

INTERNETWORKING



PURPOSE

To evaluate each contestant's preparation for employment and to recognize outstanding students for excellence and professionalism in the field of internetworking.

First, download and review the General Regulations at: <http://updates.skillsusa.org>.

ELIGIBILITY

Open to all active SkillsUSA members currently enrolled in courses.

CLOTHING REQUIREMENTS

Class E: Contest specific — Business Casual

- Official SkillsUSA white polo shirt.
- Black dress slacks (accompanied by black dress socks or black or skin-tone seamless hose) or black dress skirt (knee-length, accompanied by black or skin-tone seamless hose).

These regulations refer to clothing items that are pictured and described at: www.skillsusastore.org. If you have questions about clothing or other logo items, call 1-888-501-2183.

Note: Contestants must wear their official contest clothing to the contest orientation meeting.

EQUIPMENT AND MATERIALS

1. Supplied by the technical committee:
 - a. Computer workstation (if available).
 - b. Cisco routers, switches and equipment not listed as supplied by the contestant.
2. Supplied by contestant:
 - a. Laptop computer with wireless, Ethernet connection and COM port (USB with adapter).
 - b. Tools necessary to connect to a router or switch via an RS232 console connection (USB to serial adapter and console cable).

- c. All competitors must create a one-page résumé and submit a hard copy to the technical committee chair at orientation. Failure to do so will result in a 10-point penalty.

SCOPE OF THE CONTEST

The contest is defined by industry standards as set by the current industry technical standards. The contest will consist of five parts: An end-to-end network configuration, a troubleshooting exercise, a simulation TAC call, a written exam, and a design project.

Knowledge Performance

The contest will include a written knowledge exam assessing knowledge of general networking concepts.

Skill Performance

The contest may include but is not limited to the following assessments.

Design problem — Contestants will be evaluated on their ability to design a network that meets specific requirements. If a network design problem is in use this year it will be posted on the Facebook page and via the SkillsUSA Internetworking Competition page in Remind by the Thursday prior to the competition's start.

End-To-End Networking — Given a set of networking equipment (cable, fiber, hubs/switches routers, etc.) the student must, in a finite amount of time, install or repair a network and demonstrate that the installation properly runs internet applications. Given a logical topology and network requirements, the students will be able to develop a usable network that meets or exceeds the documentation provided. The vision and context are that client companies would request a demonstration booth that runs a particular internet application, and the student, given equipment and tools, would provide the appropriate connectivity for the application to run successfully.

Technical Assistance Call — The student must solve a networking problem while on the phone with a customer. This is a simulation of working in a Technical Assistance Center.

Written Exam — The student must answer questions related to CCNA-level networking.

Troubleshooting — Contestants will be evaluated on their ability to troubleshoot and correct issues in an already existing network.

Standards and Competencies

WORK 1.0 — Network Fundamentals

- 1.1 Compare and contrast OSI and TCP/IP models
- 1.2 Compare and contrast TCP and UDP protocols
- 1.3 Describe the impact of infrastructure components in an enterprise network
 - 1.3.1 Firewalls
 - 1.3.2 Access points
 - 1.3.3 Wireless controllers
- 1.4 Describe the effects of cloud resources on enterprise network architecture
 - 1.4.1 Traffic path to internal and external cloud services
 - 1.4.2 Virtual services
 - 1.4.3 Basic virtual network infrastructure
- 1.5 Compare and contrast collapsed core and three-tier architectures
- 1.6 Compare and contrast network topologies
 - 1.6.1 Star
 - 1.6.2 Mesh
 - 1.6.3 Hybrid
- 1.7 Select the appropriate cabling type based on implementation requirements
- 1.8 Apply troubleshooting methodologies to resolve problems
 - 1.8.1 Perform and document fault isolation
 - 1.8.2 Resolve or escalate
 - 1.8.3 Verify and monitor resolution
- 1.9 Configure, verify, and troubleshoot IPv4 addressing and subnetting
- 1.10 Compare and contrast IPv4 address types
 - 1.10.1 Unicast
 - 1.10.2 Broadcast
 - 1.10.3 Multicast
- 1.11 Describe the need for private IPv4 addressing
- 1.12 Identify the appropriate IPv6 addressing scheme to satisfy addressing requirements in a LAN/WAN environment

