

# CCIE Evolving Technologies V1.1

CCIE Written Exam Cert Guide Series

Muhammad Afaq Khan, CCIE #9070

1<sup>st</sup> Edition

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ISBN: 9781718058316

## Author Bio

Muhammad Afaq Khan started his professional career at Cisco TAC San Jose and passed his first CCIE in 2002. He held multiple technical and management positions at Cisco HQ over his 11 years tenure at the company before moving into cloud software and data center infrastructure IT markets. He has worked at startups as well as Fortune 100 companies in senior leadership positions over his career. He is also a published author (Cisco Press, 2009) and holds multiple patents in the areas of networking, security and virtualization.

Currently, he is a founder at Full Stack Networker ([www.fullstacknetworker.com](http://www.fullstacknetworker.com)) and a vocal advocate for network automation technologies and NetDevOps.

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Chapter 1: Compare and contrast public, private, hybrid, and multi-cloud design considerations

Chapter 2: Describe cloud infrastructure and operations

### **Part II**

Chapter 3: Describe architectural and operational considerations for a programmable network

### **Part III**

Chapter 4: Describe architectural framework and deployment considerations for IoT

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## Preface

Congratulations. You have taken your first step towards passing your CCIE written exam. This written exam cert guide will help you prepare for Evolving Technologies section which carries 10% weight in all CCIE and CCDE written exams.

## What this Exam Cert Guide covers

As you may already have noticed on the "Contents at a Glance" page that this guide covers Evolving Technologies V1.1 and has been *formatted* around the [Cisco's official Evolving Technologies \(V1.1\) blueprint](#) exam topics that went into effect on August 30th 2018. **Why does formatting matter?** Well, if you ever need to know where you're within your test prep journey, all you have to do is to pull up the official exam topics and you will know. It makes your learning so much easier.

Each exam topic has an "Exam Essentials" and a "Further Reading" section, which you can refer to if you are looking for key exam related takeaways and more in-depth details respectively. "Further Reading" web links are handpicked and contain in-depth information on some of the exam topics and we have done the research for you.

## How to use this Exam Cert Guide

This guide is for anyone who's studying for the CCIE written exam and feels that he or she could take some help with regard to Cloud, Network Programmability and IoT related topics. These are areas that most network engineers do not work on in their day to day lives. Having said that, using whatever resources you prefer, please be sure to brush up on exam topics that are specific to your track. In some cases where there is more than one correct answer, let's say challenges or benefits for IoT, I have gone with ones that are endorsed by Cisco.

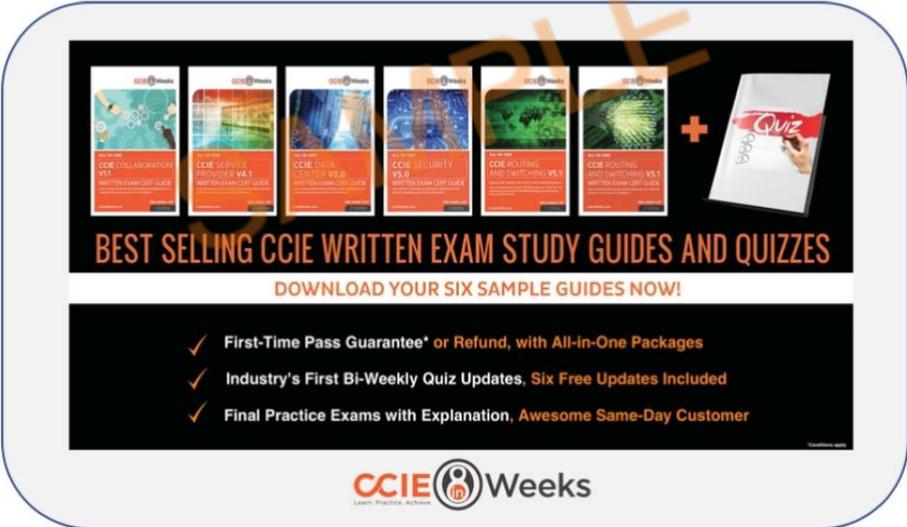
I strongly suggest that you take a methodical approach for exam preparation, i.e. start with a target date as to when you would like to sit for your exam and then work backwards to see what kind of study plan would work for you.

## What's available on the CCIEin8Weeks.com

CCIEin8Weeks.com is a home to thousands of test takers and learners worldwide. As a small token of appreciation for purchasing this book, each customer is entitled to **FREE** access to our Evolving Technologies V1.1 web Quiz.

