mentioning and the protocols basically define the format, order of the messages that has been sent and received among the different network entities and actions that are taken on message transmission or received.

So there are basically if you strictly see there are three different parts from my protocol standard point of view, one which defines the format of the messages, so what is a message the client is going to be sending to the server and what is a message that the the the response messages that the server is going to be sending back to the client and second part of the, what is governed by the protocol is the order the messages that has been sent and received, so what is a sequence in which the messages going to be sent and received by the two parties on either side of my network, so the two end systems and then thirdly the protocol is also going to be talking about what are the different actions that are basically taken on the message getting received and also when the message is getting transmitted across.

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What's a protocol?

a human protocol and a computer network protocol:

Hi

Hi

Got the time?

2:00

time

TCP connection request

TCP connection response

Get http://www.awl.com/kurose-ross

<file>

Q: Other human protocols?

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So just an example of how an analogy could be build between what a a human protocol is structured and how a computer network protocol is typically structured.

Thank you.