- 1.13. Configure, verify, and troubleshoot IPv6 addressing
- 1.14. Configure and verify IPv6 Stateless Address Auto Configuration
- 1.15. Compare and contrast IPv6 address types
 - 1.15.1 Global unicast
 - 1.15.2 Unique local
 - 1.15.3 Link local
 - 1.15.4 Multicast
 - 1.15.5 Modified EUI 64
 - 1.15.6 Autoconfiguration
 - 1.15.7 Anycast

WORK 2.0 - LAN Switching Technologies

- 2.1. Describe and verify switching concepts
 - 2.1.1 MAC learning and aging
 - 2.1.2 Frame switching
 - 2.1.3 Frame flooding
 - 2.1.4 MAC address table
- 2.2. Interpret Ethernet frame format
- 2.3. Troubleshoot interface and cable issues (collisions, errors, duplex, speed)
- 2.4. Configure, verify, and troubleshoot VLANs (normal/extended range) spanning multiple switches
 - 2.4.1 Access ports (data and voice)
 - 2.4.2 Default VLAN
- 2.5. Configure, verify, and troubleshoot interswitch connectivity
 - 2.5.1 Trunk ports
 - 2.5.2 Add and remove VLANs on a trunk
 - 2.5.3 DTP, VTP (v1&v2), and 802.1Q
 - 2.5.4 Native VLAN
- 2.6. Configure, verify, and troubleshoot STP protocols
 - 2.6.1 STP mode (PVST+ and RPVST+)
 - 2.6.2 STP root bridge selection
- 2.7. Configure, verify and troubleshoot STP related optional features
 - 2.7.1 PortFast
 - 2.7.2 BPDU guard
- 2.8. Configure and verify Layer 2 protocols
 - 2.8.1 Cisco Discovery Protocol
 - 2.8.2 LLDP
- 2.9. Configure, verify, and troubleshoot (Layer 2/Layer 3) EtherChannel
 - 2.9.1 Static
 - 2.9.2 PAGP
 - 2.9.3 LACP
- 2.10. Describe the benefits of switch stacking and chassis aggregation

WORK 3.0 - Routing Technologies

- 3.1. Describe the routing concepts
 - 3.1.1 Packet handling along the path through a network
 - 3.1.2 Forwarding decision based on route lookup
 - 3.1.3 Frame rewrite
- 3.2. Interpret the components of a routing table
 - 3.2.1 Prefix
 - 3.2.2 Network mask
 - 3.2.3 Next hop
 - 3.2.4 Routing protocol code
 - 3.2.5 Administrative distance
 - 3.2.6 Metric
 - 3.2.7 Gateway of last resort
- 3.3. Describe how a routing table is populated by different routing information sources
 - 3.3.1 Admin distance
- 3.4. Configure, verify, and troubleshoot inter-VLAN routing
 - 3.4.1 Router on a stick
 - 3.4.2 SVI
- 3.5. Compare and contrast static routing and dynamic routing
- 3.6. Compare and contrast distance vector and link state routing protocols
- 3.7. Compare and contrast interior and exterior routing protocols
- 3.8. Configure, verify, and troubleshoot IPv4 and IPv6 static routing
 - 3.8.1 Default route
 - 3.8.2 Network route
 - 3.8.3 Host route
 - 3.8.4 Floating static
- 3.9. Configure, verify, and troubleshoot single area and multi-area OSPFv2 for IPv4 (excluding authentication, filtering, manual summarization, redistribution, stub, virtual-link, and LSAs)
- 3.10. Configure, verify, and troubleshoot single area and multi-area OSPFv3 for IPv6 (excluding authentication, filtering, manual summarization, redistribution, stub, virtual-link, and LSAs)
- 3.11. Configure, verify, and troubleshoot EIGRP for IPv4 (excluding authentication, filtering, manual summarization, redistribution, stub)
- 3.12. Configure, verify, and troubleshoot EIGRP for IPv6 (excluding

authentication, filtering, manual summarization, redistribution, stub)

- 3.13. Configure, verify, and troubleshoot RIPv2 for IPv4 (excluding authentication, filtering, manual summarization, redistribution)
- 3.14. Troubleshoot basic Layer 3 end-to-end connectivity issues

