

CAREER PATHWAY NETWORK OPERATIONS SPECIALIST (441)

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Table of Contents

CAREER PATHWAY NETWORK OPERATIONS..... 1

SPECIALIST (441) 1

1 441-NETWORK OPERATIONS SPECIALIST 3

1.1 Work Role Overview3

1.2 Core Tasks.....5

1.3 Core Knowledge, Skills, and Abilities6

1.4 Core Competencies.....9

1.5 Suggested Qualifications / Capability Indicators 12

**2 APPENDIX: 441-NETWORK OPERATIONS SPECIALIST TASK ANALYSIS AND KSA MAPPING
13**

2.1 Key to Reading the Task Analysis and KSA Mapping..... 13

2.2 441-Network Operations Specialist Task Analysis and KSA Mapping 14

1 441-NETWORK OPERATIONS SPECIALIST

1.1 WORK ROLE OVERVIEW

The table below provides an overview of various role-specific elements related to 441-Network Operations Specialist.

Table 1. 441- Network Operations Specialist Work Role Overview

NICE Role Description	Plans, implements, and operates network services / systems, to include hardware and virtual environments.
OPM Occupational Series	<p>Personnel performing the 441-Network Operations Specialist work role are most commonly aligned to the following Occupational Series: (Top 5 Shown)</p> <ul style="list-style-type: none"> - 2210 – Information Technology – 70% - 391 – Telecommunications – 11% - 856 – Electronics Technical – 10% - 855 – Electronics Engineering – 2% - 1550 – Computer Science – 1%
Work Role Pairings	<p>Personnel performing the 441-Network Operations Specialist work role are most commonly paired with the following complimentary Work Roles (Top 5 shown):</p> <ul style="list-style-type: none"> - 411-Technical Support Specialist – 35% - 451-System Administrator – 29% - 521-Cyber Defense Infrastructure Support Specialist – 6% - 641-Systems Requirements Planner – 5% - 461-Systems Security Analyst – 3%
Functional Titles	<p>Personnel performing the 441-Network Operations Specialist work role may unofficially or alternatively be called:</p> <ul style="list-style-type: none"> - Network Administrator - Network Analyst - Network Designer - Network Engineer - Network Systems and Data Communications Analyst - Network Systems Engineer - Telecommunications Engineer/ Personnel/ Specialist
Distribution of GS-Levels	<p>Personnel performing the 441-Network Operations Specialist is most commonly found within the following grades on the General Schedule.*</p> <ul style="list-style-type: none"> - <input type="checkbox"/> GS-4 – redacted** - <input type="checkbox"/> GS-5 – redacted** - <input type="checkbox"/> GS-6 – redacted** - <input type="checkbox"/> GS-7 – redacted**

	<ul style="list-style-type: none"> - <input checked="" type="checkbox"/> GS-9 – 5% - <input type="checkbox"/> GS-10 – redacted** - <input checked="" type="checkbox"/> GS-11 – 18% - <input checked="" type="checkbox"/> GS-12 – 32% - <input checked="" type="checkbox"/> GS-13 – 23% - <input checked="" type="checkbox"/> GS-14 – 8% - <input type="checkbox"/> GS-15 – redacted** <p>*12% of all 441s are in non-GS pay plans and excluded from this GS distribution **Percentages below 3% and below are redacted</p>
<p>On Ramps</p>	<p>The following work roles are examples of logical roles an individual may perform prior to transitioning into the 441-Network Operations Specialist work role:</p> <ul style="list-style-type: none"> - 411-Technical Support Specialist - 421-Database Administrator - 451-System Administrator
<p>Off Ramps</p>	<p>The following work roles are examples of common transitions an individual may pursue after having performed the 441-Network Operations Specialist work role. This is not an exhaustive list, nor does it consider learning and development opportunities an individual may pursue to prepare themselves for performing alternate work roles:</p> <ul style="list-style-type: none"> - 421-Database Administrator - 461-Systems Security Analyst - 511-Cyber Defense Analyst - 541-Vulnerability Assessment Analyst - 632-Systems Developer - 641-Systems Requirements Planner - 671-System Testing and Evaluation - 521-Cyber Defense Infrastructure Support Specialist - 722-Information Systems Security Manager <p>*Note: Leveraging the knowledge, skills, abilities, and tasks of the 441-Network Operations Specialist work role, individuals may prepare themselves to transition into one or more of the following cross-functional work roles:</p> <ul style="list-style-type: none"> - <i>711- Cyber Instructional Curriculum Developer</i> - <i>712-Cyber Instructor</i> - <i>732-Privacy Officer / Privacy Compliance Manager</i> - <i>751-Cyber Workforce Developer and Manager</i> - <i>752-Cyber Policy and Strategy Planner</i> - <i>802-IT Project Manager</i> - <i>803-Product Support Manager</i>

