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COMPUTER NETWORKING, SECURITY AND AUDITING: CONCEPTUAL REVIEW

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ABSTRACT

The paper examines in detail the concepts of computer network, security and auditing of computer network. In effect, the paper highlights the difference, historical antecedents and the different types of networks as well as their classifications. The paper also examined major properties of a good network in terms of scope and typology. The paper concludes that for effective functioning a regular appraisal of performance auditing as well as good security for the network must be ensured.

KEYWORDS

computer networking, computer security, auditing of computer network.

JEL CODES

C89, L86.

INTRODUCTION

The 1980s brought us a confusing and often incompatible array of computer hardware and software. During the 1990s, the bywords are "standardization" and "connectivity". The challenge for information technologists now is to get all the different makes, models, and sizes of computers to communicate with one another. Significant progress has been made of late.

OBJECTIVE OF THE STUDY

To give a conceptual review to the Computer Networking, Security and Auditing.

COMPUTER NETWORKING

It involves connecting computers so that they can communicate with each other, allowing users to share programs, access common databases, and exchange information electronically. The percentage of work-place personal computers linked by networks is projected to grow from only 15 percent in 1989 to 87 percent by 2002. Local-area networks typically referred to as LANS, involving the writing together of computers in a single location or a restricted geographic area, have emerged as the most common approach. Larger networks are possible.

Today's networks have evolved from the distributed systems to ones in which the network itself is the computer system.

It is in view of this context that this paper seeks to examine the dimensions of Computer Network is respect to its audit and security.

A TELECOMMUNICATIONS MODEL

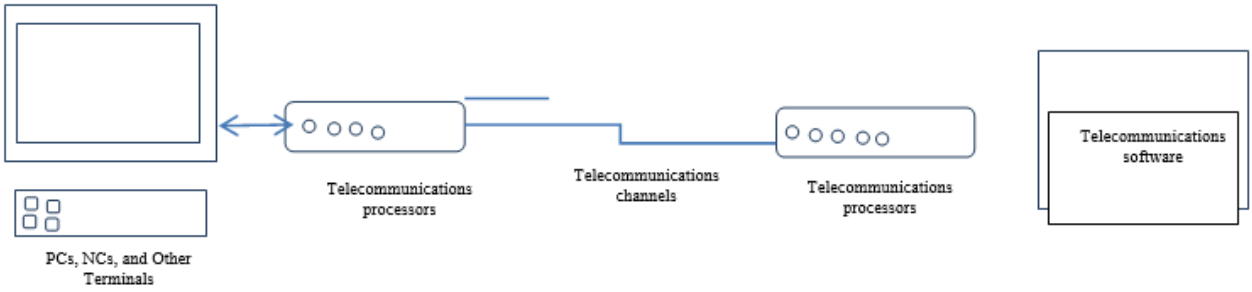
Before we get any further in our discussion of Computer Networks, we should understand the basic components of a common network. Generally, a receiver over a channel consisting of some type of medium. Figure 1. Illustrates a simple conceptual model of a computer network, which shows that it consists of five basic categories of components.

- **Terminal:** such as networked personal computers, network computers, or information appliances. Any input/output device that uses telecommunications networks to transmit or receive data in a terminal, including telephones and the various computer terminals.
- **Processors:** which support data transmission and reception between terminals and computers. These devices, such as modems, switches, and routers, perform a variety of control and support functions in a telecommunications network. For example, they covert data from digital to analog and back, code and decode data, and control the speed, accuracy, and efficiency of the communications flow between computers and terminals in a network.

- **Channels:** over which data are transmitted and received. Channels may use combinations of media, such as copper wires, coaxial cables, or fiber-optic cables, or use wireless systems like microwave, communications satellite, radio, and cellular systems to interconnect the other components of a telecommunications network.
- **Computers:** of all sizes and types are interconnected by telecommunications networks so that they can carry out their information processing assignments. For example, a mainframe computer may serve as host computer for a large network, assisted by 'a midrange computer serving as a front-end processor, while a microcomputer may act as a network server in a small network.
- **Software:** consists of programs that control telecommunications activities and manage the functions of telecommunications network. Examples include network management programs of all kinds, such as telecommunications monitors for mainframe host computers, network operating systems for network servers, and web browsers for microcomputers.

