

**Examination Details & Draft Blueprint for**
Open Networking Foundation Certified SDN Professional Program

**ONF-Certified SDN Associate Exam (SDNA-110**)

**Exam Title:** ONF-Certified SDN Associate (SDNA-110)

**Exam Details:** 40 questions in 60 minutes and a pass score of 70%

**Exam Delivery:** Delivered electronically via secure login, with attestation and affirmation of academic integrity by the candidate. Exam to be available in English and Simplified Chinese by Q4 2015.

**Credential Awarded:** ONF Certified SDN Associate (CSDNA) upon successful completion of the exam.

**Exam Purpose:** This certification exam attests and formally certifies that the successful candidate has vendor-neutral conceptual knowledge of the major domains of networking practices that support the theory and practice of Software Defined Networking (SDN). It presupposes foundational knowledge in computer networking practices, and will validate conceptual knowledge in how those computer networking foundations are affected in an SDN environment. It is an entry-level certification examination for technical professionals asserting concept-level mastery of the domain of SDN.

**Intended Exam Audience**

| Job Position | Primary Job Responsibilities |
| --- | --- |
| SDN Sales Engineer | Create BOM’sHigh Level Architecture and DesignProduct Comparisons/CapabilitiesRFP’s/RFI’sProduct Line Updates |
| Business Development Manager | Value of SolutionIdentify Business TrendsDevelop Statements of Work |
| Product Manager | Future Features/RoadmapDevelop Go to Market StrategyDefine Customer Requirements/Use Cases |
| Product Marketing/TME | Product Positioning and DifferentiationCompare/Contrast Products (Both Internal and External Products)Sales EnablementCreation/Editing of Technical Documentation/White Papers/Collateral  |
| Manager/Director for an Network/IT Group | Setting Strategy and VisionCareer Development for StaffAssignment of responsibilitiesArticulating needs of staff to higher technical and management leadership |
| Network Technician (Entry Level) | Installation/Migration (entry level, with supervision)Monitoring (entry level, with supervision) Trouble tickets and documenting/communicating issues via wiki etc. (entry level, with supervision) |
| IT Analyst (Entry Level) | Recommend IT Architectures/Products/SystemsTest Plans (product certifications for ONF)Performance & Monitoring (see above in Network Technician)Business ROI Comparisons Education if there is public material or could use high level examples of ROI savings) |
| System Administrator (Entry Level) | Manage IT SystemsOperations ProcessDeploy Server/Storage Infrastructure (non-network)Hypervisors/Overlays/Virtual Switches |
| Consultant/Professional Services Engineer | Design/Implement Network ServicesROI/CapEx/OpEx AnalysisBusiness ProposalsRecommendations for Network Architecture/Integration  |
| Student/EDU | Validate course level knowledge for online course in SDN foundations at a concept levelWriting Research Projects (remove)Learning more advanced networking technologiesTech Evangelizing/White Papers/SpeakingLooking for Future Job/CareerFundamental Understanding from Academic/Theory Perspective |
| Sales Representatives | Sell SDN Products (assumes product knowledge about specific networking hardware/software)Price/Quote Product/SolutionsIdentify Opportunities and Sales Insertion PointsCan carry on an intelligent and informed conversation with every individual in a sales cycle process |
| Project Manager (Assumes knowledge, skills, abilities in project management domain) | Sets/Tracks SchedulesAssign ResourcesFocus on Deliverables (SoW)Project PlansCommunicate with Stakeholders |
| Program Manager(Assumes knowledge, skills, abilities in program management domain) | Manage Budget/Resources (financials)Business Case DevelopmentProcurement & Contract Management & Product Certification via Testing and Interoperability via ONF recommendationsGovernance/Control/Alignment of Operations |
| Help Desk/NOC Engineer | Trouble TicketsFirst Level Triage/SupportEscalations (with experience)Bug Submission |

**Prerequisite Knowledge and Recommended Training Materials**

In order to pass the ONF CSDNA Exam, a foundational knowledge of computer networking is assumed, with specific familiarity with various conceptual models of networking (OSI, Internet, etc.) and technologies also required. Resources that would be helpful include publications on networking, the CompTIA Network+™ professional certification, and materials freely available from Open Networking Foundation. Other materials may be referenced on <https://www.opennetworking.org/sdn-learning-resources>

**ONF Certified SDN Associate Examination Blueprint (Draft)**

|  |  |
| --- | --- |
| Domain | % Weight of Exam (40 questions from random pool) |
| 1. Networking Concepts | 15% |
| 2. SDN Concepts | 25% |
| 3. OpenFlow | 25% |
| 4. SDN Architecture and Ecosystem | 25% |
| 5. SDN Open Source | 10% |

**Domain 1. Networking Concepts**

Identify and compare the layers of the OSI and TCP/IP models and functionality of various fundamental elements of networking.