1.2 CORE TASKS

The table below provides a list of tasks that represent the Core, or baseline, expectations for performance in the 441-Network Operations Specialist work role, as well as additional tasks that those in this role may be expected to perform.

Table 2. 441-Network Operations Specialist Core Tasks

Task ID	Task Description	Core or Additional
T0035	Configure and optimize network hubs, routers, and switches (e.g., higher-level protocols, tunneling).	Core
T0065	Develop and implement network backup and recovery procedures.	Core
T0081	Diagnose network connectivity problem.	Core
T0125	Install and maintain network infrastructure device operating system software (e.g., IOS, firmware).	Core
T0126	Install or replace network hubs, routers, and switches.	Core
T0153	Monitor network capacity and performance.	Core
T0160	Patch network vulnerabilities to ensure information is safeguarded against outside parties.	Core
T0232	Test and maintain network infrastructure including software and hardware devices.	Core
T0121	Implement new system design procedures, test procedures, and quality standards.	Additional
T0129	Integrate new systems into existing network architecture.	Additional
T0200	Provide feedback on network requirements, including network architecture and infrastructure.	Additional

1.3 CORE KNOWLEDGE, SKILLS, AND ABILITIES

The table below provides a ranking of KSAs that represent the Core, or baseline, expectations for performance in the 441-Network Operations Specialist work role, as well as additional KSAs that those in this role may be expected to demonstrate.

Table 3. 441-Network Operations Specialist Core KSAs

KSA ID	Description	Competency	Importance to Work Role
K0004	Knowledge of cybersecurity principles.	Information Systems/Network Security	Foundational to All Work Roles
K0001	Knowledge of computer networking concepts and protocols, and network security methodologies.	Infrastructure Design	Foundational to All Work Roles
K0003	Knowledge of national and international laws, regulations, policies, and ethics as they relate to cybersecurity.	Legal, Government, and Jurisprudence	Foundational to All Work Roles
K0002	Knowledge of risk management processes (e.g., methods for assessing and mitigating risk).	Risk Management	Foundational to All Work Roles
K0005	Knowledge of cyber threats and vulnerabilities.	Vulnerabilities Assessment	Foundational to All Work Roles
K0006	Knowledge of specific operational impacts of cybersecurity lapses.	Vulnerabilities Assessment	Foundational to All Work Roles
S0150	Skill in implementing and testing network infrastructure contingency and recovery plans.	Business Continuity	Core
S0079	Skill in protecting a network against malware. (e.g., NIPS, anti-malware, restrict/prevent external devices, spam filters).	Computer Network Defense	Core
K0104	Knowledge of Virtual Private Network (VPN) security.	Encryption	Core
K0038	Knowledge of cybersecurity and privacy principles used to manage risks related to the use, processing, storage, and transmission of information or data.	Information Assurance	Core
K0049	Knowledge of information technology (IT) security principles and methods (e.g., firewalls, demilitarized zones, encryption).	Information Systems/Network Security	Core
K0179	Knowledge of network security architecture concepts including topology, protocols, components, and principles (e.g., application of defense-in-depth).	Information Systems/Network Security	Core
S0170	Skill in configuring and utilizing computer protection components (e.g., hardware firewalls, servers, routers, as appropriate).	Information Systems/Network Security	Core
S0040	Skill in implementing, maintaining, and improving established network security practices.	Information Systems/Network Security	Core
S0077	Skill in securing network communications.	Information Systems/Network Security	Core
K0053	Knowledge of measures or indicators of system performance and availability.	Information Technology Assessment	Core
K0011	Knowledge of capabilities and applications of network equipment including hubs, routers, switches, bridges, servers, transmission media, and related hardware.	Infrastructure Design	Core
K0113	Knowledge of different types of network communication (e.g., LAN, WAN, MAN, WLAN, WWAN).	Infrastructure Design	Core
K0061	Knowledge of how traffic flows across the network (e.g., Transmission Control Protocol [TCP] and Internet Protocol [IP], Open System	Infrastructure Design	Core

