KF7046
Computer Network Implementation
Course Work 2017-18

Module tutor: David Kendall

1 Assessment submission and feedback

Date of hand out to students:
26th February 2018

Mechanism to be used to disseminate to students:
eLP

Date and Time of Submission by Student:
Demonstration: 11.00, 25th April 2018.
Reports: no later than 23.59, 3rd May 2018.

Mechanism for Submission of Work by Student:
The items should be submitted using Turnitin via the eLP using the links as follows:

- Review: `Assessment->Review`.
- Report: `Assessment->Report`.

Date by which Work, Feedback and Marks will be returned to Students:
Within 20 working days of submission date.

Mechanism(s) for return of assignment work, feedback and marks to students:

email and appointment on request.

2 Assignment brief

2.1 Research paper review (50%)

Introduction

You are required to write a technical review of a research paper from the networking literature. You may choose a paper related to either of the case studies that we are covering in the module: the Domain Name System (DNS), or the Internet of Things (IoT). There is a list of papers at the end of this document from which you can choose the paper that you would like to review. You may choose a paper that is not on this list if you wish. Remember that the University library provides electronic access to all IEEE and ACM journals and conference proceedings. Use NORA to access these resources. In either case, you must register your choice with your tutor and obtain formal agreement that you may proceed with the work for the review. Where possible, it is intended that all students should review a paper that is allocated to them individually.

Please register your paper by sending an email to David Kendall with the subject line "KF7046 Research Paper". Give the full publication details of the paper and, if you have chosen a paper of your own, a URL to an online version in the message body. You will receive an email granting or denying permission to proceed. You should have agreed a paper with your tutor by no later than 2nd March 2018.

Content

Your review should be structured as follows:

- What is the main problem considered by the paper, why is it important and what is the background?

  (10 marks)

- What other work has been done on this problem and in what respects is it lacking? *(10 marks)*

- What is the major claim of the paper? *(10 marks)*

- What methods have been adopted in order to provide evidence for the claim?*(10 marks)*

- What results are presented in support of the major claim? Are there any other interesting minor results? What is your opinion of the paper?

  (10 marks)

Guidance

You should follow the approach described in S. Keshav, *How to read a paper*, Technical Report, University of Waterloo, 2012, as discussed in the seminar sessions. You should complete at least the first two passes of the three pass approach described in the paper and then write your review using exactly the structure described in the section above.

The research papers for review can be found online in a local repository.

2.2 Network configuration and demonstration (20%)

Overview

You are required to design and implement a DNS infrastructure to satisfy the requirements of the following scenario.

A company requires a DNS infrastructure comprising primary and secondary servers to act as authoritative DNS servers for three domains:

- cnt.co.uk

- admin.co.uk

- technical.co.uk

The three domains are used to satisfy the company's requirement to restrict network privileges to staff based on their group membership and activities.

Domains and their relationship to groups of staff are identified below:

cnt This domain contains internal mappings for all staff machines and is used for sharing resources locally. Where possible, once a person is allocated a FQDN in this domain, it stays with them during their time at the company.

admin This domain is used by the technical staff to access machines remotely, using a name that represents a fixed asset number. This (name, machine) mapping remains constant for the lifetime of the machine.

technical This domain is used by the technical staff as a developmental infrastructure. As systems are introduced to the company, they are tested via mappings to the technical domain and moved to the cnt domain upon completion and testing.

CNT Domain

The staff intranet resides in the cnt domain and hosts a web server mapped to the domain name www.cnt.co.uk. In fact, the web server is implemented by a server farm. There are 3 servers that, together, provide a load-balanced web service. The DNS configuration should ensure that the servers in the web server farm are accessed in a round robin fashion.

Each server in the farm should also be mapped individually so that it can be maintained. The domain names to be used for this purpose are:

- web1.admin.co.uk

- web2.admin.co.uk

- web3.admin.co.uk

In addition, there is a shared content server attached to the network using NFS. In order to provide a fault-tolerant service, the NFS server is backed up to another machine via block replication.

The content server should be accessible via the domain name: nfs.cnt.co.uk and the replication server should be accessible via nfs2.admin.co.uk.

The cnt domain is also used to map staff in the company to machines. Each member of staff is allocated a domain name based on their personal name (e.g. William Smith will be given the name ws, and his full domain name will be ws.cnt.co.uk). The cnt domain should be replicated to a secondary server.

All DNS requests should be logged so as to allow an analysis of web usage which will allow the development of a firewall policy in the future.

Admin Domain

The admin domain is used by the technical staff to manage the infrastructure of the organisation. All equipment that the company attaches to the network is added to this domain so that it can be accessed by the technical staff who manage the equipment.

This domain regularly has additions made to it, but the mappings of devices to their allocated addresses are rarely changed, once added.

Each machine can be accessed within the admin domain, using its asset number as its name. Asset numbers start with an 'A' and are followed by an 8 digit number, giving a FQDN such as e.g. A12345678.admin.co.uk.

When necessary, server machines are also assigned an alias. The alias should be a memorable name that indicates the role of the server, (e.g. database, mail etc.). This additional level of indirection allows the role name to remain constant when equipment is updated or replaced by a new asset, i.e. the asset domain name can be changed while the role name remains the same. The admin domain should be replicated to a secondary server.