Please share with us your Amazon Kindle or paperback Order # as a proof of purchase. Please **sign up** on our website and request your complementary access by going to our [contact us](https://goo.gl/ooE79H) page (<https://goo.gl/ooE79H>). Our support staff will provision your quiz access within 72 hours.

CCIEin8Weeks.com also carries the extras, sold separately, that go hand in hand with this exam cert guide to further ensure your exam and career success. We offer exam prep material for [R&S V5.1](#), [DC V2.1](#), [Security V5.0](#), [SP V4.1](#) and [Collaboration V2.0](#) exams.



The advertisement features a row of six study guide covers: CCIE Collaboration V2.0, CCIE Service Provider V1.1, CCIE Data Center V3.0, CCIE Security V5.0, CCIE Routing and Switching V5.1, and CCIE Routing and Switching V5.1. To the right is a 'Quiz' card. Below the covers, the text reads 'BEST SELLING CCIE WRITTEN EXAM STUDY GUIDES AND QUIZZES' and 'DOWNLOAD YOUR SIX SAMPLE GUIDES NOW!'. A list of benefits includes: 'First-Time Pass Guarantee\* or Refund, with All-in-One Packages', 'Industry's First Bi-Weekly Quiz Updates, Six Free Updates Included', and 'Final Practice Exams with Explanation, Awesome Same-Day Customer'. The CCIEin8Weeks logo is at the bottom.

Let me list down the additional resources that are available on our website.

- Practice quizzes, each quiz contains questions that are broken down into sections as per Cisco's official written exam blueprint. For example, if you are preparing for [CCIE R&S](#) written exam, you will find seven different quizzes in your membership area, i.e.
  - Network Principles

- L2 Technologies
- L3 Technologies
- VPN Technologies
- Infrastructure Security
- Infrastructure Services
- Evolving Technologies (V1.1)
- Our quiz engine is web-based and can be used from desktop as well as mobile devices. You can check out our sample questions by going to product pages for each track.
- Study guides, much like this one, each CCIE written exam guide is organized around the Cisco's official blueprint so you can track and pace your exam prep journey
- Study plans, to help you organize your learning goals and stay motivated
- [CCIE blog](#), where we regularly publish articles in the areas of networking industry and technologies as well as CCIE related news
- Last but not least, we also offer a curated list of [CCIE books as well as free resources](#) that you can optionally tap into to round out your learning and test prep

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## Background

As you may recall that Cisco added Evolving Technologies v1.0 (ET v1.0) section around mid-2016 to entire CCIE/CCDE program to keep pace with the rapidly changing technology arena and in order to keep Expert track programs relevant for Cisco certified individuals. ET section primarily focuses on cloud, network programmability (i.e. [SDN](#), NFV etc.) and Internet of Things (IOT). Cisco recently announced an [update \(v1.1\)](#) to their initial list of topics in order to achieve the above stated goal.

I am happy to see that Cisco has taken a step in the right direction by adding newer topics and making the overall section more meaningful this time around. Now, I'd like to see Cisco turn Cloud into Cloud architecture and implementation whereas network programmability into more of a primer on network automation and NetDevOps and increase ET weight to at least 20% across both written and lab exam formats. **What do I mean by that?** There is still some room to improve, but we're heading in the right direction. Overall, it seems that Cisco has added 18 topics whereas removed about 10.

Let me summarize the topics that are added or removed in Evolving Technologies v1.1 by each domain of knowledge.

### Topics Added in V1.1

- Cloud
  - Scalability
  - High Availability
  - Compliance
  - Compute Virtualization (Containers)
  - Connectivity (virtual switches, SD-WAN and SD-Access)
  - NFVI, VNF and L4-L7
  - Orchestration Tools (CloudCenter, DNA Center, and Kubernetes)
- Network Programmability
  - Models and Structures (YANG, JSON, and XML)
  - Device Programmability (qRPC, NETCONF, and RESTCONF)
  - Policy-Driven configuration

- Management Tools (Agent and Agentless)
- Version Control Systems (Git and SVN)
- Internet of Things (IOT)
  - Network Hierarchy and Data Acquisition and Flow
  - Characteristics Within IT and OT Environments
  - IoT Security (Network Segmentation, Device Profiling, and Secure Remote Access)
  - IoT Edge and Fog Computing (Data Aggregation and Edge Intelligence)

## Topics Removed in V1.1

- Cloud
  - Interoperability
  - OpenStack components
  - Intercloud
- Network Programmability
  - DevOps tools
- Internet of Things (IOT)
  - Performance, availability, and scaling considerations
  - Performance, reliability and scalability
  - Mobility
  - Security and privacy
  - Standards and compliance
  - Migration
  - Environmental impacts on the network

## OpenStack and Intercloud

It is not surprising that “OpenStack Components” and Intercloud sub-sections from V1.0 blueprint have been dropped. If you recall, [Cisco abandoned OpenStack-based InterCloud](#) efforts back in September 2016. Cisco has replaced that with CloudCenter, DNA Center, and Kubernetes topics.