KSA ID	Description	Competency	Importance to Work Role
	Interconnection Model [OSI], Information Technology Infrastructure Library, current version [ITIL]).		
K0050	Knowledge of local area and wide area networking principles and concepts including bandwidth management.	Infrastructure Design	Core
K0332	Knowledge of network protocols such as TCP/IP, Dynamic Host Configuration, Domain Name System (DNS), and directory services.	Infrastructure Design	Core
K0029	Knowledge of organization's Local and Wide Area Network connections.	Infrastructure Design	Core
K0137	Knowledge of the range of existing networks (e.g., PBX, LANs, WANs, WIFI, SCADA).	Infrastructure Design	Core
S0035	Skill in establishing a routing schema.	Infrastructure Design	Core
S0162	Skill in applying various subnet techniques (e.g., CIDR)	Infrastructure Design	Core
A0055	Ability to operate common network tools (e.g., ping, traceroute, nslookup).	Network Management	Core
A0052	Ability to operate network equipment including hubs, routers, switches, bridges, servers, transmission media, and related hardware.	Network Management	Core
K0180	Knowledge of network systems management principles, models, methods (e.g., end-to-end systems performance monitoring), and tools.	Network Management	Core
S0004	Skill in analyzing network traffic capacity and performance characteristics.	Network Management	Core
S0084	Skill in configuring and utilizing network protection components (e.g., Firewalls, VPNs, network intrusion detection systems).	Network Management	Core
S0041	Skill in installing, configuring, and troubleshooting LAN and WAN components such as routers, hubs, and switches.	Network Management	Core
S0056	Skill in using network management tools to analyze network traffic patterns (e.g., simple network management protocol).	Network Management	Core
K0111	Knowledge of network tools (e.g., ping, traceroute, nslookup)	Network Management	Core
A0058	Ability to execute OS command line (e.g., ipconfig, netstat, dir, nbtstat).	Operating Systems	Core
A0063	Ability to operate different electronic communication systems and methods (e.g., e-mail, VOIP, IM, web forums, Direct Video Broadcasts).	System Administration	Core
K0076	Knowledge of server administration and systems engineering theories, concepts, and methods.	Systems Integration	Core
K0071	Knowledge of remote access technology concepts.	Technology Awareness	Core
K0108	Knowledge of concepts, terminology, and operations of a wide range of communications media (computer and telephone networks, satellite, fiber, wireless).	Telecommunications	Core
K0010	Knowledge of communication methods, principles, and concepts (e.g., crypto, dual hubs, time multiplexers) that support the network infrastructure.	Telecommunications	Core
K0093	Knowledge of telecommunications concepts (e.g., Communications channel, Systems Link Budgeting, Spectral efficiency, Multiplexing).	Telecommunications	Core
K0136	Knowledge of the capabilities of different electronic communication systems and methods (e.g., e-mail, VOIP, IM, web forums, Direct Video Broadcasts).	Telecommunications	Core
K0135	Knowledge of web filtering technologies.	Web Technology	Core
K0160	Knowledge of the common attack vectors on the network layer.	Computer Network Defense	Additional
K0260	Knowledge of Personally Identifiable Information (PII) data security standards.	Data Privacy and Protection	Additional

