

AK/ITEC 3210 – APPLIED DATA COMMUNICATIONS & NETWORKS
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Assignment

PART 1: Network Performance and Best Practices (39 marks)

1) Briefly discuss **the 3 most important and non-redundant** indicators of network performance. Use the format below:

- **Availability:** The percentage of time the network is available to users.
- **Response Time:** The delay between the last keystroke of a send request and the time it takes to get a response to that request.
- **Scalability:** How easy it is to expand the capacity of a network when the demand increases, and how easy it is to decrease the capacity of the network as the demand decreases.

2) For EACH indicator above, discuss THREE best practices¹ in network design one can use to improve that indicator. Do NOT use a single best practice more than once in this exercise. Use the format below:

Availability:

- Use devices with **higher MTBF**:
 - MTBF or *mean time between failures* is the number of hours or days of continuous operation before the component fails.
 - Using devices with higher MTBF improves network availability because a higher MTBF means a more reliable component / device, which in turn means higher uptime.
- Use devices with **lower MTTR**:
 - MTTR or *mean time to repair* is the average number of minutes or hours until the failed device or circuit is operational again.
 - Using devices with lower MTTR improves network availability because a lower MTTR means quicker maintenance and repair, which in turn means higher uptime.
- Using **managed devices**:
 - Managed devices (that work in a managed network) in addition to performing their normal functions (e.g. routing, switching) also record data on the messages they process.
 - Using managed devices improves network availability because network problems can be detected and reported by the devices themselves before they become serious. These problems can be rectified in a timely/convenient manner thereby increasing uptime.

Response Time:

- Use devices with **low latency**:

¹ Do NOT use a same best practice for two or three indicators

- Latency is the delay imposed by the device (e.g. a router, switch, server) in processing messages.
- Using devices with low latency improves network response time because such devices are fast and add little to no delay, whereas high-latency devices take a long time to process a message thereby increasing response time.
- Use devices with **sufficient dedicated memory**:
 - Device memory allows for storage of packets/messages so they can be processed.
 - Using devices with sufficient memory improves network response time because it prevents lost packets, which in turn prevents retransmission, which in turn decreases unnecessary network traffic (effectively decreasing response time).
- **Minimizing Network Traffic**:
 - Instead of maximizing the speed at which a network can move the traffic it receives, minimize the amount of traffic a network receives.
 - Minimizing Network Traffic improves network response time by moving most commonly used data closer to the users who need it, decreasing unnecessary traffic, and effectively decreasing response time.

Scalability:

- Implementing a **Client/Server application architecture**:
 - In this architecture the server handles data storage and data access logic, the client takes care of the presentation logic, and the application logic may reside on the client, server, or be split up between the two.
 - Using the client-server computing application architecture improves network scalability because servers can be added to (or removed from) the architecture when processing needs change.
- Using **Virtual Servers**:
 - A configuration of a server (usually a WEB server) that appears to clients as an independent server but which is actually running on a computer that is shared by any number of other virtual servers.
 - Using virtual servers improves network scalability because dozens of virtual servers can co-reside on the same computer allowing both processing power and capacity to be allocated when and where needed, and quickly redeployed to accommodate changing requirements.
- Using **T-Carrier Services / T-carrier circuits**:
 - Most commonly used form of dedicated-circuit services in North America.
 - Using T-Carrier services improves network scalability because they are digital and packet switched (breaks digital information into packets and transmits them over many connections), making them much more scalable than previous analog and circuit switched systems.

PART 2: Internet connection for DATAPRO (6 marks)

Datapro (see assignment1) has approached you to recommend an Internet connection. Log onto to www.allstream.com/services to answer the following questions:

- 1) Briefly explain WHICH Internet connection you recommend and WHY (TWO sentences MAX)

We recommend a T1 Internet access, as most employees will need access to the internet, however they probably will not need to send and receive large amounts of data. T1 is a perfect solution for this due to its good speed, reliability, relatively low cost, and is highly scalable which is a desirable feature for a new company that can grow fast.

- 2) Briefly explain which additional hardware component(s) are needed for such Internet connection. Use the format below:

- Edge router with available expansion slot (default gateway) – connects to Internet
- WIC Card with integrated CSU/DSU for T1 – a digital-interface device (that can be inserted into a router slot) used to connect to a digital circuit (T1).
- Cat5e Cable - carry signal
- Firewall – security protection

- 3) Briefly explain the difference between an Internet connection and a WAN (or a MAN) service (TWO sentences MAX)

The internet connection requires the data to go through web based servers before reaching its destination. In the case of a MAN or a WAN, data is sent and received directly between computers (and connecting devices) as they would be in a LAN, only it's done over a much larger distance.

PART 3: Research on data storage (15 marks)

- 1) Storage area network (SAN)

- a) Definition: segment of network used for storing vast amounts of data
- b) Typical HARDWARE components used in SAN: RAID storage components, hubs, switches, bridges, backup devices, interface cards, cabling
- c) Major benefits:
 - (1) High performance achieved because of fiber technology that enables to send data across fiber optic channels at very high speeds and bandwidths to sites as far away as 10 kilometers
 - (2) Flexibility - isolated data sources can be interconnected and made generally available to multiple servers

- 2) Network attached storage (NAS)

- a) Definition: a hard disk storage that is set up with its own network address rather than being attached to the department computer that is serving applications or file sharing capabilities to a network's workstation users
- b) Compare NAS to SAN: NAS adds file storage on a network and almost any machine that can connect to the LAN can use NFS, CIFS or HTTP protocol to connect to a NAS and

share files while SAN extends direct attached storage to external disk arrays shared by many servers and only server class devices with SCSI fibre channel can connect to the SAN. NAS allows greater sharing of information especially between disparate operating systems such as Unix and Windows whereas file sharing of SAN is operating system dependent and does not exist in many operating systems, as such NAS is more suitable for smaller companies.

