BCS Level 4 Award in Network and Digital Communications Theory Syllabus
QAN 603/0703/1

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Contents

Change History

Any changes made to the syllabus shall be clearly documented with a change history log. This shall include the latest version number, date of the amendment and changes made. The purpose is to identify quickly what changes have been made.

Version Number	Changes Made
Version 1.0 October 2016	Syllabus created
Version 1.1 November 2106	Ofqual number added 01/11/2016
Version 1.2 November 2016	Formatting and minor spelling corrections
Version 1.3 November 2016	Additional formatting and minor spelling corrections
Version 1.4 November 2016	Added mandatory Ofqual text
Version 2.0 July 2019	Update to Question Weighting. Tweaks to wording of generic text.
Version 3.0 March 2020	Full syllabus review.

Introduction

This award is the second of five knowledge modules that are applicable to the Technologist pathway for the Level 4 Cyber Security Technologist Apprenticeship. It covers the range of concepts, approaches and techniques that are applicable to network and digital communications theory, for which apprentices are required to demonstrate their knowledge and understanding.

Objectives

Apprentices should be able to demonstrate an understanding of modern computer networks. Key areas are:

- Explain what is meant by data and protocol and how they relate to each other. Describe an example data format and a simple protocol in current use (using protocol diagrams). Describe example failure modes in protocols, for example reasons why a protocol may 'hang' and the effect on a protocol of data communication errors, Describe at least one approach to error control in a network. Describe the main features of network protocols in widespread use on the Internet, their purpose and relationship to each other in a layered model (e.g. TCP/IP), including the physical and data link layer. (e.g. https, HTTP, SMTP, SNMP, TCP, IP, etc).
- Describe the main routing protocols in current use in computer networks and explain the differences between static and dynamic routing protocols and the pros and cons of each in different circumstances.
- Explain some of main factors that affect network performance (e.g. the relationship between bandwidth, number of users, nature of traffic, contention) and propose ways to improve performance (e.g. application of traffic shaping, changes to architecture to avoid bottlenecks, network policy that prohibit streaming protocols).

Evidence of lessons learnt in these key areas should be collected and reflected upon when the apprentice is compiling the summative portfolio as the apprentice could identify how the task might be done better / differently with knowledge subsequently gained.

Target Audience

The award is relevant to anyone enrolled in the Level 4 Cyber Security Technologist Apprenticeship programme requiring an understanding of modern computer networks and digital communication theory.

Course Format and Duration

Apprentices can study for this award by attending a training course provided by a BCS accredited Training Provider. The estimated total qualification time for this award is 85 hours.

Eligibility for the Examination

Individual employers will set the selection criteria, but this is likely to include 5 GCSEs (especially English, mathematics and a science or technology subject); other relevant qualifications and experience; or an aptitude test with a focus on IT skills.
Level 2 English and Maths will need to be achieved, if not already, prior to taking the endpoint assessment.

Duration and Format of the Examination

The format for the examination is a 30-minute multiple-choice examination consisting of 20 questions. The examination is closed book (no materials can be taken into the examination room). The pass mark is 13/20 (65%).

Additional Time for Apprentices Requiring Reasonable Adjustments Due to a Disability

Apprentices may request additional time if they require reasonable adjustments. Please refer to the reasonable adjustments policy for detailed information on how and when to apply.

Additional Time for Apprentices Whose Language Is Not the Language of the Exam

If the examination is taken in a language that is not the apprentice's native / official language, then they are entitled to 25% extra time.

If the examination is taken in a language that is not the apprentice's native / official language, then they are entitled to use their own **paper** language dictionary (whose purpose is translation between the examination language and another national language) during the examination. Electronic versions of dictionaries will **not** be allowed into the examination room.

