CCDE Practical Studies

Practice Lab Exam 3 – “Western Rail”

Full Practice Lab Examination & Debrief

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About the Author

Martin J Duggan CCDE™ 2016::6 and CCIE™ #7942 is a Senior Network Architect and Cisco Press author. Martin gained his CCIE™ in 2001 and has been passionate about Cisco qualifications and mentoring ever since. Martin successfully passed his CCDE™ practical in 2016.

Previous Publications include:

Author of CCDE Practical Studies, Practice Lab 1 & 2
https://leanpub.com/ccdepracticalstudies-practicelab1
https://leanpub.com/ccdepracticalstudies-practicelab2

Author of Cisco CCIE Routing and Switching v5.0 Configuration Practice Labs ISBN-10: 0-13-378631-5
http://www.ciscopress.com/store/cisco-ccie-routing-and-switching-v5.0-configuration-9780133786316

Author of Cisco CCIE Routing and Switching v5.0 Troubleshooting Configuration Practice Labs ISBN-10: 0-13-378633-1 http://www.ciscopress.com/store/cisco-ccie-routing-and-switching-v5.0-troubleshooting-9780133786330

Co Author of CCIE Routing and Switching Practical Studies ISBN: 1587051478 (Ciscopress)
http://www.ciscopress.com/title/1587051478

Technical Editor of Cisco Field Manual, Catalyst Switch Configuration ISBN:1587050439 (Ciscopress)
http://www.ciscopress.com/title/1587050439

Want to know more about Martin's journey to CCDE™?

https://learningnetwork.cisco.com/blogs/unleashing-ccde/2016/06/17/60-limit-by-martin-duggan

Want to know more about Martin's CCIE book?

http://www.gocertify.com/articles/interview-martin-duggan-author-of-ccie-routing-and-switching-v5-0-configuration-practice-labs.html

Technical Editors

Nicholas (Nick) Russo, CCDE#20160041 and CCIE#42518, holds active CCIE certifications in both Routing and Switching and Service Provider. Nick served 6 years in the US Marine Corps, many of which were in a technical networking capacity, then went on to become a professional network engineer as a civilian. Nick also holds a Bachelor's of Science in Computer Science, and a minor in International Relations, from the Rochester Institute of Technology (RIT). Nick lives in Maryland, USA with his wife, Carla, and their daughter, Olivia.

Nick's website is http://njrusmc.net, follow him on Twitter @nickrusso42518

Daniel Dib, CCIE#37149, CCDE#20160011, is a Senior Network Architect at Conscia Netsafe. He works with creating scalable, modular and highly available network designs that meet business needs. Daniel started out in implementation and operations and got his CCIE in 2012. In May 2016 he became the second person in Sweden to get CCDE certified.

He often acts as a subject matter expert for his customers with deep expertise in routing, switching, multicast and fast convergence.

He is the founder of Lostintransit (http://lostintransit.se) and co-founder of Network4dev (http://network4dev.net) and a well-known contributor to the networking industry. He is also a Cisco Learning Network VIP and Cisco Champion as well as part of the CCIE advisory council.

Follow Daniel on Twitter @danieldibswe

About the Book

This book is the third part of a 3 part series. I intended to release a single publication which included 3 complete CCDE practice lab exams and full debriefs for each but quickly realized that I could help CCDE candidates approaching their lab examinations if I released a lab at a time. All 3 lab exams however have now been completed and are available as a complete book on Amazon including additional hints, tips and background information on the CCDE exam https://www.amazon.com/dp/1793439729 . These practice labs are the culmination of my journey towards CCDE and the thousands of hours of study I undertook in order to be successful.

Taking the CCDE lab exam was a real challenge for me, personally I found it significantly harder than achieving my CCIE back in 2001. The certification has been running for some 9 years at time of writing and there are only approximately 350 certified individuals to date. My biggest issue in joining the 349 others was practice, I just couldn't get enough quality practice exams that would prepare me for the technical marathon that is the CCDE lab exam. That's why I wrote this lab exam and why I will create an additional practice lab to help you achieve your goal of joining the CCDE club.

