Making IT good for society

BCS Level 4 Certificate in Network Principles Syllabus QAN 603/0548/4

Version 2.1
September 2017

This is a United Kingdom government regulated qualification which is administered and approved by one or more of the following: Ofqual, Qualification in Wales, CCEA or SQA

BCS Level 4 Certificate in Network Principles

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 July 2016	Syllabus Created
Version 1.2 September 2016	Syllabus Finalised
Version 1.3 October 2016	Updated Title to include QAN code
Version 1.4 December 2016	Included regulation statement
Version 1.5 March 2017	Learning Outcome 13.3 standard code BS EN 6701 corrected
Version 2.0 August 2017	Major amendments following full review and updated TQT
Version 2.1 September 2017	Question weightings added. Statement for the use of calculators added.

Introduction

This certificate is the first of the three knowledge modules required for the Level 4 Network Engineer Apprenticeship. It covers the range of concepts, approaches and techniques that are applicable to network principles, for which apprentices are required to demonstrate their knowledge and understanding.

Objectives

Apprentices should be able to demonstrate knowledge and understanding of network principles and techniques. Key areas are:

1. Understanding of network protocols and how they are used to implement data communications.
2. Understanding of the differences between the latest published versions of OSI layer model, IP, TCP/IP, routing and switching, WANs, LANs i.e. the differences between IP v4 and IP v6.
3. Understanding of numbering systems to enable apprentices to calculate and convert values, including algorithms, data, binary, probability and statistics.

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 certificate is relevant to anyone enrolled on the Level 4 Network Engineer Apprenticeship programme.

Course Format and Duration

Candidates can study for this certificate by attending a training course provided by a BCS accredited training provider. The estimated total qualification time for this certificate is 150 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.

Format and Duration of the Examination

The format for the examination is a 1-hour multiple-choice examination consisting of 40 questions. The examination is closed book (no materials can be taken into the examination room). The pass mark is 26/40 (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 Examination

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.

Calculators

Candidates taking on-line examinations will have access to an on-screen calculator. No other calculators or mobile technology will be allowed.

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   Principles of Networking (35%, K2)

In this topic, the apprentice will understand the principles of networking. The successful apprentice should be able to:

1.1 Describe the components of a network.

1.2 Explain how rules are used to facilitate data communication.
- encoding;
- formatting and encapsulation;
- size;
- timing;
- delivery options;
  - unicast;
  - multicast;
  - broadcast.

1.3 Explain the role of protocols in facilitating interoperability in network communications.
- RIPv1;
- RIPv2;
- OSPF;
- EIGRP;
- RIPng;
- OSPFV3;
- EIGRP for IPv6.

1.4 Describe LANs, WANs and MANs.

1.5 Understanding of all seven layers and representative protocols at each layer within the OSI model.
- the Physical layer;
  - electrical;
  - optical;
  - wireless.
- the Data Link layer;
  - purpose of the Data Link layer;
  - data format;
  - description of an Ethernet frame;
- the Network layer;
  - purpose of the Network layer;
  - Internet Protocol;
- the Transport layer;
  - purpose of the Transport layer;
  - Transport layer protocols (TCP and UDP);

- the Session layer;
  - purpose of the Session layer;
- the Presentation layer;
  - purpose of the Presentation layer;
- the Application layer;
  - purpose of the Application layer.

2 Principles of Network Addresses (10%, K2)

In this topic area, the apprentice will learn the principles of network addresses. The successful apprentice should be able to:

2.1 Explain the purpose and features of IP.
- IP addressing - definition of network and host addresses;
- classful addressing (class A, B, C, D, E);
  - IP address allocation;
  - IP address format
    - binary;
    - dotted decimal notation;
  - network and broadcast addresses;
- IP header format;
  - type of service (TOS) field;
  - protocol field;
  - time to live (TTL) field;
  - checksum;
- mapping IP to the Datalink layer;
  - Address Resolution Protocol (ARP);
    - ARP broadcast;
  - Reverse Address Resolution Protocol (RARP);
- IP scaling problems;
  - growth of Internet;
  - subnet masks – the need for 3rd level of hierarchy;
    - subnet mask format;
    - logical AND operation;
    - public and private addresses;
    - default gateway;
  - static and dynamic address allocation;
    - Dynamic Host Configuration Protocol (DHCP);
    - DHCP server requirements;
    - the DHCP process (DORA);
    - DHCP lease;
    - domain names;
    - domain name resolution;
    - requirements of DNS servers;
    - host name resolution (7 step sequence);
    - NetBIOS name resolution (6 step sequence);
    - subnetting (and supernetting) networks;
    - design considerations (the 4 key questions);
- purpose of IP v6
  - benefits of IP v6;

- o extended address space;
- IP v6 addressing (binary, hexadecimal);
  - o octet pair notation;
  - o abbreviated octet pair notation;
- IP v6 header format;
  - o version;
  - o priority, traffic class;
  - o flow label;
  - o payload length;
  - o next header;
  - o hop limit;
- host address calculation;
  - o EU164 addresses;
  - o default gateway;
- router advertisement;
- extended features;
  - o path MTU discovery;
  - o mobility – destination options;
  - o IPSec authentication.

3   Mathematics for Network Engineers (55%, K3)

In this topic area, the apprentice will develop a solid understanding of numbering systems. The successful apprentice should be able to:

3.1 Explain different numbering systems
- binary;
- decimal;
- hexadecimal.

3.2 Demonstrate an ability to convert between binary and decimal.

3.3 Demonstrate an ability to calculate the number of host addresses available when given a network and a subnet mask.

3.4 Demonstrate an ability to calculate the necessary subnet mask when given a network diagram in order to accommodate the requirements of the network.

3.5 Explain the benefits of variable length subnet masking (VLSM).

3.6 Explain what an algorithm is and give examples of their use in computer networking.
- DUAL.
  - o Which routing protocol uses it.
  - o How it determines the correct path.
- Dijkstra.
  - o Which routing protocol uses it.
  - o How it determines the correct path.

3.7 Explain how network monitoring systems enable the collection of data for statistical analysis and forecasting.
- hardware;
- bandwidth.

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. Principles of Networking	14
2. Principles of Network Addresses	4
3. Mathematics for Network Engineers	22
Total	**40 Questions**

Format of Examination

Type	40 Question Multiple Choice.
Duration	1-hour. An additional 15 minutes will be allowed for apprentices sitting the examination in a language that is not their native / mother tongue.
Pre-requisites	Training from a BCS accredited training provider is strongly recommended but is not a pre-requisite.
Supervised	Yes.
Open Book	No.
Pass Mark	26/40 (65%).
Calculators	Calculators may be used during this examination.
Total Qualification Time (TQT)	150 hours, 37.5 GLH recommended.
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