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1 Infrastructure, platform, and software services (XaaS)
2 Performance and reliability
3 Security and privacy
4 Scalability and interoperability
5 Automation and orchestration
6 Workload mobility
7 Troubleshooting and management
8 CloudStack components
9 Controllers
10 APIs
11 Scripting
12 Agents
13 Northbound vs. Southbound protocols
14 Device methodologies, tools and workflows
15 Network/application function virtualization (NFV, AFV)
16 Service function chaining
17 Performance, availability, and scaling considerations
18 Performance, reliability and scalability
19 Mobility
20 Security and privacy
21 Standards and compliance
22 Migration
23 Environmental impacts on the network
24

C:\Windows\Temp\..._edp_clip_b2fdd329-0246-4f4f-b330-158a51b6e0f0
1 Infrastructure, Platform, and Software Services (XaaS)
2 Performance, Scalability, and High Availability
3 Security Implications, Compliance, and Policy
4 Workload Migration
5 Compute Virtualization (Containers and Virtual Machines)
6 Connectivity (Virtual Switches, SD-WAN, and SD-Access)
7 Virtualization Functions (NFVI, VNF, and I4=I7)
8 Automation and Orchestration Tools (CloudCenter, DNA Center, and Kubernetes)
9 Data Models and Structures (YANG, JSON, and XML)
10 Device Programmability (eRPC, NETCONF, and RESTCONF)
11 Controller-Based Network Design (Policy-Driven Configuration and Northbound/Southbound)
12 Configuration Management Tools (Agent and Agentless) and Version Control Systems (Git)
13 IoT Technology Stack (IoT Network Hierarchy and Data Acquisition and Flow)
14 IoT Standards and Protocols (Characteristics Within IT and OT Environments)
15 IoT Security (Network Segmentation, Device Profiling, and Secure Remote Access)
16 IoT Edge and Edge Computing (Data Acquisition and Edge Intelligence)
17
18

19 Mobility

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### Topics Added/Removed in Evolving Technologies V1.1

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## Part I: Cloud

This part covers the following exam topics from Cisco's [official Evolving Technologies](#) (v1.1) written exam curriculum.

### Chapter 1: Compare and Contrast Public, Private, Hybrid, and Multi-cloud Design Considerations

- Infrastructure, platform, and software as a service (XaaS)
- Performance, scalability, and high availability
- Security implications, compliance, and policy
- Workload migration

### Chapter 2: Describe Cloud Infrastructure and Operations

- Compute virtualization (containers and virtual machines)
- Connectivity (virtual switches, SD-WAN and SD-Access)
- Virtualization functions (NFVi, VNF, and L4/L1)
- Automation and orchestration tools (cloud center, DNA-center, and Kubernetes)

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## Part I: Cloud

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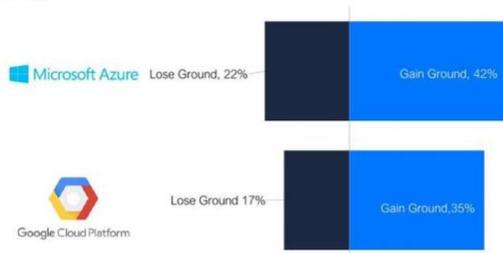
### Chapter 1: Compare and Contrast Public, Private, Hybrid, and Multi-cloud Design Considerations

Cloud computing is the result of a well thought out infrastructure by the providers, in the same way that electricity, water, and gas are the result of decades of infrastructural development by the utility providers. Cloud computing is made available through network connections in the same way that public utilities have been made available through networks of pipes and wires. By definition, all clouds are scalable (resources are added as demand rises) and elastic (grow or shrink resources as demand rises or falls).