The book is in two parts, Part 1 covers the practice lab exam and Part 2 is the debrief to the exam. Don't even think about reading the debrief section until you have taken the practice lab.

You need to treat this practice lab as if you were taking the real exam, get somewhere quiet and comfortable where you can focus and imagine you are taking your exam for real. Follow the rules of the real lab exam and do not go backwards or forwards on the questions but feel free to read the background information and any emails that come in as much as you want to. Have a piece of paper to make notes and create drawings on as some of the questions will require diagrams and if possible highlight relevant information within documents to help you detail the facts which are ultimately requirements or constraints.

Read the background information and make notes but do so quickly, highlight what you to be relevant facts if you have editing tools at your disposal (as you will within the real lab exam) you should save as much time as possible for the questions. If you feel you don't have sufficient information to answer a question then head back to the documentation or emails as the information you need is there.

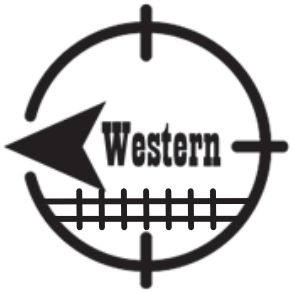
Don't worry about stopping at 2 hours and seeing how you have done, carry on until completion but do make a note of your time, if you only managed to get half way through by following the status bar included in the questions and you are at 2 hours just make a note that you need to improve your speed, significantly!

This practice lab is about as close as you can get to taking the real exam, I hope you enjoy it.

Part 1: Practice Lab

Western Rail

CCDE Lab Practice Exam 3



Email 1

From: Jake Green
To: Candidate
Subject: Welcome on board

Hi

Welcome to Western Rail, your reputation proceeds you and we're really pleased to have you "on board" – we have some very interesting work for you to develop our network as we grow our business, exciting times ahead and a great time to join the company.

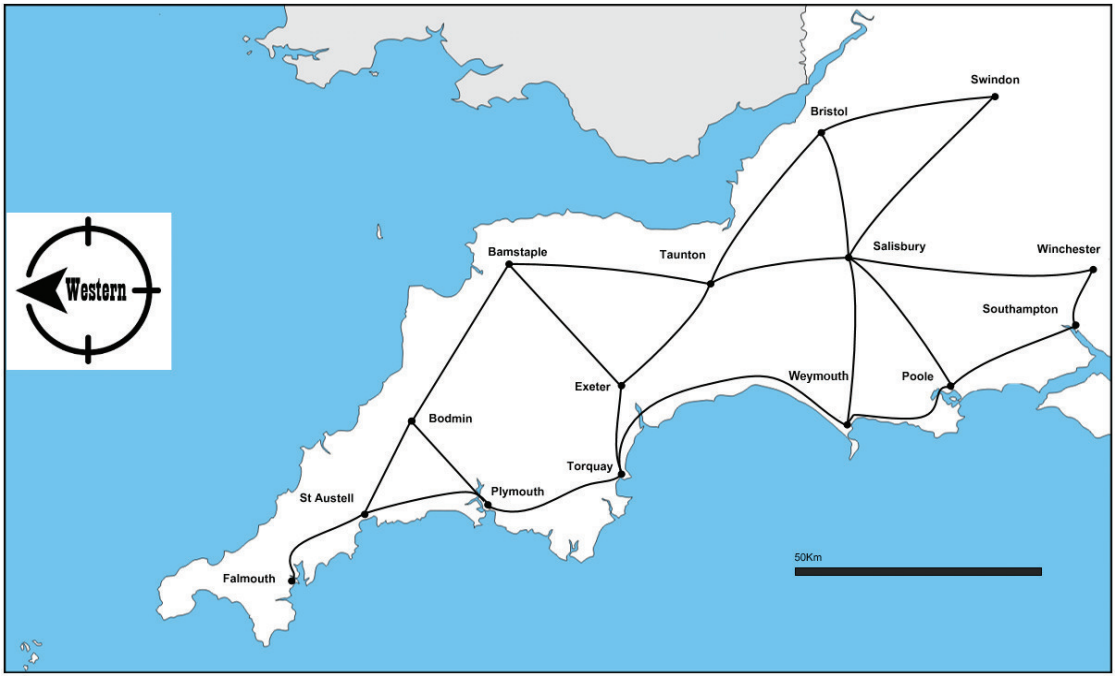
Please take a look through the attached documentation to familiarize yourself with our company and network.