KSA ID	Description	Competency	Importance to Work Role
K0261	Knowledge of Payment Card Industry (PCI) data security standards.	Data Privacy and Protection	Additional
K0262	Knowledge of Personal Health Information (PHI) data security standards.	Data Privacy and Protection	Additional
K0622	Knowledge of controls related to the use, processing, storage, and transmission of data.	Database Administration	Additional
K0201	Knowledge of symmetric key rotation techniques and concepts.	Encryption	Additional
K0200	Knowledge of service management concepts for networks and related standards (e.g., Information Technology Infrastructure Library, current version [ITIL]).	Enterprise Architecture	Additional
K0203	Knowledge of security models (e.g., Bell-LaPadula model, Biba integrity model, Clark-Wilson integrity model).	Information Assurance	Additional
K0287	Knowledge of an organization's information classification program and procedures for information compromise.	Information Management	Additional
A0062	Ability to monitor measures or indicators of system performance and availability.	Information Technology Assessment	Additional
K0113	Knowledge of different types of network communication (e.g., LAN, WAN, MAN, WLAN, WWAN).	Infrastructure Design	Additional
A0059	Ability to operate the organization's LAN/WAN pathways.	Network Management	Additional
A0065	Ability to monitor traffic flows across the network.	Network Management	Additional
A0159	Ability to interpret the information collected by network tools (e.g. Nslookup, Ping, and Traceroute).	Network Management	Additional
K0138	Knowledge of Wi-Fi.	Telecommunications	Additional
K0159	Knowledge of Voice over IP (VoIP).	Telecommunications	Additional
K0274	Knowledge of transmission records (e.g., Bluetooth, Radio Frequency Identification (RFID), Infrared Networking (IR), Wireless Fidelity (Wi-Fi), paging, cellular, satellite dishes, Voice over Internet Protocol (VoIP)), and jamming techniques that enable transmission of undesirable information, or prevent installed systems from operating correctly.	Telecommunications	Additional

1.4 CORE COMPETENCIES

The table below is a compilation of competencies aligned to the 441-Network Operations Specialist work role, and their associated importance. Listed competencies are collections of three or more similar Knowledge, Skills, or Abilities aligned to the Work Role. *These competencies originate from the [NICE Framework Competency Pivot Tool](#).*

Table 4. 441-Network Operations Specialist Core Competencies

Technical Competency	Comp . ID	Definition	Work Role Related KSAs	Importance
Network Management	C033	This area contains KSAs that relate to the operation, management, and maintenance of network and telecommunication systems and linked systems and peripherals.	<ul style="list-style-type: none"> • Skill in analyzing network traffic capacity and performance characteristics. (S0004) • Ability to interpret the information collected by network tools (e.g. Nslookup, Ping, and Traceroute). (A0159) • Skill in installing, configuring, and troubleshooting LAN and WAN components such as routers, hubs, and switches. (S0041) • Ability to monitor traffic flows across the network. (A0065) • Knowledge of network tools (e.g., ping, traceroute, nslookup). (K0111) • Ability to operate common network tools (e.g., ping, traceroute, nslookup). (A0055) • Skill in configuring and utilizing network protection components (e.g., Firewalls, VPNs, network intrusion detection systems). (S0084) • Ability to operate network equipment including hubs, routers, switches, bridges, servers, transmission media, and related hardware. (A0052) • Skill in using network management tools to analyze network traffic patterns (e.g., simple network management protocol). (S0056) • Ability to operate the organization's LAN/WAN pathways. (A0059) • Knowledge of network systems management principles, models, methods (e.g., end-to-end systems performance monitoring), and tools. (K0180) 	Core

Technical Competency	Comp . ID	Definition	Work Role Related KSAs	Importance
Infrastructure Design	C026	This area contains KSAs that relate to the architecture and typology of software, hardware, and networks, including LANS, WANS, and telecommunications systems, their components and associated protocols and standards, and how they operate and integrate with one another and with associated controlling software.	<ul style="list-style-type: none"> • Knowledge of the range of existing networks (e.g., PBX, LANs, WANS, WIFI, SCADA). (K0137) • Knowledge of network protocols such as TCP/IP, Dynamic Host Configuration, Domain Name System (DNS), and directory services. (K0332) • Skill in establishing a routing schema. (S0035) • Knowledge of computer networking concepts and protocols, and network security methodologies. (K0001) • Knowledge of organization's Local and Wide Area Network connections. (K0029) • Knowledge of different types of network communication (e.g., LAN, WAN, MAN, WLAN, WWAN). (K0113) • Skill in applying various subnet techniques (e.g., CIDR) (S0162) • Knowledge of how traffic flows across the network (e.g., Transmission Control Protocol [TCP] and Internet Protocol [IP], Open System Interconnection Model [OSI], Information Technology Infrastructure Library, current version [ITIL]). (K0061) • Knowledge of capabilities and applications of network equipment including routers, switches, bridges, servers, transmission media, and related hardware. (K0011) • Knowledge of local area and wide area networking principles and concepts including bandwidth management. (K0050) 	Core
Telecommunications	C054	This area contains KSAs that relate to the transmissions, broadcasting, switching, control, and operation of telecommunications and/or telephony or conferencing systems and related network infrastructure.	<ul style="list-style-type: none"> • Knowledge of communication methods, principles, and concepts that support the network infrastructure. (K0010) • Knowledge of Voice over IP (VoIP). (K0159) • Knowledge of transmission records (e.g., Bluetooth, Radio Frequency Identification (RFID), Infrared Networking (IR), Wireless Fidelity (Wi-Fi). paging, cellular, satellite dishes, Voice over Internet Protocol (VoIP)), and jamming techniques that enable transmission of undesirable information, or prevent installed systems from operating correctly. (K0274) • Knowledge of concepts, terminology, and operations of a wide range of communications media (computer and telephone networks, satellite, fiber, wireless). (K0108) • Knowledge of Wi-Fi. (K0138) • Knowledge of telecommunications concepts (e.g., Communications channel, Systems Link Budgeting, Spectral efficiency, Multiplexing). (K0093) • Knowledge of the capabilities of different electronic communication systems and methods (e.g., e-mail, VOIP, IM, web forums, Direct Video Broadcasts). (K0136) 	Core