* Ethernet networks
* Collision domains and broadcast domains
* Function of routers and switches
* Routing Protocols (RIP, OSPF, ISIS, BGP)
* Optical network fundamentals – SONET/SDH, OTN
* IP Network Services ( DHCP, DNS, ARP, NAT, ICMP)
* Layer 2 addressing, including address resolution
* IPv4 and IPv6 fundamentals
* Layer 3 / IP addressing, including subnet masks
* Longest match routing
* Connection-oriented vs. connectionless protocols
* Packet Filtering with Match/Action Pairs

**Domain 2. SDN Concepts**

Describe the fundamental characteristics of SDN, definitions, use cases, and history

* History of SDN (Clean Slate, Ethane, OpenFlow™ , donation to ONF)
* What is SDN? (control and forwarding)
* SDN Value Proposition
* SDN Use Cases in the Data Center
* SDN Use Cases in Campus Networks
* SDN Use Cases in Service Providers
* SDN Use Cases in the Enterprise
* SDN Use Cases in Mobile Networks
* The Five characteristics of an SDN Network (Plane Separation, Simplified Forwarding Element, Centralized Control, Network Automation, Virtualization, and Openness)
* SDN Devices (Controllers, Switches, Orchestration, API’s)

**Domain 3. OpenFlow™**

Identify the OpenFlow Protocol operations and list the packet types and contents

* TCP level secure channel/communication/session establishment between controller/switch
* Message Types
* Basic Operation/Packet Matching
* Differences between OpenFlow versions
* Proactive vs Reactive Flows
* Statistics/Counters
* Setting up a flow
* Policy Enforcement
* OpenFlow Management and Configuration Protocol
* Flow Table Entry Format
* Flow Timers
* Pipeline Processing
* Match Types
* Match Actions

**Domain 4. SDN Architecture and Ecosystem**

Understand and Identify SDN architectural components, standards bodies, controller design, API’s and applications

* SDN Layers
* Northbound API’s
* Southbound API’s
* East/West API’s
* Security and Availability
* Packet and Optical Integration methods
* Migration Strategies
* Hybrid Mode Switches
* Organizations in the SDN Ecosystem
	+ Standards Bodies and Industry alliances
	+ Network Operators and Enterprises
	+ Network Equipment Manufacturers
	+ Software vendors
	+ Academic and Industry research institutions and labs
	+ Open Source Initiatives
* Who is the ONF and what do they do?
	+ Purpose
	+ Structure
	+ Technical Working Groups
	+ Open Source Software Development
	+ Activities and Initiatives
* Controller Placement and Redundancy
* SDN Applications (service chaining, virtualized network functions, analytics)

**Domain 5. Open Source SDN**

Identify key open source projects in the SDN Ecosystem

* OpenFlow Agents
	+ Indigo
	+ Linc
	+ OVS
* OpenFlow Controllers
	+ NOX
	+ POX
	+ ONOS
	+ ODL
	+ Floodlight
	+ RYU
* Utilities and Tools
	+ FlowSim
	+ Loxi
	+ Mininet
	+ Of DPA
	+ OF Test
	+ Wireshark
	+ Avior
* Open Source SDN Distributions
* Open vSwitch
* Orchestration Systems
* Open Source Initiatives (OPNFV, OCP, ODCA, Open Config)

**List of Abbreviations & Acronyms***note: terms and basic definitions referenced to Wikipedia and TechTerms.com, reference texts, as well as other non-proprietary sources, including ONF publications posted at* [*http://wwwopennetworking.org*](http://wwwopennetworking.org) *.*

