Telcom 2110 Network Design

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Top Down Network Design Approach

- Regardless of network design problem type, can follow a top down network design approach.
  A top down network design project should follow the four steps below:
  - Conceptual Model
    - Objectives, Requirements, Constraints
  - Logical Model
    - Technology, network graph, node location, link size, etc. (where algorithms are used to minimize cost)
  - Physical Model
    - Specific hardware/software implementations
    - (e.g., wiring diagram, repeater locations, etc.)
  - Implementation, Testing, Tuning and Documentation
Request for Proposals (RFPs)

- Many organizations develop a Request for Proposal (RFP) before making large network purchases or services
- RFP intended to create a competitive environment for providing network equipment and/or services
- Once vendors/consultants have submitted network proposals, the organization evaluates them against specific criteria and selects the winner(s)
- No fixed format for RFPs across all industries/organizations – many templates available for specific scenarios on the web
- May need to write/develop an RFP or a response to an RFP

RFP Components

- If writing an RFP some standard components
  - **Background Information**
    - Organizational profile;
    - Overview of current network/system and services;
    - Goals of the network design
  - **Network Requirements**
    - Choice sets of possible network designs (hardware, software);
      - Mandatory, desirable, and wish list items
    - Security and control requirements
    - Throughput, Response time, loss and availability requirements (i.e., performance and reliability guarantees)
    - Vendor constraints
    - Guidelines for proposing network designs
    - Intent is to scope out the design requirements to the best of your knowledge
RFP Components

• **Service Requirements**
  – Continuity of services
  – Implementation timeline plan
  – Support service needs
    • For example, spare parts on site, on-call service support, training on use and management
  – Workforce requirements

• **Bidding Process**
  – Time schedule for the bidding process;
  – Ground rules and bid evaluation criteria;
  – Availability of additional information and mechanism to ask and respond to questions

• **Information Required from Proposer**
  – Corporate profile;
  – Experience with similar projects; Reference list

• **Formatting requirements.**
  – Page limit or fixed format structure to RFP
  – Who will evaluate responses and how much time is allocated for it?

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Responding to an RFP

• If RFP has strict format be sure to follow the exact format that the RFP specifies.

• If no fixed format, write a sales design document
  – Describe your customer’s requirements and how your design meets those requirements
    • Presenting the design with focus on:
      – Organizational needs
      – Business objectives
      – Best practices
  – Document the budget for the project
  – Explain plans for implementing the design

• **Goal is to Sell the proposal to reviewers**
### Typical RFP Response Topics

- A network topology for the new design
- Information on the protocols, technologies, and products that form the design
- An implementation plan
- A training plan
- Support and service information
- Prices and payment options
- Qualifications of the responding company
- Recommendations from other customers
- Legal contractual terms and conditions

### Typical RFP Response Format

- Executive summary
- Project goal
- Project scope and services
- Design requirements
- New logical and physical design
- Implementation plan including testing
- Project budget
- Appendices with various details
Design Requirements

• Following Top Down Network Design method – partition into business and technical
• Business goals/requirements explain the role the network design will play in helping the organization succeed
  – Be creative – this is a sales pitch
  – What services can be offered in addition to the requirements in RFP
• Technical goals:
  – How does network meet goals in RFP and some not mentioned
  – scalability, performance, security, manageability, usability, adaptability, and affordability

Logical and Physical Design

• Logical design
  – Topology
  – Models for addressing and naming
  – Switching and routing protocols
  – Security strategies
  – Network management strategies, including possible staffing needs
• Physical design
  – Actual technologies and devices including vendor and software
Implementation Plan

- Recommendations for deploying the network design
- Project schedule
  - Including any dates and times for service provider installations
- Any plans for outsourcing
- Training
- Risks Management strategy
  - A fallback plan if the implementation should fail
  - A plan for evolving the design as new requirements arise

Possible Appendixes

- Detailed topology maps
- Device configurations
- Addressing and naming details
- Network design testing results (e.g., simulations)
- Pricing and payment options
- More information about the company that is presenting the design
  - Annual reports, product catalogs, press releases
- Legal contractual terms and conditions
Course Review

• Introduction
  – Network design categories
  – Top-down design method

• Requirements and Planning
  – Technical Goals and Constraints
    • Availability calculations, performance models
  – Traffic Demand Estimations
  – Project Costing

• Network Design Modeling and Algorithms
  – Relevant Results from Graph Theory
    • Basic graph analysis
    • Tree Design (MST, SPT, Prim-Dijkstra Trees)
    • Ring Design (nearest neighbor, multi-ring)

• Network Design Modeling and Algorithms
  – Relevant Results from Optimization Theory
    • Linear Programming
      – Formulation, Solution, Simplex Method, Software Tools
    • Integer Linear Programming
      – Branch and Bound Method
    • Network Design Models
      – Arc flow formulation, path formulation

• Access Network Design
  – Topology algorithms
    • One speed one center design (CMST – EW or Sharma algorithms)
    • Multi-speed one center (Cahn’s MSLA)
    • Multi-center Design (NNEW, MCEW)
  – Wireless access network design

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Review

- Metro Network Design
  - Mentor, Mentour Algorithms, optimization based approaches

- Wide Area Network Design
  - Design Algorithms (IP/MPLS/WDM)
  - Capacity Assignment for packet services
    - Min Delay, Min Max Delay, etc.
  - Virtual network design in MPLS
  - Network Survivability
    - Rings, Link protection, path protection, p-cycles
  - WDM network Design
    - RWA, Survivability, Traffic Grooming

Summary

- Network Design is not a precise science.
  - Many different types of problems
    - e.g., greenfield vs. incremental, wired vs. wireless
  - There can be several good answers (many more bad ones!) - usually no one best solution.
  - It involves trade-offs among cost vs. performance, technical vs. non-technical issues

- Top Down Design approach useful as a framework

- In many network designs (WAN, Metro) use mathematics/algorithms to help designers identify good solutions
  - Use computer models to solve mathematical formulations when possible