Technical Competency	Comp . ID	Definition	Work Role Related KSAs	Importance
Information Systems/Network Security	C024	This area contains KSAs that relate to the methods, tools, and procedures, including development of information security plans to prevent information systems vulnerabilities and to provide or restore security of information systems and network services.	<ul style="list-style-type: none"> • Skill in configuring and utilizing computer protection components (e.g., hardware firewalls, servers, routers, as appropriate). (S0170) • Skill in securing network communications. (S0077) • Skill in implementing, maintaining, and improving established network security practices. (S0040) • Knowledge of information technology (IT) security principles and methods (e.g., firewalls, demilitarized zones, encryption). (K0049) • Knowledge of cybersecurity and privacy principles. (K0004) • Knowledge of network security architecture concepts including topology, protocols, components, and principles (e.g., application of defense-in-depth). (K0179) 	Core
Data Privacy and Protection	C014	This area contains KSAs that relate to the relationship between the collection and dissemination of data, technology, the public expectation of privacy, legal and political issues surrounding them	<ul style="list-style-type: none"> • Knowledge of Payment Card Industry (PCI) data security standards. (K0261) • Knowledge of Personally Identifiable Information (PII) data security standards. (K0260) • Knowledge of Personal Health Information (PHI) data security standards. (K0262) 	Additional

1.5 SUGGESTED QUALIFICATIONS / CAPABILITY INDICATORS

Table 5. 441-Network Operations Specialist Suggested Qualifications / Capability Indicators

For indicators of capability for the 441-Network Operations Specialist work role, please see [Draft NISTR 8193 - National Initiative for Cybersecurity Education \(NICE\) Framework Work Role Capability Indicators](#).

Section to be populated with updated DoD-8140 Qualification Matrix for 441-Network Operations Specialist.

2 APPENDIX: 441-NETWORK OPERATIONS SPECIALIST TASK ANALYSIS AND KSA MAPPING

2.1 KEY TO READING THE TASK ANALYSIS AND KSA MAPPING

Table 6. Key to Reading the Task Analysis and KSA Mapping

Proficiency	Task Statement	Importance
As Written	Task as written within the NICE Cybersecurity Workforce Framework (NICE Framework).	Overall Importance to Work Role
Entry	<i>Example behavioral indicator / task permutation for performing this task at an Entry skills proficiency level.</i>	
Intermediate	<i>Example behavioral indicator / task permutation for performing this task at an Intermediate skills proficiency level.</i>	
Advanced	<i>Example behavioral indicator / task permutation for performing this task at an Advanced skills proficiency level.</i>	

Table 7. Primary Knowledge, Skills, and Abilities Required to Perform the above Task

KSA ID	Description	Competency
ID of K, S, or A	Knowledge, Skill or Ability needed to perform the task as written within the NICE Framework	Competency mapped to the individual K, S, or A.