Rgds
Jake Green
IT Director Western Rail

Document 1 – Company Information

Western Rail (formerly South West Railroads) is a Train Operating Company (TOC) in the South West region of the UK. Western Rail is a public company which was formed after the privatization of the UK National Rail network under the Railways Act in 1993. The company owns their rail track infrastructure and station buildings including adjacent land which typically includes commuter car parking facilities. Initially, rolling stock was also owned as part of the privatization but due to a cost savings exercise in 2008 to reduce the Total Cost of Ownership the rolling stock was offloaded to other TOCs and new efficient and reliable diesel powered rolling stock was leased from Rail UK (a corporation formed prior to the privatization in 1993). Offloading the high cost trains allowed the company to improve cash flow and thus increasing Net Present Value, this allowed stations to be modernized and reduced overall maintenance OPEX which was increasing substantially year on year.

Western Rail's railroad infrastructure is detailed below:



Western Rail's primary income stream is from passenger services throughout its rail network, the secondary income stream is from licensing other national TOCs to use specific routes within their network for freight services. TOC operators can run services for the duration of their license validity (typically either 2 or 5 years). The company has experienced a decline in license renewal from TOCs during the past 5 years. Passenger revenue has remained static primarily due to annual fare increases counteracting a minor decline in annual season pass ticket purchases.

Western Rail own their own data fiber network which runs adjacent to their rail infrastructure and provides IP connectivity between stations and head office services hosted in Salisbury.

Due to the trend seen in a reduction of passengers and TOC licensing revenue the company has decided to diversify in order to enhance profitability. Market research conducted by Western Rail and a commissioned specialist external company has shown that many of the areas the rail network covers are not well served by national Telecom companies. Telco's have since expressed a

high interest in expanding their national telecoms networks using bandwidth created from the rail infrastructure fiber, which could provide connectivity between towns and cities and into remote and rural areas. Telco's could also make use of expanded networks to connect cellular masts to improve mobile phone capacity / coverage, which has become a target of complaints in rural parts of the country.

Rather than lease bandwidth to Telco's from their own network Western Rail has decided (with the full backing of the board) to invest in a project based on the information gained from the market research. Western Rail's value proposition is based around using their own fiber infrastructure to provide IP connectivity for local businesses for private networks themselves and to become a Service Provider as a secondary business function. The company has also decided to sponsor research related to an additional revenue stream by offering residential broadband services via its fiber core network if the Service Provider business proves to be successful.

Document 2 – Network Background

In 2000 when finance was readily available, Western Rail invested in a specially adapted railroad car to run along tracks within their rail network plowing Single Mode fiber cable underground as they moved in order to provision an IP network for their own use. In comparison, the cost of assembling the paths for conduits from scratch manually would have led the initiative to be non-viable and would have meant continued use of an existing ISDN network or alternative Service Provider offerings at that time to provide a corporate IP network in order to support the train services.