No matter how large and complex real world telecommunications networks may appear t to be, these five basic categories of network components must be at work to support an organization's telecommunications activities. This is the conceptual framework you can use to help you understand the various types of telecommunications networks in the use today.

FIG. 1: THE FIVE BASIC COMPONENTS IN A COMPUTER NETWORK: (1) TERMINALS, (2) COMPUTER PROCESSORS, (3) COMPUTER CHANNELS, (4) COMPUTERS, AND COMPUTER SOFTWARE



CHARACTERISTICS OF EFFECTIVE COMPUTER NETWORKS

Essential characteristics of functional computer network include:

- **Facilitate Communications:** Using a network, people can communicate efficiently and easily via email, instant messaging, chat rooms, telephones, video telephone calls and video conferencing.
- **Permit sharing of files, data, and other types of information:** In a network environment, authorized users may access data and information stored on other computers on the network. The capability of providing access to data and information on shared storage devices is an important feature of many networks.
- **Share network and computering resources:** In a networked environment, each computer on a network may access and use resources provided by devices on the network, such as printing a document on a shared network printer. Distributed computing uses computing resources across a network to accomplish tasks.
- **May be insecure:** A computer network may by computer hackers to develop computer viruses or computer works on devices connected to the network, or to prevent these devices from normally accessing the network (denial of service)
- **May interfere with other technologies:** power line communication strongly disturbs certain forms of radio communication, e.g., amateur radio. It may also interfere with last mile access technologies such as ADSL and VDSL.
- **May be difficult to set up:** A complex computer network may be difficult to set up. It may also be very costly to set up an effective computer network in a large organization or company.

A well-known family of communication media is collectivity known as Ethernet. It is defined by IEEE 802 and utilizes various standards and media that enable communication between devices. Wireless LAN technology is designed to connect deices without writing. These devices use radio waves or infrared signal as a transmission medium.

TYPES OF COMPUTER NETWORKS

There are many difference types of telecommunications networks. However, from an end user's point of view, there are only a few basic types, such as wide area and local area networks and interconnected networks like the Internets, and extranets, as well as client/server and interenterprise networks.

Telecommunications networks covering a large geographic area are called wide area networks (WANs). Networks that cover a large city or metropolitan area (metropolitan area networks) can also be included in this category. Such large networks have become a necessity for carrying out the day-to-day activities of many business and government organizations and their end users. For example, WANs are used by many multinational companies to transmit and receive information among their employees, customers, suppliers, and other organizations across cities, regions, countries, and the world. Figure 2 illustrates and example of a global wide area network for a major multinational corporation.

Local area networks (LANs) connect computers and other information processing devices within a limited physical area, such as an office, classroom, building manufacturing plant, or other work site. LANs have become commonplace many organizations for providing telecommunications network capabilities that link end users in offices, departments, and other workgroups.

LANs use a variety of telecommunications media, such as ordinary telephone wiring, coaxial cable, or even wireless radio and infrared systems, to interconnect microcomputer workstations and computer peripherals. To communicate over the network, each PC usually has a circuit broad called a network interface card. Most LANs use a more powerful microcomputer having a large hard disk capacity, called a file server or network server, that contains a network operating system program that controls telecommunications and the use and sharing of network resources. For example, it distributes copies of common data file and software packages to the other microcomputers in the network and controls access to shared laser printers and other network peripherals. See figure 3.

Intranets are designed to be open, but secure, internal networks whose Web browsing software provides easy point-and-click access by end users to multimedia information on internal websites. Intranet websites may established on internal Web servers **by a** company, its business units, departments, and workgroups. For example, **a** human resources department may establish an intranet website so employees can easily access up-to-the-minute information on the status of their benefits accounts, as well as the latest information on company benefits options. One of the attractions of corporate intranets is that their Internet-like technology makes them more adaptable, as well as easier **and** cheaper to develop and use than either traditional client/server or **mainframe-based** legacy systems. See Figure 4.

