1.264 Lecture 34 (Solutions)

Telecom: Connecting wired LAN, WAN

Next class: Green chapter 17. Exercise due before class
http://web.mit.edu/subjectevaluation

Exercise

- Your transportation brokerage company also handles billing for freight shipments, collecting from shippers and forwarding payment to carriers.
  - This data must be secure; you route funds directly to banks in some cases and between customers in other cases.
- How would you communicate between your three major sites in New Jersey, Houston and Los Angeles?
  - You transfer approximately 10,000 bills of lading in a 1 hour window at the end of each day from Houston and Los Angeles to New Jersey, which is the only site connected to banks and customers
  - Each bill is about 500 kB of data (documents and signatures are scanned)
- Select the technology and bandwidth
  - Will you use LAN, WAN or MAN technology, or combination?
  - Which specific technologies will you use? Discuss options, pros/cons briefly.
  - Discuss broader options surrounding your choice.

Solution

- **Bandwidth:**
  - **500 kB x 8 bits/byte x 10 000 docs / 3600 seconds/hr**
  - **Approximately 11 Mbps raw data rate**
  - **Connection should be at least 15 Mbps, for overhead, etc.**
  - **If we route LA traffic via Houston, Houston-NJ needs 25-30 Mbps**
  - **Either case requires OC-1 (45-51 Mbps) bandwidth**
- **Technology: WAN between LANs at each site**
  - **With only two links (LA-Houston and Houston-NJ), two point to point fiber optic links are a possible solution**
    - **Used only 1 hour a day, though…**
  - **Internet could handle it but large bursty traffic across the country would have reliability problems**
    - **Business traffic has security issues on open Internet**
  - **Satellite bandwidth too low (network video has special deal!).**

Solution, p.2

- **Business process can/must change:**
  - **Established years ago with small amount of data and expensive telecom**
  - **Cheaper to send documents in real time now**
  - **If docs sent in real time 10 hrs/day, bandwidth = 1.5Mbps, which can be handled by T1, DSL, … much less expensively. 1.5 Mbps is a sweet spot.**
  - **Or, look further: do we need to send all 500 kB to the bank? If we store the full document, can we send just the part the bank needs? Trade off complexity vs cost**
- **Another reason why we use spiral model**
  - **Telecom considerations at the very end can require changing a business process**
    - **Which requires changing requirements among channel partners**
    - **And changes UML, database (maybe), Web services, etc.**
  - **If we find this in the first spiral, we can change it**
  - **If we find this at the end of chaos/waterfall, it can be desperate**

Exercise: MAN

	LAN	MAN
Distance (kilometers)		
Owner		
Number of devices		
Bandwidth (Mbps)		
Resiliency/redundancy (yes/no)		
Is there a service level agreement (contract)?		

Give approximate ranges for distance, devices, bandwidth.

Solution

	LAN	MAN
Distance (kilometers)	1-5 km	5-50 km
Owner	Company/user	Carrier
Number of devices	10-1000	1000-100,000
Bandwidth (Mbps)	100Mbps-1 Gbit/sec	2 Mbps-10 Gbit/sec
Resiliency/redundancy (yes/no)	No	Yes, usually
Is there a service level agreement (contract)?	No	Yes

Exercise

- You have a depot in an industrial area without carrier fiber optics
- You have 1,000 buses that return to the depot every evening and upload video to a remote site
- Each bus has 10 hours of 384 kbps video.
- Data goes via WiFi (wireless LAN) from each bus to a depot server, and then to the remote server.
- You want all data to transmit in 2 hours.
- Choose between DSL, cable TV and 4G wireless access. Which of these 3 can handle it?
  - If they can't, what do you need?

Solution

- Data/sec= 1,000 veh * 384 kbps= 384 Mbps
- Time to send= 2 hr
- Time to record= 10 hr
  - Thus, the data must be sent 5 times as fast as it was recorded.
- Bandwidth= 5 * 384 Mbps= 1920 Mbps= 1.92 Gbps
- DSL, CATV or 4G/LTE cannot handle this
- You need OC-48 (2.5 Gbps) over fiber to do this.
  - You might be better off having each bus send real time video over LTE, though it would be expensive… You could sample, have driver control it (usually), etc.

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