ITEP Midterm Fall 2015 – Solution

This is a closed-book, closed-notes exam scheduled for one (1) hour. For each problem, justify your answer, where applicable and use a separate page in your "blue book".

1. (a) Consider a bridge crossing a river, with cars crossing. What channel sharing mechanism does this correspond to? (b) Consider a ski lift (aerial tram, cable car) such as the one depicted above. What is the rough equivalent technique for communication systems?

2. Both television stations and newspapers rely on advertising as a principal source of revenue. What are the differences in their business models? Could newspapers become more like television stations?

3. What are two important similarities and two important differences between the provision of electric energy and Internet service?

4. What are two important advantages of copper/DSL networks and two advantages of fiber-to-the-home (FTTH) networks?

5. Describe the transport layer as a service: What service does it provide to the layer above and what does it expect from the layer below?

6. Where is plenty of “space” in the spectrum bands above 10 GHz. Why not just move all communications services to these higher frequencies? (Provide at least two reasons.)

7. We discussed several common network models, one being “unbundled loops” (unbundled network elements). Under what conditions does this model work well and where does it face challenges?

8. Explain the decision to obtain an MS degree in terms of opportunity cost.

Solutions

1. (a) packet switching (random arrivals); (b) ski lift gondolas arrive at fixed intervals, so the capacity of the “channel” (lift) is time-division multiplexed.

2. Most newspapers also rely on subscription revenue and on-line advertising. It is much easier to just watch a single show on TV than buy a paper newspaper, but the distribution model is similar for on-line. Many newspapers now have “pay walls” that provide monthly subscription options, while TV stations rely on obtaining retransmission consent revenue
through cable bundles. Each newspaper is largely independent. Newspapers would have to become part of “networks” and sell subscriptions as a bundle to approximate the TV model. (Given the largely local content of newspapers, this seems unlikely.) [Generally, any well-founded description of the business model differences is acceptable.]

3. **Similarities:** considered a basic utility by many consumers; small number of distribution networks; separation of generation (content) and distribution; both share the same utility poles; roughly similar notion of long-haul and distribution networks; similar notion of high-capacity (backbone) and lower-capacity (access) networks; shared among many users. **Differences:** generally, only one electric utility, but two or three wireline Internet service provides; rates of electric service are often regulated, Internet fees are not; no equivalent of cellular service (although there’s short-range wireless power…); Internet service is connected internationally, electric grids are mostly regional or national.

4. **Advantage DSL:** cheaper to deploy since it relies on existing copper loops; can provide central office power during commercial power outages; can be upgraded incrementally to fiber (FTTN). **Advantage fiber:** Scalable speed to 1 Gb/s and above; lower maintenance (not affected by moisture); not attractive to copper thieves; fewer active (electronic) elements needed in field.

5. The transport layer can provide one or more reliable end-to-end data connection, with congestion and flow control, between two network endpoints. [This assumes TCP; UDP only provides multiple connections, without the reliability.] It expects an unreliable, best-effort delivery of packets between two network endpoints.

6. Radio waves at these higher frequencies behave similar to light, i.e., these frequencies do not penetrate common building materials well and are affected by rain, heavy fog or snow. Secondly, the electronics needed to generate and process these higher frequencies are more complicated and costly.

7. Unbundled network elements describes allowing competitive providers to rent (typically) copper loops owned by the incumbent carrier, often at a regulated rate. This can increase retail competition and reduce consumer prices for Internet connectivity where the infrastructure has already been deployed. However, forced wholesale may discourage incumbents from replacing their copper infrastructure by fiber.