ECE544 Network Architecture Paper
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This assignment is intended as a practice exercise for high-level network architecture design based on top-down requirements analysis. Select one of the following “new” network design scenarios and write a ~10-page (12 pt, single-spaced, normal margins) architecture paper that explains how you would build a network for that application. This project is meant to be done during the first ~8 weeks of the course and may require some advance reading of the textbook or related research materials. Emphasis is on using network architecture principles in a reasonable (rather than optimum) way as a practicing engineer would. Creativity is encouraged and minor technical errors are acceptable as long as you demonstrate an understanding of the principles.

[Note: the paper must be written clearly and concisely with correct language, organization and technical diagrams. Absolutely no copying of text or figures from Internet sources – use your own words and diagrams for the whole report – cut-and-paste material will be rejected without review. Papers that do not meet a minimum standard of readability will not be graded!]

The paper should contain the following key items:
1. Concept for the network (why is it needed, what are the services, who does it serve, why a new design approach is needed, usage scenarios, cost factors, etc.) [2 pages]
2. High-level concept diagram of proposed network (outlines topology, major technology components, service API, type of end-user terminals, etc.) [2 pages]
3. Requirements table (list of key requirements such as services, QoS, mobility, security, reliability, cost, etc.) [1 page]
4. Network architecture diagram which shows all major components (terminals, network interfaces, Ethertnets, satellites, routers, switches, etc.) and interfaces between them. Specify protocol stacks used at each node of the network including definition of inter-protocol gateways if any. [4 pages]
5. A brief performance evaluation (using analysis or simulation) to determine system throughput vs offered traffic and major QoS measures if any. A rough calculation of cost (related to capacity = maximum throughput and $ invested in equipment) is also instructive. [1 page]
6. Conclusions and further work [1/2 page]
7. References

Total ~10 pages

Select any ONE of the following topics:

1. Robust rapid deployment emergency infrastructure for a large disaster area (~1000 sq-mi) supporting emergency personnel (police, fire, national guard, etc.) as well as information and warning messages to affected communities.

2. Distributed data storage/backup system with ~100 locations, each with ~1 Terabyte capacity and 1 Gbps access speed, intended to support a US-wide customer base by up to 10,000 end-users.

3. Data center network which provides fast and efficient interconnection inside a single large data center site containing ~1000’s of compute and storage servers, while also providing high-speed/high volume connectivity for customer queries/data to and from the Internet.

4. Ultra high speed international broadband network to support scientific collaborations across multiple countries. This network will have ~30-50 major sites across the globe each producing ~100 Terabytes of research data (supercollider, gene sequencing, etc.) per day to be transferred to ~2-3 other sites daily. Also, supports access to ~10 central data repositories and supercomputers.
5. Video distribution network in which a service provider similar to Netflix builds a private network to support fast/high-quality delivery from multiple video server/data center sites to ISP access networks connecting to their end-customers. The design may utilize techniques such as adaptive media streaming and content delivery networks (CDN).

6. City-wide video surveillance network, with ~4000 digital video cameras, each @ 1 Mbps being selectively displayed at ~100 displays in a single control center; all recorded video should also be archived either in a centralized or distributed data storage for non-real time access when desired.

7. Mobile social network in which ~10-50 users in geographic proximity can exchange information, participate in games, and collaborate using mobile computers and smartphone/Android type devices. The system should also include in-network storage and computational services necessary to support this application.

8. Real-time augmented reality services aimed at devices such as Google glasses. In this scenario, mobile users receive supplementary information from context-aware cloud services for display below objects in their field of view. This requires a fast wireless network with low latency along with cloud computing resources distributed appropriately for real-time services.

9. System to support reality cloud-based gaming at scale. In reality cloud gaming, players use wearable computing devices such as FitBit, IWatch, TinyScreen, GoPro, Google Glass, Reconjet, etc. to engage in physical activities competing with other players. Requirements include real-time and high bandwidth across as many as 10,000 simultaneous players nationwide per game.

10. Vehicular communication network for safety messaging between cars on the roadway (V2V), as well as for infrastructure to vehicle (V2I) messages originating from roadway sensors, traffic lights, etc. The design should consider the geography of the system, maximum density of vehicular devices, traffic types and quality-of-service requirements.

11. Edge cloud system in which an Internet Service Provider (ISP) provides both computing and communication services from their local network. The edge cloud consists of distributed computing clusters co-located with access network switches or routers, designed to support computing services such as mobile off-loading, image analytics or navigation for people on the move. The design should consider both the network design (architecture, main elements and protocol stacks) as well as the computing software architecture for cloud computing such as Hadoop/OpenStack, etc.

12. National scale Internet-of-Things (IoT) service such as remote monitoring and management of trucking fleets across the USA. In this scenario, each trucking operator may have ~1000 trucks in active use across the country and the goal is to design a network which provides connectivity for custom navigation as well as short status messages from truck-central server and control messages from server-truck. The design should identify the required wireless access technologies, the core network architecture and the protocols used at each network element with the goal of achieving the required scale and performance at reasonable cost per user.