WORK 4.0 - WAN Technologies

- 4.1. Configure and verify PPP and MLPPP on WAN interfaces using local authentication
- 4.2. Configure, verify, and troubleshoot PPPoE client-side interfaces using local authentication
- 4.3. Configure, verify, and troubleshoot GRE tunnel connectivity
- 4.4. Describe WAN topology options
 - 4.4.1 Point-to-point
 - 4.4.2 Hub and spoke
 - 4.4.3 Full mesh
 - 4.4.4 Single vs dual-homed
- 4.5. Describe WAN access connectivity options
 - 4.5.1 MPLS
 - 4.5.2 Metro Ethernet
 - 4.5.3 Broadband PPPoE
 - 4.5.4 internet VPN (DMVPN, site-to-site VPN, client VPN)
- 4.6. Configure and verify single-homed branch connectivity using eBGP IPv4 (limited to peering and route advertisement using Network command only)
- 4.7. Describe basic QoS concepts
 - 4.7.1 Marking
 - 4.7.2 Device trust
 - 4.7.3 Prioritization
 - 4.7.3.1 Voice
 - 4.7.3.2 Video
 - 4.7.3.3 Data
 - 4.7.4 Shaping
 - 4.7.5 Policing
 - 4.7.6 Congestion management

WORK 5.0 - Infrastructure Services

- 5.1. Describe DNS lookup operation
- 5.2. Troubleshoot client connectivity issues involving DNS
- 5.3. Configure and verify DHCP on a router (excluding static reservations)

- 5.3.1 Server
- 5.3.2 Relay
- 5.3.3 Client
- 5.3.4 TFTP, DNS, and gateway options
- 5.4. Troubleshoot client- and router-based DHCP connectivity issues
- 5.5. Configure, verify, and troubleshoot basic HSRP
 - 5.5.1 Priority
 - 5.5.2 Preemption
 - 5.5.3 Version
- 5.6. Configure, verify, and troubleshoot inside source NAT
 - 5.6.1 Static
 - 5.6.2 Pool
 - 5.6.3 PAT
- 5.7. Configure and verify NTP operating in a client/server mode

WORK 6.0 - Infrastructure Security

- 6.1. Configure, verify and troubleshoot port security
 - 6.1.1 Static
 - 6.1.2 Dynamic
 - 6.1.3 Sticky
 - 6.1.4 Max MAC addresses
 - 6.1.5 Violation actions
 - 6.1.6 Err-disable recovery
- 6.2. Describe common access layer threat mitigation techniques
 - 6.2.1 802.1x
 - 6.2.2 DHCP snooping
 - 6.2.3 Nondefault native VLAN
- 6.3. Configure, verify, and troubleshoot IPv4 and IPv6 access list for traffic filtering
 - 6.3.1 Standard
 - 6.3.2 Extended
 - 6.3.3 Named
- 6.4. Verify ACLs using the APIC-EM Path Trace ACL analysis tool
- 6.5. Configure, verify, and troubleshoot basic device hardening
 - 6.5.1 Local authentication
 - 6.5.2 Secure password
 - 6.5.3 Access to device
 - 6.5.3.1 address
 - 6.5.3.2 Telnet/SSH
 - 6.5.3.3 Login banner
- 6.6. Describe device security using AAA with TACACS+ and RADIUS

WORK 7.0 - Infrastructure Management

- 7.1. Configure and verify device-monitoring protocols
 - 7.1.1 SNMPv2
 - 7.1.2 SNMPv3
 - 7.1.3 Syslog
- 7.2. Troubleshoot network connectivity issues using ICMP echo-based IP SLA
- 7.3. Configure and verify device management
 - 7.3.1 Backup and restore device configuration
 - 7.3.2 Using Cisco Discovery Protocol or LLDP for device discovery
 - 7.3.3 Licensing
 - 7.3.4 Logging
 - 7.3.5 Time zone
 - 7.3.6 Loopback
- 7.4. Configure and verify initial device configuration
- 7.5. Perform device maintenance
 - 7.5.1 Cisco IOS upgrades and recovery (SCP, FTP, TFTP, and MD5 verify)
 - 7.5.2 Password recovery and configuration register
 - 7.5.3 File system management
- 7.6. Use Cisco IOS tools to troubleshoot and resolve problems
 - 7.6.1 Ping and traceroute with extended option
 - 7.6.2 Terminal monitor
 - 7.6.3 Log events
 - 7.6.4 Local SPAN
- 7.7. Describe network programmability in enterprise network architecture
 - 7.7.1 Function of a controller
 - 7.7.2 Separation of control plane and data plane
 - 7.7.3 Northbound and southbound APIs