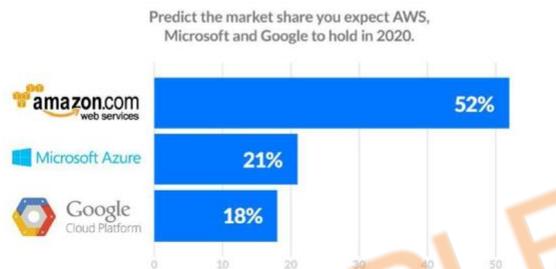
It is estimated that AWS, Azure and GCE will have 52%, 21% and 18% market share by 2020.

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## Do you expect Microsoft and Google to gain ground, lose ground or hold steady to AWS over the next 3 years?



## Market Share by 2020



Cisco's definition of cloud outlines the following four aspects as must-have for a cloud service, i.e.

- On-demand means resources follow demand pattern, they are provisioned and deprovisioned with increasing and decreasing demands respectively
- At-scale, means cloud provider has enough supply of resources to meet demands from all its customers, i.e. providing cloud services at-scale.
- Multitenant, means cloud services are inherently multi-tenant out of the box
- Elastic means that corresponding cloud services will grow or shrink based on customer's demand patterns

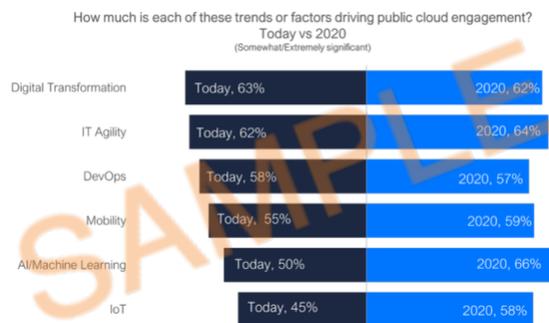
Before we dive into "design considerations" for each cloud deployment model, let's first understand each type of the cloud that exists out there.

## Public Cloud

The public cloud is defined as computing services offered by third-party providers, such as AWS, over the public Internet, making them available to anyone who wants to use or purchase them. Cloud services may be free or sold on-demand i.e. pay-as-you-go, allowing customers to pay only per usage for the CPU cycles, storage, or bandwidth they actually use. Public cloud users simply sign up for a service, use the resources made available to them, and pay for what they used within a given amount of time.

As per CLOUD VISION 2020 survey, digital transformation, IT agility and DevOps are the top drivers for public cloud adoption.

### Public Cloud Drivers



Technically speaking, a public cloud is a pool of virtual resources that include compute, storage and networking, all developed from commodity hardware owned and managed by a third-party provider such as AWS or Azure, that is automatically provisioned and allocated among multiple customers in a multi-tenant fashion through a self-service interface. It's an economically compelling way to scale out workloads that experience unexpected demand fluctuations.

A public cloud is the simplest form of all cloud deployments: A customer that needs more resources and platforms such as servers or storage, or services simply pays a public cloud vendor by the hour or the minute, to get access to what's needed when it's needed. Infrastructure, computing power, storage, or cloud applications are decoupled from underlying hardware with the help of virtualization by the vendor, orchestrated mostly by open source management and automation software. Connectivity to a public cloud generally happens via the internet (obviously, encrypted) but also through dedicated low latency network connections available at large colocation data centers, much like [AWS Direct Connect](#).

## Private Cloud

The private cloud is about offering computing services either over the Internet or a private internal network, such as WAN. In terms of service offering, private cloud is no different than public cloud, but dedicated to the needs and goals of a single enterprise as opposed to being shared and multi-tenant. It is worth mentioning that private cloud is not to be confused with its location, because it can be located on-premise (internal) or off-premise (hosted).

Due to single-tenant provisioning and dedicated use of resources, private clouds deliver higher degree of control and customization, as well as higher level of security and privacy. Private cloud also provides better service SLAs and data security when hosted on-premise or what is known as an internal cloud. One drawback of an internal cloud is that the company's central IT department is held responsible for the cost and accountability of managing the cloud leading to similar staffing, management, and maintenance expenses as traditional data center ownership. Private clouds can be either self or provider-managed such as [Rackspace](#).



## Virtual Private Cloud (VPC)

Virtual private cloud (or VPC) is a private cloud carved out inside a public cloud for the sole purpose of being used by a single tenant. It provides isolation of data both in transit and at-rest resulting in enhanced security and data control.