Extranets are networks that link some of the intranet resources of a company with other organizations and individuals. For example, extranets enable customers, suppliers, subcontractors, consultants, and others to access selected intranet websites and other company databases. Organizations can establish private extranets among themselves, or use the Intranet as part of the network connections between them.

Many organizations use *virtual private networks* (VPNs) to establish secure Internets and extranets. A virtual private network is a secure network that uses the Internet as its main *backbone network,* but relies on the firewalls and other security features of its Internet and intranets connections and those of participating

organizations. Thus, for example, VPNs would enable a company to use the Internet to establish secure intranets between its distant branch offices and manufacturing plants, and secure extranets between itself and its customers and suppliers. Let us look at a real world example.

ORGANIZATIONAL SCOPE

Networks are typically managed by organizations which own them. According to the owner's point of View, networks are seen as intranets or extranets. A special case of network is the Internet, which has no single owner but a distinct status when seen by an organizational entity-that of permitting virtually unlimited global connectivity for a greater multitude of purpose.

Network topology

A network topology is the layout of the interconnections of the nodes of a computer network. Common layouts are:

- A bus network: all nodes are connected to a common medium along this medium. This was the layout used in the original Ethernet, called 10BASE5 and 10BASE2.
- A star network: all nodes are connected to a special central node. This is the typical layout found in a Wireless LAN, where each wireless client connects to the central Wireless access point.
- A ring network: each node is connected to its left and right neighbor node, such that all nodes are connected and that each node can reach each other node by traversing nodes left- or rightwards. The Fiber Distributed Data Interface (FDDI) made use of such a topology.
- A mesh network: each node is connected to an arbitrary number of neighbors in such a way that there is at least one traversal from any node to any other.
- A fully connected network: each node is connected to every other node in the network.

Note that the physical layout of the nodes in a network may not necessarily reflect the network topology. As an example, with FDDI, the network topology is a ring (actually two counter- rotating rings), but the physical topology is a star, because all neighboring connections are routed via a central physical location.

BASIC HARDWARE COMPONENTS

Apart from the physical communications media themselves as described above, networks comprise additional basic hardware building blocks interconnecting their terminals, such as network interface cards (NICs), hubs, bridges, switches, and routers.

1. NETWORK INTERFACE CARDS

A network card, network adapter, or NIC (network interface card) is a piece of computer hardware designed to allow computers to physically access a networking medium. It provides a low-level addressing system through the use of MAC addresses.

Each Ethernet network interface has a unique MAC address, which is usually stored in a small memory device on the card, allowing any device to connect to the network without creating an address conflict. Ethernet MAC addresses are composed of six octets. Uniqueness is maintained by the IEEE, which manages the Ethernet address space by assigning 3-octet prefixes to equipment manufacturers. The list of prefixes is publicly available. Each manufacturer is then obliged to both use only their assigned prefix(es) and to uniquely set the 3-octet suffix of every Ethernet interface they produce.

2. REPEATERS AND HUBS

A repeater is an electronic device that receives a signal, cleans it of unnecessary noise, regenerates it, and retransmits it at a higher power level, or to the other side of an obstruction, so that the signal can cover longer distances without degradation. In most twisted pair Ethernet configurations, repeaters are required for cable that runs longer than 100 meters. A repeater with multiple ports is known as a hub. Repeat<#s work on the Physical Layer of the OSI model. Repeaters require a small amount of time to regenerate the signal. This can cause a propagation delay, which can affect network communication when there are several repeaters in a row. Many network architectures limit the number of repeaters that can be used in a row (e.g. Ethernet's 5-4-3 rule). Today, repeaters and hubs have been made mostly obsolete by switches (see below).

