

1.264 Homework 7
Fall, 2002
Solutions

A. Review of Development Cycle 1

No formal solution is provided. The key items in the revised requirement document are:

1. The user interface should reflect the FrontPage (or other tool's) format and navigation. It should reflect the structure of the Web site as implemented (as in the Navigation view in FrontPage). The contents of each Web page should match those in the Web site in homework 6. Students can reference those pages; they don't need to copy them into their revised requirements document. Students should compare their finished Web site with their original requirements and comment on the major differences. Items in the original requirements that were omitted to save time (such as not having Web interfaces to all the database tables) don't need to be mentioned or discussed.
2. Process descriptions should be revised. These almost certainly were simplified during the construction of the Web site. The order process may be more complex than the original requirements.
3. Resource estimates. Based on the revised requirements, students should re-compute the resources required using the same method as in homework 1. The actual estimates will vary by group, since the requirements and implementations vary. Students should comment on whether their new estimates fall within the range of their original estimates. The range of the estimation at this point should be at the 'Product Design' level. We know more than at the original product specification; some groups may be able to justify using the 'Detailed Design' level.

The comments should cover the following:

1. Outcome of efforts in the following two cases:
 - a. Contracting development to a vendor after HW1: Vendor would have stated that the requirements are inadequate and would insist on a change order process that would be invoked many times as changes are made and details are specified. It would be a slow, costly and contentious process to build a production system from your initial requirements. The data model would have to be built, processes would be changed, the user interface would be changed, etc.
 - b. Contracting development to a vendor after HW7: Vendor would be pleased that the requirements are well defined and a first version of the system exists, albeit with missing parts and imperfections. Data model, processes and user interface would be quite stable. Effort would be highly likely to succeed.
2. Error bounds on next cycle. Error bounds at the 'Product Design' level are 0.8 to 1.25 times the point estimate. At the 'Detailed Design' level they are 0.95 to 1.05. These are narrow ranges but they should be attainable as long as omitted issues

are addressed in the revised requirements. Examples are database transactions, scalability to large volumes, security, etc.

3. Can requirements be translated into a design and a system? Except for the items noted immediately above (transactions, scalability, security and a few related items), a system could be built by a vendor.

B. Telecom

1. Cambridge and Burlington are about 12 miles apart; Cambridge and Worcester are about 45 miles apart, and Burlington and Worcester are about 50 miles apart.
 - i. These are within the limits for SMDS or FDDI but dark fiber isn't available. If students assume that it is, we'll accept that answer. FDDI would be a private network just for the company; two links (e.g., Cambridge-Burlington, Burlington-Worcester would be required). SMDS would provide full connectivity between all three pairs of points over a public, carrier-provided network. The data rates of FDDI and SMDS are more than sufficient.
 - ii. Otherwise, we need more than a T-1 (1.5Mbps), so we need a T-3 (45Mbps) or OC-1 (51 Mbps) link.
 1. The distances are too far for microwave.
 2. Satellite is not effective in this situation when fiber alternatives exist, and it doesn't have enough bandwidth
 3. Wireless is not an option for this long a distance.
 - iii. Frame relay at 10Mbps might be available. If so, it's almost certainly the best option. Getting 7 1.5Mbps frame relay connections may be an effective option if that's the limit on frame relay service available in this area.
 - iv. We can use a T-3 line from Cambridge to Burlington to Worcester, sourced from the telco carrier as a private network. This will be expensive but not unreasonably so.
 - v. We can use the Internet and buy T-3 connections to Internet Service Provider (ISP) access points. If the Internet is used, company traffic should be encrypted for security. The technology for this is called Virtual Private Network (VPN); I don't expect students to discuss this.
 - vi. DSL and cable modems don't have sufficient bandwidth as access links.
 - vii. ATM, if available, would have sufficient bandwidth. This is an acceptable answer.
 - viii. So, a T-3 or OC-1 private net, or frame relay, or VPN over the Internet are acceptable choices (or ATM).
2. You would not directly connect all three sites unless you needed redundant routing, but your telecom carrier would provide that redundancy even with the two link network.
3. The picture would be:

Ethernet <-> Router with: <-> T-3 link <-> Central office <-> Central office
FRAD card if frame relay (Cambridge) (Burlington)
CSU if T-3 circuit
(If the Internet is used,
either frame relay or T-3
will be used for access)

In Burlington central office there is a T-3 access link (frame relay or standard T-3) to the Burlington company office and the T-3 circuit continues to the Worcester central office, where there is a T-3 access link (frame relay or standard T-3) to the Worcester company office.

The T-3 links between central offices can be frame relay links if 10Mbps frame relay is offered; these would be shared, public links provided by the telecom carrier and used by other companies and individuals.

4. Network protocols
 - i. Layer 7: http in all columns
 - ii. Layer 4: tcp in all columns
 - iii. Layer 3: ip in all columns
 - iv. Layer 2: Ethernet in company offices, frame relay or T-3 for access and linehaul. T-3 circuit carried over SONET
 - v. Layer 1: Fiber or copper in company offices; fiber from company offices to central office (10Mbps is beyond the capacity of copper at distances over a few hundred meters), fiber between central offices

If a MAN is used, layer 2 will be either FDDI or SMDS and layer 1 will be fiber end to end.

5. If a single link failed with a SONET service, the carrier will be able to reroute traffic and there should be no interruption. This is true for a private network (individual T-3 links, for example) or a shared network (frame relay, SMDS, etc.) If two links failed, each would be handled as described in the previous line, and the service would still likely be intact.

We will accept any reasonable discussion of these issues as a valid answer for this question.