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| --- | --- |
| **Term, Abbreviation or Acronym** | **Full Text Name** |
| **3GPP** | third generation partnership project |
| **Abstraction** | a representation of an entity in terms of selected characteristics, while hiding or summarizing characteristics irrelevant to the selection criteria. |
| **ACL** | access control list |
| **A-CPI** | Application-controller plane interface |
| **AES** | advanced encryption standard |
| **API** | application program interface |
| **ARP** | address resolution protocol |
| **ASIC** | application-specific integrated circuit |
| **BGP** | border gateway protocol |
| **Broadcast** | Broadcast or flooding is a simple routing algorithm in which every incoming packet is sent through every outgoing link except the one it arrived on.  |
| **CAPEX** | capital expenditure |
| **CHAP** | challenge handshake redundancy protocol |
| **CLI** | command line interface |
| **CO** | central office |
| **Controller** | see *SDN Controller* |
| **CPU** | central processing unit |
| **Data link layer** | The second lowest layer of the seven-layer Open Systems Interconnection (OSI) model of computer networking. |
| **DDoS** | distributed denial of service |
| **DHCP** | dynamic host configuration protocol |
| **DPI** | deep packet inspection |
| **DNS** | domain name system |
| **East-West** |  |
| **FEC** | forward error correction |
| **Flood** | **Flooding** is a simple routing algorithm in which every incoming packet is sent through every outgoing link except the one it arrived on.  |
| **Frame** | a unit of data transferred over a L2 network |
| **FTP** | file transfer protocol |
| **FOSS** | free and open source software |
| **HTTP** | hypertext transfer protocol |
| **HTTPS** | hypertext transfer protocol secure |
| **iBGP** | interior border gateway protocol |
| **ICMP** | internet control message protocol |
| **IDS** | intrusion detection system |
| **Information model** | a set of entities, together with their attributes and the operations that can beperformed on the entities. An instance of an information model is visible at an interface. |
| **IPS** | intrusion prevention system |
| **IP** | internet protocol |
| **IP address** | the unique value assigned to each host on a computer network that is employing the Internet Protocol for addressing |
| **IPsec** | internet protocol security |
| **IPv4** | internet protocol version 4, using a 32-bit integer value for host addressing |
| **IPv6** | internet protocol version 6, using a 128-bit integer value for host addressing |
| **ISIS** | intermediate system to intermediate system protocol |
| **Layer** | a stratum in a framework that is used to describe recursion within the data plane. Adjacent layers have a client-server relationship. |
| **Layer 1 or Layer One or L1** | see Physical layer in the OSI model |
| **Layer 2 or Layer Two or L2** | see data link layer in the OSI model |
| **Layer 3 or Layer Three or L3** | see the network layer in the OSI model |
| **Level** | a stratum of hierarchical SDN or networking abstraction. |
| **LAN** | local area network |
| **LIFO** | last in/first out |
| **LLDP** | link layer discovery protocol |
| **MAC** | media access control |
| **MAN** | metropolitan area network |
| **MPLS** | multiprotocol label switching protocol  |
| **Network layer** | Provides the functions and processes that allow data to be transmitted from sender to receiver across multiple intermedia networks. |
| **NFV** | network function virtualization |
| **NOC** | network operations center |
| **NOS** | network operating system |
| **NV-GRE** | network virtualization using generic routing encapsulation |
| **OFA** | OpenFlow agent |
| **OFC** | OpenFlow controller |
| **OPEX** | operational expense |
| **OS** | operating system |
| **OSPF** | open shortest path first |
| **OVSDB** | Open vSwitch database management protocol |
| **Packet** | a unit of data transferred over an L3 network. |
| **Packet switch** | A packet switch is a node in a network which uses the packet switching paradigm for data communication. Packet switches can operate at a number of different levels in a protocol suite; although the exact technical details differ, fundamentally they all perform the same function: they store and forward packets. |
| **Physical layer** | lowest layer of the seven layer Open Systems Interconnection (OSI) model of computer networking |
| **PKI** | public key infrastructure |
| **Port** | A virtual data connection between computer programs connected through a computer network |
| **RDP** | remote desktop protocol |
| **Router** | A router is a networking device that forwards data packets between computer networks. A router is connected to two or more data lines from different networks (as opposed to a network switch, which connects data lines from one single network). When a data packet comes in on one of the lines, the router reads the address information in the packet to determine its ultimate destination. Then, using information in its routing table or routing policy, it directs the packet to the next network on its journey. |
| **RSVP** | resource reservation protocol |
| **SDN** | software defined networking |
| **SDN Architecture** | The SDN architecture is:* Directly programmable: Network control is directly programmable because it is decoupled from forwarding functions.
* Agile: Abstracting control from forwarding lets administrators dynamically adjust network-wide traffic flow to meet changing needs.
* Centrally managed: Network intelligence is (logically) centralized in software-based SDN controllers that maintain a global view of the network, which appears to applications and policy engines as a single, logical switch.
* Programmatically configured: SDN lets network managers configure, manage, secure, and optimize network resources very quickly via dynamic, automated SDN programs, which they can write themselves because the programs do not depend on proprietary software.
* Open standards-based and vendor-neutral: When implemented through open standards, SDN simplifies network design and operation because instructions are provided by SDN controllers instead of multiple, vendor-specific devices and protocols.
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| **SDN Controller** | A software entity that has exclusive control over an abstract set of data planeresources. An SDN controller may also offer an abstracted information model instance to at least one client. |
| **SLA** | service level agreement |
| **SNMP** | simple network management protocol |
| **Switch** | A network switch (also called switching hub, bridging hub, officially MAC bridge) is a computer networking device that connects devices together on a computer network, by using packet switching to receive, process and forward data to the destination device. A network switch forwards data only to one or multiple devices that need to receive it, rather than broadcasting the same data out of each of its ports. |
| **TCP** | transmission control protocol |
| **TLS** | transport-layer security |
| **UDP** | user datagram protocol |
| **Virtualization** | an abstraction whose selection criterion is dedication of resources to a particular client or application. When the context is general, for example when speaking of virtual network elements (VNEs), the term virtual may be used even when abstract might suffice. Virtual is also sometimes used colloquially to mean non-physical. |
| **VM** | virtual machine |
| **WAN** | wide area network |
| **WLAN** | wireless local area network |
| **XML** | extensible markup language |

**References**

Links to relevant material to be added at final publication.