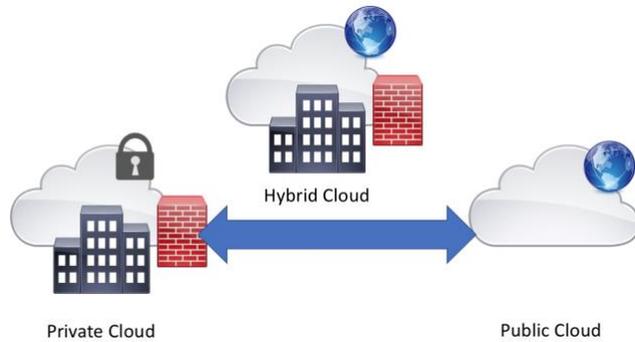
Cloud provider will let you provision a cloud router and a firewall, so you can connect remote or on-premise resources to a VPC. AWS provides features such as security groups, ACLs and flow logs that capture information about the IP traffic going to and from network interfaces within your VPC.

## Hybrid Cloud

A hybrid cloud combines the benefits of public and private clouds by allowing data and applications to be shared between them. When workload demand changes, hybrid cloud computing allows businesses the ability to seamlessly scale using public cloud and thus handle overflow or demand bursts without giving third-party service provider access to the totality of their data.

Hybrid cloud architecture is a best of both worlds approach and that is what allows enterprises to run critical workloads in the private cloud and lower risk workloads in the public cloud and allocate resources from either environment as desired in an automated fashion via APIs. It's a setup that minimizes data exposure and allows medium to large enterprises to maintain a scalable, elastic, and secure portfolio of IT resources and services.

Using a hybrid cloud helps companies eliminate the need to make CAPEX investment to handle short-term or seasonal spikes in demand as well as when the business needs to free up on-premise resources for more sensitive data or applications. In summary, hybrid cloud computing delivers flexibility, scalability, elasticity and cost efficiencies with the lowest possible risk of data exposure.



As per Cisco, there are five major challenges involved with deploying and managing a hybrid cloud, i.e.

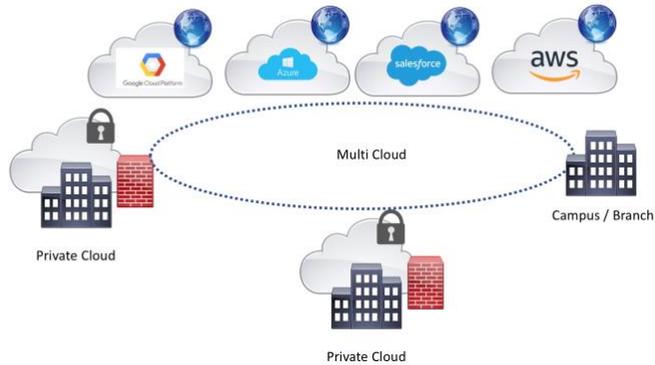
- Cloud management
- OPEX
- Security
- No common ground
- Lack of expertise within IT

## Multi-cloud

Multi-cloud is not yet another cloud model per se, but a cloud deployment approach made up of multiple cloud services, from multiple cloud service providers, public or private.

By definition, “multi” cloud refers to the presence of more than one cloud deployment of the same type. Unlike hybrid cloud, multi-cloud refers to the presence of multiple clouds of the same type, e.g. two private clouds or two public clouds. The drivers behind the trends are avoiding vendor lock-in, cost savings, performance, better defenses against Distributed Denial of Service (DDoS) attacks, improved reliability and the existence of shadow IT.

[IDC](#) predicted that more than 85% of Enterprise IT organizations will chalk up a plan to use multi-cloud architectures by 2018. Cisco also said that a small number of gigantic hyperscale data centers would hold just over half of all data center servers, and account for 69% of all data center processing power, and 65% of all data stored in data centers. Primarily on the basis of multi-cloud, [Gartner](#) also expects 80% of enterprises will have shut down their traditional data centers by 2025, up from just 10 percent today.



Let us compare the two major cloud models' side by side in the critical areas of capacity, control, cost, service SLAs, security and customization.

	Public	Private
Capacity	Multi-tenant, virtually unlimited resources	Single-tenant, limited resources (matched to demand)
Control	Shared with cloud service provider	Complete control to configure and manage resources
TCO	Shared resources, highest return on investment with no upfront costs  Everything is OPEX	Non-shared resources with upfront costs, but predictable  CAPEX + OPEX
Reliability or Service SLA	$\geq 99.99\%$ ( <a href="#">AWS</a> ) $\geq 99.99\%$ ( <a href="#">GCE</a> )	Up to 99.999%
Security	Shared resources, lower	Non-shared resources, highest
Customization	Shared resources, limited	Non-shared resources,

		unlimited
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