The fiber is used to create a switched Layer 2 IP corporate network which connects the stations throughout the network with the Head Office located in Salisbury where the compute environment is hosted. The network utilizes 802.1D STP to maintain a loop free topology. The fiber runs are terminated between stations linking the IP switches directly to negate the requirement for repeaters, as such the fiber runs run from station to station rather than connecting each station directly to Salisbury. Western Rail found that at time of implementation the maximum fiber distance run they could achieve without repeaters was 50Km with the quality of fiber they purchased and type of optics in use within the station switches. Repeaters were not an option available to the company due the issue of provisioning power access alongside the track at the point where some runs may have required signal regeneration. An investigation was conducted which concluded that repeaters could be provisioned if Western Rail updated its rail track network to “fully electric”. Conversion of the railroad infrastructure is high on the list of Business Priorities but it is not in delivery plan until 2025 when environmental restrictions will mean Western Rail is no longer able to run a fleet of Diesel powered trains and must upgrade its rail infrastructure to accommodate electric trains. However, fiber repeaters have since been installed between Weymouth and Poole stations (the repeaters have physically been implemented within each station) due to excessive loss experienced between locations even though the fiber run distance was less than 50Km.

Western Rail have 15 station locations in the UK with an average of 10 staff members in each station. The head office is located in Salisbury which houses 130 staff as well as being a station location and primary location to host the central IT systems. Each station has a single 24 port IP switch installed which although capable of running in a Layer 3 mode runs purely at layer 2. The station IP switch terminates the fiber runs between stations by use of 1Gbps Single Mode optics and provides 10/100/1000Mbps copper LAN access ports for connectivity at each station. As well as desktop computer equipment at each station there is connectivity for the Ticketing terminals, digital signage boards, printers & CCTV infrastructure. Telephony is completely separate to the data network and each station has an ISDN2 line allowing a maximum of two external calls at any one time with a small PABX system so the staff can place internal and external calls. Salisbury telephony is serviced by an ISDN PRI line and larger PABX system. All calls between stations are therefore placed over ISDN lines with an increasing trend in use of email and instant messaging for communication between staff.

The company currently runs a total of 36 applications with Ticketing, Digital Signage & signaling applications being developed in house and deemed mission critical to the business.

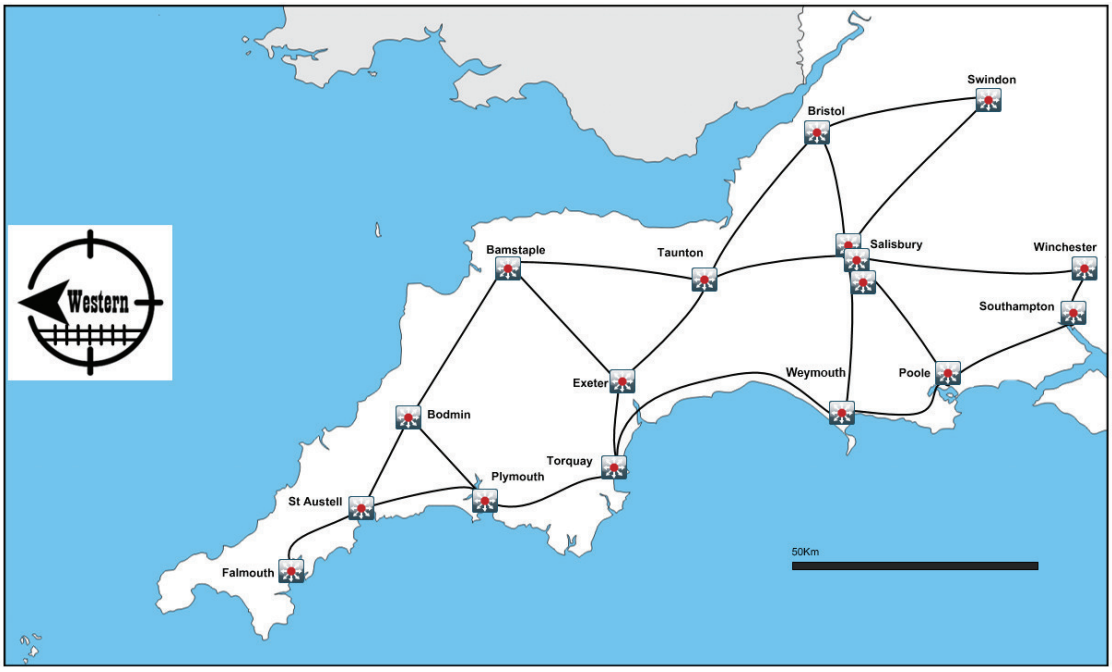
The Salisbury site is the primary location hosting all of the applications & systems with the Bristol location used as Business Continuity site for Ticketing, Digital Signage & Signaling systems only. IP addresses of systems are typically hard coded into the applications. The Salisbury location has a single stack of switches which are Layer 3 capable but running in Layer 2 mode providing connectivity for the compute environment, local users and onward connectivity to adjacent