Technical Domain

The technical domain is used only by the technical staff. It is used for research and development within the organisation. The domain is highly active, requiring frequent updates as new ideas are evaluated. Servers are often installed, updated, deleted and reconfigured. Virtual machines are prevalent in this environment.

The technical domain should be managed using a DNS server that is independent from the server for the cnt and admin domains. Only the technical staff require access to the DNS server for this domain. Nevertheless, this DNS server is required to forward all requests that it cannot resolve to the main DNS server. This helps to promote security by ensuring that all DNS requests are logged. There is no need to replicate the technical domain data at a secondary server.

Additional notes

1. Your DNS configuration will be assessed by a demonstration in the lab, where you will be required to show that your network satisfies its functional requirements. You should prepare a set of tests that will allow you to demonstrate all aspects of the required functionality. You will be examined orally on your understanding of the design, implementation and testing of your network. You will be allocated a class C address block to use as you wish for your demonstration.

2. Marks will be allocated for the demonstration as follows:

   (a) Master DNS configuration, supporting forward and reverse queries   *(5 marks)*

   (b) Slave DNS configuration and use in the event of failure of the master server. *(5 marks)*

   (c) Logging   *(5 marks)*

   (d) Independent master for the technical domain, including
       forwarding   *(5 marks)*

2.3 Performance experiments (30%)

You should investigate some aspect(s) of the performance of a networked system in the area of DNS or IoT. A typical experiment might be intended to investigate a hypothesis about the impact of TTL values on the mean response latency experienced by a local client when making DNS queries for names in the domains managed by a DNS server. If you want to consider a different experiment, you should discuss that with your lecturer.

You should submit a report that covers the following aspects of your experiment:

1. Statement of the hypothesis *(6 marks)*

2. Description and evaluation of the experimental method *(6 marks)*

3. Presentation of the experimental data *(6 marks)*

4. Analysis of the experimental data *(6 marks)*

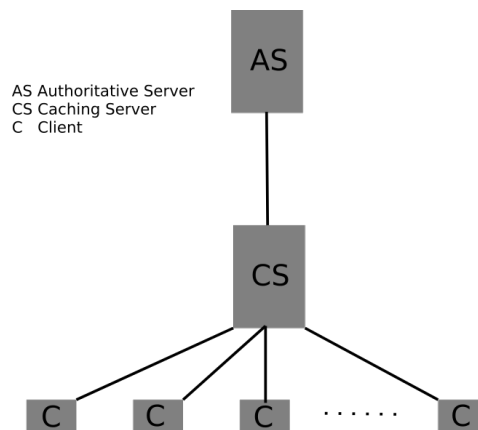5. Conclusion and critical evaluation of the experiment *(6 marks)*

Figure 1: Basic experimental configuration

Figure 1 shows a basic configuration for the typical DNS experiment. You can configure AS (the authoritative server) using your CNT DNS configuration. Configure CS (the caching server) to forward DNS requests to AS. Configure your clients so that they use CS as their default DNS server. Vary the TTL on CS for a variety of query loads. You can also use the `tc` traffic control tool to vary the communication characteristics of the link from AS to CS. Think carefully about what to measure and how to measure it. Construct a set of test scenarios and collect the raw data. Analyse the data using the statistical techniques outlined in the module. Draw conclusions and evaluate your experiment.

3   Further information

Learning Outcomes assessed in this assessment:

1. Apply and critically discuss principles in managing the complexity of computer networks, in particular layered, service-oriented and protocol-oriented views of network architecture.

2. Discuss the design principles and implementation of a variety of key networking protocols and algorithms and critically evaluate their effectiveness in practice.

3. Discuss applications, protocols, algorithms and tools of current interest to the computer network research community.

4. Apply appropriate theory, practices and tools to the design, implementation, testing and evaluation of computer networks.

5. Develop an independent, scientifically rigorous approach to the the acquisition of knowledge and the advancement of learning.

Assessment Criteria/Mark Scheme: The coursework consists of

1. a review of a research paper (50%)

2. a demonstration of a network configuration (20%)

3. a report on network performance experiments (30%)

More detailed marks allocation is provided in the assignment brief.

Referencing Style: Harvard

Expected size of the submission: Your research paper review should be about 5 A4 pages and your report on performance experiments should be about 4 A4 pages (assuming 10pt and normal margins in each case). There is no fixed penalty for exceeding these limits but unnecessary verbosity, irrelevance and 'padding' make it difficult for the marker to identify relevant material and may lead to some loss of marks.

Assignment weighting: 100%

Academic Integrity Statement: You must adhere to the university regulations on academic conduct. Formal inquiry proceedings will be instigated if there is any suspicion of plagiarism or any other form of misconduct in your work. Refer to the University's Assessment Regulations for Northumbria Awards if you are unclear as to the meaning of these terms. The latest copy is available on the University website.

Note: For this assignment, you may, with prior permission from the module tutor, work with a study partner to develop and demonstrate your DNS infrastructure solution, and to design and implement your performance experiments. You should ensure that you are completely familiar with all aspects of the work so that you can complete it on your own if necessary. Your reports must be the result of your own individual effort and must not be written in collaboration with any other person.

Failure to submit: Note that failure to submit work or submission of work after the required deadline without an authorised late approval will result in a record of incomplete (IC) for the assessment component. Referral in that component will then be required even when the module is passed overall.