NSHG: A Network Simulation Hacking Game

# 1 Analysis

## 1.1, 1.2 Introduction (What is networking and why is it important)

The fundamentals of communication and networking is a massively important topic in the computer science A-level, with the growing connectivity of the world through the internet of things it is growing ever important that any computer scientists worth their weight will need a strong understanding of what these concepts are and how they ate implemented in the real world.

The topic in the A-Level is split up into 4 topics which are each split into further sub topics, these main and sub topics are as follows.

1. Communication
   1. Communication methods
   2. Communication basics
2. Networking
   1. Network Topology
   2. Types of networking between hosts
   3. Wireless networking
3. The Internet
   1. The Internet and how it works
   2. Internet Security
4. The TCP/IP protocol
   1. TCP/IP
   2. Standard application layer protocols
   3. IP address structure
   4. Subnet masking
   5. IP standards
   6. Public and private IP addresses
   7. DHCP
   8. Port Forwarding
   9. Client server model
   10. Thin vs Thick client computing

This is a vast specification and in order to answer the questions fully the student must understand all of these points

Networking is a large part of the computer science course and for some students is one of the hardest topics to engage with. This was evident in my Computer science class where many students failed to engage with the material taught by the teacher

To begin my project I am going to interview my end users, whom are teachers and students, to see some of the problems they have with teaching networking concepts, engaging students with the material and the understanding of the abstract concepts covered in networking and the internet.

The interview will be semi-structured having a list of required questions, written before the interview, and asking more questions based of the end users answers. This will allow for more in-depth information to be gathered reducing the risk of a possible re-design when showing the end user the “alpha” version of the project.

During the interview I will be taking notes

In the interviews I will discuss the problems and then possible solutions to those problems. I will focus on managing the expectations of the end user as to not have them expect more than I can produce in the given time.

## Current systems

The subject of networking is usually taught in 4 weeks with 5 hours a week. The lessons 1 hour long with 1 block of 3 lessons and 1 block of 2 lessons each week.

The class size currently is 7 people thought this varies from year to year (with a maximum of 15)

### What’s the problem?

## Interview Summary

After having an interview with the teacher he has given me a list of lessons/concepts that are covered in networking and the internet when teaching the subject:

* The OSI Model
* Encryption
* Routing
* Packet Switching
* TCP/IP protocol stack
* DNS
* Gateways
* Fire Walls
* Proxy Severs
* Smtp. Imap, pop, ftp

## The Current system

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The lessons consist of a power point with several task sheets to provoke questions from the students and assess their ability while going through the lesson. These tasks are fast and easy to complete.

At the end of the subject there is a 2 hour subject test which allows the teacher to make sure that the teaching has been successful and that the students have taken in the information this can then be processed to find what parts of the subject were misunderstood and what was received well which is used for revision/ recaps for a re-test if it is deemed necessary by the teacher.

## 1.4 Success Criteria

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| --- | --- |
| Success Criteria | Operationalised |
| The solution must teach all of the specification points fully. | Have a check list of all teaching/information points that need to be taught & check they are all covered. Further check that they someone who hasn’t completed the specification before can use the program, with the test in front of them, and answer all of the questions fully. |
| Allow the students to revise different areas in the specification |  |
| The solution must be engaging to students to make them want to learn about networking. | Test with the students to make sure that they enjoy the solution and engage with it. Found through observation. |
| The solution must have an “End of unit test” in order for the teacher to be sure all the students fully understand the topic | Have the end of unit test implemented as well as the one in the system to compare results to make sure the system is working, this ensures reliability of the new test. |
| The end of unit test would be self-marked | Have a teacher and the system mark the test to make sure it is marked correctly (interrater reliability) |
| Results should be output as a file making it easy to analyse | Have the results of each of the students be output as a CSV value (or another file type that can be imported into google docs/excel) |

## Limitations of my system

With this system being used in a school environment there are many technical limitations to my solution. Firstly the school network has a large firewall that will blocks lots of network traffic to make sure the school network says secure. This means that any data will have to be hosted within the school system so it can be accessed while in school. However this has the problem that the data would only be available while in school. A possible (though unlikely) solution to this is allowing an exception through the school firewall to allow the data to be accessed from outside the system.

Another limitation is that I will not be able to store information about students as otherwise I wouldn’t be able to be able to ensure its security (as I am not qualified). My solution to this is not storing any personal information about the student meaning it cannot be stolen from me. This does mean that I can’t do any data analysis on the students and instead have that handled by the current data handling system, which has been recently updated.

*With the time given it will be difficult to implement all specification points fully so I will most likely have the result of this project be a polished first quarter of the networking & the internet specification*

## Possible Solutions

I brainstormed some ideas that I thought could solve the problems my end user was having from there I will show those ideas to the teacher and the students and see what idea they will find most engaging and will be most representative of what my end user had in mind

### 1 Revision Game

My first idea was to create a revision game where students would answer questions and be told if their answers were right or wrong. When the student got a question wrong it would be added to a Challenge bank to be used later. The challenge bank would allow students to continue with questions then revisit what they found hard to see if they had learned what they got wrong after a period of time, this is to make sure it goes into their long term memory instead of short term memory.

When a student gets a question correct they are given points

## Chosen solution (and why)

“I have the attention span of a fish so the ‘hacking’ game would keep me occupied and engaged for longer”

Solution 1 doesn’t fully address the solution

## Research

### The OSI model

The Open Systems Interconnection model (OSI model) is a way to standardise the communication between systems it is broken down into 7 layers;

1. The physical layer
2. Data Link
3. Network
4. Transport
5. Session
6. Presentation
7. Application

I will go over each of the layers in detail now

#### Layer 1: Physical

This defines the physical, electrical connections between devices e.g electrical cable or optical fibre. This includes: voltage levels, timing of voltage changes, physical data rates, maximum transmission distances, and physical connectors.

#### Layer 2: Data Link

This layer describes the connections between nodes and doesn’t deal with the physical layers. This layer has basic error correction that will occur on the physical layer. This layer doesn’t deal with connecting multiple nodes together (networking) it is only concerned with the connection between two nodes and terminating it.

This layer can sometimes be divided into two sub layers

##### The Medium access control (Mac) Layer

This is the sub layer responsible for how devices gain access to data and permission to transfer

##### The Logic Link Control (LLC) layer

This layer controls the encapsulation of protocols and error correction

#### Layer 3: Network

#### Layer 4: Transport

#### Layer 5: Session

#### Layer 6: Presentation

#### Layer 7: Application

### Headers

How does data travel across the internet?

I purchased the book The Networking Bible in which I found a reference to something called an RFC so I decided to investigate, the rfc it pointed to was rfc 791 which is the official standard for how the IP Header works and how IP addresses are structured

#### IP

# Design