3. BRIDGES

A network bridge connects multiple network segments at the data link layer (layer 2) of the OSI model. Bridges broadcast to all ports except the port on which the broadcast was received. However, bridges do not promiscuously copy traffic to all ports, as hubs do, but learn which MAC addresses are reachable through specific ports. Once the bridge associates a port and an address, it will send traffic for that address to that port only. Bridges learn the association of ports and addresses by examining the source address of frames that it sees on various ports. Once a frame arrives through a port, its source address is stored and the bridge assumes that MAC address is associated with that port. The first time that a previously unknown destination address is seen, the bridge will forward the frame to all ports other than the one on which the frame arrived. Bridges come in three basic types:

- Local bridges: Directly connect local area networks (LANs)
- Remote bridges: Can be used to create a wide area network (WAN) link between LANs. Remote bridges, where the connecting link is slower than the end networks, largely have been replaced with routers.
- Wireless bridges: Can be used to join LANs or connect remote stations to LANs.

4. SWITCHES

A network switch is a device that forwards and filters OS! layer 2 datagrams (chunks of data communication) between ports (connected cables) based on the MAC addresses in the packets. A switch is distinct from a hub in that it only forwards the frames to the ports involved in the communication rather than all ports connected. A switch breaks the collision domain but represents itself as a broadcast domain.

Switches make forwarding decisions of frames on the basis of MAC addresses. A switch normally has numerous ports, facilitating a star topology for devices, and cascading additional switches. Some switches are capable of routing based on Layer 3 addressing or additional logical levels; these are called multi-layer switches, The term *switch* is used loosely in marketing to encompass devices including routers and bridges, as well as devices that may distribute-traffic on load or by application content (e.g., a Web URL identifier).

5. ROUTERS

A router is an internetworking device that forwards packets between networks by processing information found in the datagram or packet. In many situations, this information is processed in conjunction with the routing table (also known as forwarding table). Routers use routing tables to determine what interface to forward packets (this can include the "null" also known as the "black hole" interface because data can go into it, however, no further processing is done for said data).

6. FIREWALLS

A firewall is an important aspect of a network with respect to security. It typically rejects access requests from unsafe sources while allowing actions from recognized ones. The vital role firewalls play in network security grows in parallel with the constant increase in 'cyber' attacks for the purpose of stealing / corrupting data, planting vimses, etc. Network Audit and Network Performance.

Network performance refers to the service quality of a telecommunications product as seen by the customer. It should not be seen merely as an attempt to get "more through" the network.

The following list gives examples of Network Performance measures for a circuit-switched network and one type of packet-switched network, viz. ATM:

- Circuit-switched networks: In circuit switched networks, network performance is ' synonymous with the grade of service. The number of rejected calls is a measure of how well the network is performing under heavy traffic loads. Other types of performance measures can include noise, echo and so on.
- ATM: In an Asynchronous Transfer Mode (ATM) network, performance can be measured by line rate, quality of service (QoS), data throughput, connect time, stability, technology, modulation technique and modem enhancements.

There are many different ways to measure the performance of a network, as each network is different in nature and design. Performance can also be modelled instead of measured; one example of this is using state transition diagrams to model queuing performance in a circuit-switched network. These diagrams allow

the network planner to analyze how the network will perform in each state, ensuring that the network will be optimally designed. In the same vein, the network in use must constantly be audited for effective feedback.

NETWORK SECURITY

In the field of networking, the area of network security consists of the provisions and policies adopted by the network administrator to prevent and monitor unauthorized access, misuse, modification, or denial of the computer network and network-accessible resources. Network Security i£ the authorization of access.