3) Direct attached storage (DAS)

- a) Definition: a computer storage that is directly attached to one computer or server and is not, without special support, directly accessible to other ones
- b) Compare NAS to DAS: in DAS any storage is connected through SCSI or IDE to a server while NAS is an integrated box, that has an OS running, but those boxes are most of the time completely redundant, where the OS is installed on a part of the disks or on a chip. DAS relies on a dedicated connection via a SCSI, IDE, or other local bus and the disk is accessed via block mode while NAS relies on CIFS or NFS or other protocols to provide file mode access to files that reside on the disk on a remote server

List any IT vendors' website or documentation you have used to answer this research question.

IT vendors' website or documentation used to answer this research question:

<http://www.bitpipe.com> <http://www.pc-pitstop.com/das/>

<http://www.microsoft.com/windowsserversystem/storage/dastosan.mspx>

<http://www.dothill.com/> <http://www.sun.qassociates.co.uk/storage>

<http://searchstorage.techtarget.com>

<http://www.mcse.ms>

<http://www.nas-san.com/differ.html>

PART 4: WAN/MAN services (15 marks)

Log onto <http://www.qwest.com/business/products/products-and-services/data-networking/list.html> Fill out the table below. Use **20 words MAX** per cell.

| Service | Type ² | Most distinctive feature ³ | Typical (or possible) usage |
|------------------------------|--|--|---|
| DS3 | Dedicated-circuits QWEST Private Line: DS3 | High Scalability: Provides the capacity you currently need and accommodates growing future demands. | Video and audio conferencing. |
| Ethernet Private Line | Dedicated-circuits Qwest Ethernet Private Line Services | Reliability: all-fiber SONET guarantees up to a 99.999 percent SLA | Users of high bandwidth applications for data, voice, video and Internet. |
| Metro | Both Packet-switched and Dedicated-circuits Ethernet: Metro Optical Ethernet (QMOE) | Meshed internet network | data file transfer, Internet access, off-site data storage and access to hosting, outsourced mail server service, and outsourced application service. |
| Geomax | Optical Wavelength/DWDM: GeoMax | Highly flexible and scalable solution supporting up to 32 protected or 64 nonprotected channels on two fiber pairs | Transfer of data between workstations, mainframes, supercomputers, etc. Business continuity and disaster recovery applications |

² Circuit-switched, Dedicated-circuits, Packet-switched or Virtual private network or don't know (if information provided is incomplete)

³ The feature **MUST** be meaningful i.e., it **MUST** refer to content presented in class

| | | | |
|---------------|--|---|--|
| Analog | Circuit-switched Private Line: Analog | Dedicated, secure, private transmission path. | Audio services (available at 3,500–15,000KHz): Voice-grade services (available at 300–3000 baud): |
|---------------|--|---|--|

PART 5: Security measures for networks (25 marks): Log onto [IT vendors' websites of your choice](#) to fill out the table below.

- Use **20 words MAX per cell** and **clearly** indicate your sources (sources are not included in the word count)
- Do NOT use desirable features related to availability in stock and cost (**too obvious!**)

| Security measure | Function (Protects against...) | Operation (How it protects against...) | Desirable feature AND rational³ |
|---|---|---|---|
| Intrusion detection system (IDS) | It is used to protect against external attacks and also used to monitor potential intrusions, Malicious activities. www.Checkpoint.com | Blocks user or source IP address from accessing the network and alerts the network admin about any unusual activities www.Checkpoint.com | attack halting: stops attack. attack blocking: closes the loophole through which the attacker gained access. www.Checkpoint.com |
| Firewall | Protects against network and application layer attacks, virus, worms, that try to reach the pc over the internet. www.Checkpoint.com | by hiding you computer from external users and preventing unauthorized connections. www.Checkpoint.com | Anti-phishing and site status Blocks fraudulent websites including “phishing” sites. Authentication: confirms ID of valid users authorized network access. www.Checkpoint.com |
| VPN device | allows employees to access their internal networks and computers over the Internet or other public network with security www.cisco.com | using encrypted tunnels (encrypts the message) | Extend geographic connectivity. Improve security where data lines have not been ciphered. www.cisco.com |

³ A desirable feature is a meaningful feature one can use to compare 2 IDS or 2 firewalls or 2 VPN devices, etc. before selecting the better one (i.e., the better IDS or the better firewall or the better VPN device).

| | | | |
|------------------------------------|---|--|---|
| Network address translation | Allows a single device (router) to act as agent between the Internet ("public network") and a local network ("private" network). www.cisco.com | Translates private addresses in the internal network into legal addresses before packets are forwarded to another network (hides PC). www.cisco.com | Security : It creates a firewall between the internal network and outside Network or internet www.cisco.com |
| Storage area network (SAN) | an architecture to attach remote computer storage devices to servers such that the devices appear locally attached to the OS http://en.wikipedia.org/wiki/Storage_area_network | Protects against physical intrusions because it uses Fibre Channel instead of TCP/IP. | Also enables more effective disaster recovery processes. www.cisco.com |