Guidelines for Training Providers

Each major subject heading in this syllabus is assigned an allocated time. The purpose of this is two-fold: first, to give both guidance on the relative proportion of time to be allocated to each section of an accredited course and an approximate minimum time for the teaching of each section; second, to guide the proportion of questions in the exam. Training providers may spend more time than is indicated and apprentices may spend more time again in reading and research. Courses do not have to follow the same order as the syllabus. Courses may be run as a single module or broken down into two or three smaller modules.

This syllabus is structured into sections relating to major subject headings and numbered with a single digit section number. Each section is allocated a minimum contact time for presentation. Apprentices should be encouraged to consider their summative portfolio throughout the modules.

Syllabus

For each top-level area of the syllabus, a percentage and K level is identified. The percentage is the exam coverage of that area and the K level identifies the maximum level of knowledge that may be examined for that area.

1. Data and Protocols (70%, K2)

In this key topic, the apprentice will explain what is meant by data and protocols and how they relate to each other. Outcomes should include an ability to:

1.1 Describe the OSI and TCP/IP models and example protocols.

- Application:
  - HTTP/S;
  - SNMP;
  - SMTP.
- Transport:
  - TCP;
  - UDP.
- Internet:
  - IPv4 and IPv6;
  - ICMP.
- Link:
  - Ethernet.

1.2 Explain what a network protocol is and how it transmits data with reference to:

- host addressing;
- frames;
- packets;
- datagrams;
- data.

1.3 Describe how protocols can fail and give examples of communication errors at different OSI layers.

- failure to find a route to a host;
- failure to negotiate an encryption method;
- failure to receive or acknowledge packets;
- failure agree packet formats;
- failure to agree transmission speed or duplex modes.

1.4 Describe how error control is applied to protocols.

1.5 Explain what a routing protocol does and the difference between static and dynamic routing.

1.6 Describe the main routing protocols in current use, describing the pros and cons of each and when they are used:
- RIPv2 and RIPng;
- OSPF;
- BGP;
- EIGRP;
- IS-IS.

2. Network Performance (30%, K2)

In this key topic, the apprentice will explain some of main factors that affect network performance and propose ways to improve performance. Outcomes should include an ability to:

2.1 Explain how network performance can be affected by various factors including:
- available bandwidth;
- number of users;
- applications in use;
- WAN contention.

2.2 Describe ways to improve network performance including:
- using QOS;
- traffic shaping and throttling;
- increasing local capacity;
- reducing WAN contention;
- increasing network bandwidth;
- using VLANs;
- restricting application use;
- restricting traffic at the border.

Levels of Knowledge / SFIA Levels

This syllabus will provide apprentices with the levels of difficulty / knowledge skill highlighted within the following table, enabling them to develop the skills to operate at the levels of responsibility indicated. The levels of knowledge and SFIA levels are explained on the website www.bcs.org/levels. The levels of knowledge above will enable apprentices to develop the following levels of skill to be able to operate at the following levels of responsibility (as defined within the SFIA framework) within their workplace:

Level	Levels of Knowledge	Levels of Skill and Responsibility (SFIA)
K7		Set strategy, inspire and mobilise
K6	Evaluate	Initiate and influence
K5	Synthesise	Ensure and advise
K4	Analyse	Enable
K3	Apply	Apply
K2	Understand	Assist
K1	Remember	Follow

Question Weighting

Syllabus Area	Target Number of Questions
1. Data and Protocols	14
2. Network Performance	6
Total	**20 Questions**

Format of Examination

Type	20 Question Multiple Choice.
Duration	30 minutes. An additional 25% will be allowed for apprentices sitting the examination in a language that is not their native / mother tongue.
Pre-requisites	Accredited training is strongly recommended but is not a pre-requisite.
Supervised	Yes.
Open Book	No.
Pass Mark	13/20 (65%).
Calculators	Calculators cannot be used during this examination.
Total Qualification Time (TQT)	85 Hours.
Delivery	Online.

Trainer Criteria

Criteria	▪ Have 10 days' training experience or have a Train the Trainer qualification. ▪ Have a minimum of 3 years' practical experience in the subject area.

Classroom Size

Trainer to apprentice ratio	1:16