2.2 441-NETWORK OPERATIONS SPECIALIST TASK ANALYSIS AND KSA MAPPING

Table 8. T0081 Task Analysis

Proficiency	Task Statement	Importance
As Written within Framework	Diagnose network connectivity problems.	Core
Entry	<i>Diagnose basic network connectivity problems.</i>	
Intermediate	<i>Diagnose network connectivity problems.</i>	
Advanced	<i>Diagnose complex and/or enterprise-wide network connectivity problems.</i>	

Table 9. Primary Knowledge, Skills, and Abilities Required to Perform the above Task

KSA ID	Description	Competency
K0010	Knowledge of communication methods, principles, and concepts that support the network infrastructure.	Telecommunications
K0011	Knowledge of capabilities and applications of network equipment including routers, switches, bridges, servers, transmission media, and related hardware.	Infrastructure Design
K0029	Knowledge of organization's Local and Wide Area Network connections.	Infrastructure Design
K0049	Knowledge of information technology (IT) security principles and methods (e.g., firewalls, demilitarized zones, encryption).	Information Systems/Network Security
K0050	Knowledge of local area and wide area networking principles and concepts including bandwidth management.	Infrastructure Design
K0053	Knowledge of measures or indicators of system performance and availability.	Information Technology Assessment
K0061	Knowledge of how traffic flows across the network (e.g., Transmission Control Protocol [TCP] and Internet Protocol [IP], Open System Interconnection Model [OSI], Information Technology Infrastructure Library, current version [ITIL]).	Infrastructure Design
K0071	Knowledge of remote access technology concepts.	Technology Awareness
K0093	Knowledge of telecommunications concepts (e.g., Communications channel, Systems Link Budgeting, Spectral efficiency, Multiplexing).	Telecommunications
K0104	Knowledge of Virtual Private Network (VPN) security.	Encryption
K0108	Knowledge of concepts, terminology, and operations of a wide range of communications media (computer and telephone networks, satellite, fiber, wireless).	Telecommunications
K0111	Knowledge of network tools (e.g., ping, traceroute, nslookup)	Network Management
K0113	Knowledge of different types of network communication (e.g., LAN, WAN, MAN, WLAN, WWAN).	Infrastructure Design
K0137	Knowledge of the range of existing networks (e.g., PBX, LANs, WANs, WIFI, SCADA).	Infrastructure Design
K0138	Knowledge of Wi-Fi.	Telecommunications
K0159	Knowledge of Voice over IP (VoIP).	Telecommunications
K0180	Knowledge of network systems management principles, models, methods (e.g., end-to-end systems performance monitoring), and tools.	Network Management
K0332	Knowledge of network protocols such as TCP/IP, Dynamic Host Configuration, Domain Name System (DNS), and directory services.	Infrastructure Design
S0004	Skill in analyzing network traffic capacity and performance characteristics.	Network Management
S0035	Skill in establishing a routing schema.	Infrastructure Design
S0040	Skill in implementing, maintaining, and improving established network security practices.	Information Systems/Network Security

KSA ID	Description	Competency
S0041	Skill in installing, configuring, and troubleshooting LAN and WAN components such as routers, hubs, and switches.	Network Management
S0056	Skill in using network management tools to analyze network traffic patterns (e.g., simple network management protocol).	Network Management
S0084	Skill in configuring and utilizing network protection components (e.g., Firewalls, VPNs, network intrusion detection systems).	Network Management
S0162	Skill in applying various subnet techniques (e.g., CIDR)	Infrastructure Design
A0052	Ability to operate network equipment including hubs, routers, switches, bridges, servers, transmission media, and related hardware.	Network Management
A0055	Ability to operate common network tools (e.g., ping, traceroute, nslookup).	Network Management
A0058	Ability to execute OS command line (e.g., ipconfig, netstat, dir, nbtstat).	Operating Systems
A0059	Ability to operate the organization's LAN/WAN pathways.	Network Management
A0062	Ability to monitor measures or indicators of system performance and availability.	Information Technology Assessment
A0065	Ability to monitor traffic flows across the network.	Network Management
A0159	Ability to interpret the information collected by network tools (e.g. Nslookup, Ping, and Traceroute).	Network Management

Table 10. T0153 Task Analysis

Proficiency	Task Statement	Importance
As Written within Framework	Monitor network capacity and performance.	Core
Entry	Review and monitor network capacity and performance.	
Intermediate	Monitor network capacity and performance.	
Advanced	Engage in network capacity planning; recommend and implement network architectural changes as appropriate.	