Work 8.0 – Network Systems Administration

- 8.1. Installation, configuration, and management of
 - 8.1.1 Windows Workstation Software
 - 8.1.2 Windows Server software
 - 8.1.3 Linux Software
 - 8.1.4 Network Services
 - 8.1.5 Virtualized Environments

Work 9.0 – Provide customer support

- 9.1. Converse effectively and correctly with a customer
- 9.2. Speak clearly and to the point when conversing about products and solutions for the customer
- 9.3. Repeat name, location, and phone number back to the customer during technical support conversations
- 9.4. Take the needed actions to fix the customer's problem
- 9.5. Close the conversation with a positive, reassuring attitude

Committee Identified Academic Skills

The technical committee has identified that the following academic skills are embedded in this contest.

Math Skills

- Use proportions and ratios to solve practical problems.
- Solve problems using proportions, formulas and functions.
- Binary number systems.
- Bitwise shifting binary numbers.
- Boolean logic functions.

Science Skills

- Plan and conduct a scientific investigation.
- Use knowledge of mechanical, chemical and electrical energy.
- Use knowledge of heat, light and sound energy.
- Use knowledge of the nature and technological applications of light.
- Use knowledge of principles of electricity and magnetism.
- Use knowledge of static electricity, current electricity and circuits.

Language Arts Skills

- Provide information in oral presentations.
- Demonstrate use of such verbal communication skills as word choice, pitch, feeling, tone and voice.
- Demonstrate use of such nonverbal communication skills as eye contact, posture and gestures using interviewing techniques to gain information.
- Demonstrate comprehension of a variety of informational texts.

- Understand source, viewpoint and purpose of texts.
- Demonstrate knowledge of appropriate reference materials.
- Use print, electronic databases and online resources to access information in books and articles.
- Demonstrate informational writing.

Connections to National Standards

State-level academic curriculum specialists identified the following connections to national academic standards.

Math Standards

- Numbers and operations.
- Problem solving.
- Reasoning and proof.
- Communication.
- Connections.
- Representation.

Source: NCTM Principles and Standards for School Mathematics. For more information, visit: www.nctm.org.

Science Standards

- Understands the sources and properties of energy.
- Understands forces and motion.
- Understands the nature of scientific inquiry.

Source: McREL compendium of national science standards. To view and search the compendium, visit: www2.mcrel.org/compendium/browse.asp.

Language Arts Standards

- Students apply a wide range of strategies to comprehend, interpret, evaluate and appreciate texts. They draw on their prior experience, their interactions with other readers and writers, their knowledge of word meaning and of other texts, their word identification strategies and their understanding of textual features (e.g., sound-letter correspondence, sentence structure, context, graphics).
- Students adjust their use of spoken, written and visual language (e.g., conventions, style, vocabulary) to communicate effectively with a variety of audiences and for different purposes.

- Students employ a wide range of strategies as they write and use different writing process elements appropriately to communicate with different audiences for a variety of purposes.
- Students use spoken, written and visual language to accomplish their own purposes (e.g., for learning, enjoyment, persuasion and the exchange of information).

Source: IRA/NCTE Standards for the English Language Arts.
To view the standards, visit: www.ncte.org/standards.

Additional Information and Contest Updates

- For any contest updates, please reference the SkillsUSA Internetworking Competition’s Facebook page: www.facebook.com/SkillsUSA.Internetworking.
- It is crucial to check Facebook, as we may use it to post work, we expect competitors to have completed prior to their arrival at the national competition.
- Updates will not be posted after the Thursday prior to the national competition.
- Additionally, we will make our best effort to post updates in Remind under the “SkillsUSA Internetworking Competition” class. Due to size limitations in Remind we cannot guarantee everyone will be able to enroll in the class. If this occurs, we will drop all active registrations to purge teachers from previous years that do not need updates for this year. If this happens, please re-register. We will make sure all updates are posted in Facebook – Remind updates will be posted as best effort.