COMMUNICATIONS PROTOCOL

A communications protocol defines the formats and rules for exchanging information via a network and typically comprises a complete protocol suite, which describes the protocols used at various usage levels. An interesting feature of communications protocols is that they may be - and in fact very often are - stacked above each other, which means that one is used to carry the other. The example for this is HTTP running over TCP over IP over IEEE 802.11. where the second and third are members of the Internet Protocol Suite, while the last is a member of the Ethernet protocol suite. This is the stacking, which exists between the wireless router and the home user's personal computer when surfing the World Wide Web. Communication protocols have themselves various properties, such as whether they are connection-oriented versus connectionless, whether they use circuit mode or packet switching, or whether they use hierarchical or flat addressing.
There exist a multitude of communication protocols, a few of which are described below

ETHERNET

Ethernet is a family of connectionless protocols used in LANs, described by a set of standards together called IEEE 802 published by the Institute of Electrical and Electronics Engineers. It has a flat addressing scheme and is mostly situated at levels 1 and 2 of the OSI model. For home users today, the most welt-known member of this protocol family is [EEF 802.11, otherwise known as Wireless_LAN (WLAN), However, the complete protocol suite deals with a multitude of networking aspects not only for home use, but especially when the technology is deployed to support a diverse range of business needs. MAC bridging IEEE 802. ID) deals with the routing of Ethernet packets using a Spanning Tree Protocol. IEEE. 8Q2. IQ describes VLANs, and IEEE 802. IX defines a port-based Network Access Control protocol which forms the basis for the authentication mechanisms used in VLANs, but also found in WLANs - it is what the home user sees when they have to enter a "wireless access key".

INTERNET PROTOCOL SUITE

The Internet Protocol Suite is used not only in the eponymous Internet, but today nearly ubiquitously in any computer network. While at the Internet Protocol (IP) level it operates connectionless, it also offers a connection-oriented service layered on top of IP, the Transmission Control Protocol (TCP). Together, TCP/IP offers a semi-hierarchical addressing scheme (IP address plus port number).

SONET/SDH

Synchronous optical networking

Synchronous Optical NETworking (SONET) and Synchronous Digital Hierarchy (SDH) are standardized multiplexing protocols that transfer multiple digital bit streams over optical fiber using lasers. They were originally designed to transport circuit mode communications from a variety of different sources, primarily to support real-time, uncompressed, circuit-switched voice encoded in PCM format. However, due to its protocol neutrality and transport-oriented features, SONET/SDH also was the obvious choice for transporting Asynchronous Transfer Mode (ATM) frames. Asynchronous Transfer Mode.

ASYNCHRONOUS TRANSFER MODE

Asynchronous Transfer Mode (ATM) Is a switching technique for telecommunication networks. It uses asynchronous time-division multiplexing and encodes data into small, fixed-sized cells. This differs from other protocols such as the Internet Protocol Suite or Ethernet that use variable sized packets or frames. ATM has similarity with both circuit and packet switched networking. This makes it a good choice for a network that must handle both traditional high-thro ugh put data traffic, and real-time, low-latency content such as voice and video. ATM uses a connection-oriented model in which a virtual circuit must be established between two endpoints before the actual data exchange begins.
While the role of ATM is diminishing in favour of next-generation networks, it still plays a role in the last mile, which is the connection between an Internet service provider and the home user. For an interesting write-up of the technologies involved, including the deep stacking of communications protocols used.

CONCLUSION

Computer systems, made up of data, hardware, programs, procedures, and trainee) operators, are essential to organizational success today. Thanks to technological advancements, computers have become significantly smaller, faster, and less expensive. Traditional centralized computer systems are being replaced by distributed systems, stand-alone personal computers, and computer networks. The large number of personal computers in the workplace has transformed managers from passive consumers of computerized information into active "producers" of computerized information. Networks of microcomputers, often configured as local-area networks, represent the present direction of organizational computing. Accordingly, standardization and connectivity are the bywords for computerized information processing during the 1990s.
A management information system (MIS) is a computer-based network that integrates the collection, processing, and transmission of information for an entire organization. All types of MIS share several common design components. Their ultimate objective is to get the right information to the right manager at the right time.
In the electronic workplace, managers need to face unique challenges related to computer literacy training, computer security risks, telecommuting pros and cons, and new information technologies, as it is constantly emerging these days.

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