stations in a collapsed core / aggregation / access model. Salisbury and Bristol are the only locations where UPS systems are available.

A single VLAN has been provisioned on the corporate network to provide connectivity between hosts and the compute environment with a subnet of 10.10.0.0/16 in use throughout the station infrastructure. The IT team is small and typically is not specialized in networking with day to day tasks involving multiple IT domains, some of the team members however have basic routing and switching experience with knowledge of OSPF from previous employment.

The network is outlined in the figure below.

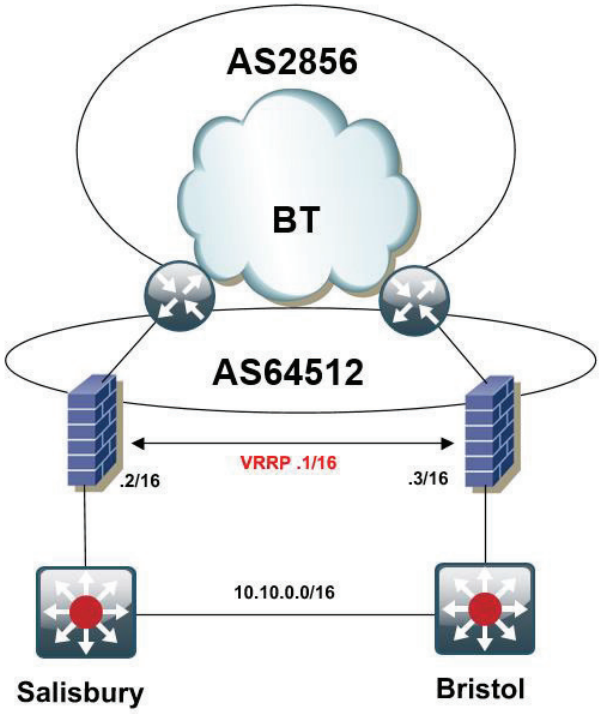
Western Rail Fiber network



Primary DNS & DHCP services plus Internet connection are provisioned within the Salisbury location with a secondary DNS & DHCP plus Internet connection within the Bristol location. A single ISP is used for connectivity – British Telecom (BT) with PA Provider Assigned IP addressing (192.0.2.0/25) allocated to AS64512 for Western Rail. The public IP address range is used on the firewall for an Internet accessible DMZ (192.0.2.0/26) which hosts online ticketing and scheduling services and NAT range (192.0.2.64/26) for employee Internet access originating from the 10.10.0.0/16 prefix. The DMZ subnet is identical in both Salisbury and the DR location Bristol - although services are only live within one location at any time and the subnet / VLAN between locations is not joined at layer 2 within the network. DMZ host servers are connected into the local LAN switches in a separate VLAN (VLAN2) from the corporate VLAN (VLAN1). A default route is used on each firewall with a next hop pointing to the local ISP router. All hosts on the LAN within the stations and head office use the VRRP IP address of the firewalls internal network (10.10.0.1/16) as their Default Gateway. BT provide all routing into and out of the network based on the operational primary Firewall location as no state is maintained between firewalls and asymmetric routing would result in a failure of established sessions. Ingress routing of traffic from BT into the South Western network is manipulated by management scripts running on the local

Internet facing routers which modify the MED and prepend value of the 192.0.2.0/25 prefix as advertised into the BT AS depending on the health & VRRP status of the local firewall. BT also provides firewall rule base management and provide 10 MACs (Moves / Adds / Changes) on the firewalls / routers per month with a 7 day lead time inclusive of their service charge.

Internet access is outlined in the figure below.



Q1) What are the three key business challenges facing Western Railway currently?

Challenges	Key Business Challenge
High Maintenance Opex	
Business Model Innovation	
Business Growth	
High Capex	
Skill deficit	
Inadequate investment capital for diversification	
High Rolling Stock rental Opex	
Business Disruption	

Status %	6

Q4a) If you chose Yes in Q4 then what additional information do you require? Choose 1

A) Is it possible to install additional fibers to create a new core network for network services to external customers?
B) Has the original fiber topology been implemented in multi or single strand within conduits between stations?
C) Can the LAN switches support DWDM?
D) Can the LAN switches support CWDM?

Status %	14

Q5) What separation technology would be best suited to Western Rail's plans to provision additional networks for customers over their own infrastructure based on their existing network & constraints? Choose 1

A) CWDM Channels over existing fiber creating & core Western Rail network & separate Customer network
B) DWDM Channels over existing fiber creating & core Western Rail network & separate Customer network
C) IPsec GRE tunnels linking Multi VRF networks at each station for a core Western Rail network & separate Customer networks
D) VRF Lite for a core Western Rail network & separate Customer networks over trunked core connections
E) MPLS VPNs

Status %	16

Q12) What would be the optimal Route Reflector (RR) solution for Western Rail? Choose1

A) A pair of RRs in Salisbury configured as a cluster with common cluster ID with all PE's peering to each RR and each RR peering together - even Route Targets (RTs) advertised by one RR & odd RTs by the other)

B) A pair of RRs in Salisbury configured as a cluster with a local common cluster ID & a pair of RRs in Bristol configured as a cluster with a different local common cluster ID with all PE's peering to each RR and each RR peering together within the local cluster - even RTs advertised by one RR pair & odd RTs by the other pair)

C) A pair of RRs in Salisbury configured as a cluster with a local common cluster ID & a pair of RRs in Exeter configured as a cluster with a different local common cluster ID with all PE's peering to each RR and each RR peering together within the cluster (even RTs advertised by one RR pair & odd RTs by the other pair)

D) A pair of RRs in Salisbury with a pair of RRs in Bristol with all PE's peering to each RR and each RR peering together in a full mesh (even RTs advertised by one RR pair & odd RTs by the other pair)

E) A pair of RRs in Salisbury with a pair of RRs in Bristol with all PE's peering to each RR (even RTs advertised by one RR pair & odd RTs by the other pair)

Q22) How would you recommend having the two separate networks represented externally as a single AS if the buyout was to go ahead? Choose 1

A) Use the local AS feature on Dragonet connections using the AS of Western Rail to each customer / IXP running eBGP
B) Configure BGP Confederations with Western Rail & Dragonet peering with eBGP to each other
C) Configure a VRF on Dragonet PE routers with the Western Rail AS number and peer to customers through this while enabling VRF route leaking to provide connectivity throughout the network
D) Create a new common AS and migrate each network into the new AS

Status %	57

Q34) Guards have been complaining about poor service on the pilot Wi-Fi system for their 802.11e mobile ticket payment systems. Investigations have shown zero to minimal congestion between Access Points and the Wireless LAN controller on the train and a mix of passenger Wi-Fi devices ranging from the very latest technology to a large number of legacy handsets. What would be the best option to quickly improve the pilot service with minimal change and expense? Choose 1

A) Create a priority queue on the AP's and mark the mobile payment traffic as DSCP EF with all other traffic marked as DSCP0.
B) Disable low data rates on the AP's
C) Provision an additional 4G link on the router on the train load share the IPsec connection over both 4G links
D) Provision separate AP's for the Passengers and Western Rail systems on each carriage of the train with single SSIDs on each AP
E) Create a priority queue on the AP's and mark the mobile payment traffic as UP 6 with all other traffic marked as UP 1 for 802.11e clients.

Status %	100