Table 11. Primary Knowledge, Skills, and Abilities Required to Perform the above Task

KSA ID	Description	Competency
K0010	Knowledge of communication methods, principles, and concepts that support the network infrastructure.	Telecommunications
K0011	Knowledge of capabilities and applications of network equipment including routers, switches, bridges, servers, transmission media, and related hardware.	Infrastructure Design
K0029	Knowledge of organization's Local and Wide Area Network connections.	Infrastructure Design
K0050	Knowledge of local area and wide area networking principles and concepts including bandwidth management.	Infrastructure Design
K0053	Knowledge of measures or indicators of system performance and availability.	Information Technology Assessment
K0061	Knowledge of how traffic flows across the network (e.g., Transmission Control Protocol [TCP] and Internet Protocol [IP], Open System Interconnection Model [OSI], Information Technology Infrastructure Library, current version [ITIL]).	Infrastructure Design
K0108	Knowledge of concepts, terminology, and operations of a wide range of communications media (computer and telephone networks, satellite, fiber, wireless).	Telecommunications
K0111	Knowledge of network tools (e.g., ping, traceroute, nslookup)	Network Management
K0113	Knowledge of different types of network communication (e.g., LAN, WAN, MAN, WLAN, WWAN).	Infrastructure Design
K0136	Knowledge of the capabilities of different electronic communication systems and methods (e.g., e-mail, VOIP, IM, web forums, Direct Video Broadcasts).	Telecommunications
K0137	Knowledge of the range of existing networks (e.g., PBX, LANs, WANs, WIFI, SCADA).	Infrastructure Design
K0138	Knowledge of Wi-Fi.	Telecommunications
K0159	Knowledge of Voice over IP (VoIP).	Telecommunications
K0274	Knowledge of transmission records (e.g., Bluetooth, Radio Frequency Identification (RFID), Infrared Networking (IR), Wireless Fidelity (Wi-Fi), paging, cellular, satellite dishes, Voice over Internet Protocol (VoIP)), and jamming techniques that enable transmission of undesirable information, or prevent installed systems from operating correctly.	Telecommunications
K0332	Knowledge of network protocols such as TCP/IP, Dynamic Host Configuration, Domain Name System (DNS), and directory services.	Infrastructure Design
S0004	Skill in analyzing network traffic capacity and performance characteristics.	Network Management
S0035	Skill in establishing a routing schema.	Infrastructure Design
S0040	Skill in implementing, maintaining, and improving established network security practices.	Information Systems/Network Security
S0041	Skill in installing, configuring, and troubleshooting LAN and WAN components such as routers, hubs, and switches.	Network Management

KSA ID	Description	Competency
S0056	Skill in using network management tools to analyze network traffic patterns (e.g., simple network management protocol).	Network Management
S0077	Skill in securing network communications.	Information Systems/Network Security
S0150	Skill in implementing and testing network infrastructure contingency and recovery plans.	Business Continuity
S0162	Skill in applying various subnet techniques (e.g., CIDR)	Infrastructure Design
A0052	Ability to operate network equipment including hubs, routers, switches, bridges, servers, transmission media, and related hardware.	Network Management
A0055	Ability to operate common network tools (e.g., ping, traceroute, nslookup).	Network Management
A0058	Ability to execute OS command line (e.g., ipconfig, netstat, dir, nbtstat).	Operating Systems
A0059	Ability to operate the organization's LAN/WAN pathways.	Network Management
A0062	Ability to monitor measures or indicators of system performance and availability.	Information Technology Assessment
A0065	Ability to monitor traffic flows across the network.	Network Management
A0159	Ability to interpret the information collected by network tools (e.g. Nslookup, Ping, and Traceroute).	Network Management

Table 12. T0160 Task Analysis

Proficiency	Task Statement	Importance
As Written within Framework	Patch network vulnerabilities to ensure that information is safeguarded against outside parties.	Core
Entry	<i>Under direct or indirect supervision, patch network vulnerabilities to ensure that information is safeguarded against outside parties, in accordance with standard operating procedures.</i>	
Intermediate	<i>Patch network vulnerabilities to ensure that information is safeguarded against outside parties.</i>	
Advanced	<i>Conduct risk assessment & vulnerability analysis of network infrastructure and develop remediation solutions and patching strategies. Assess the impact the remediation solution & patching strategy will have on production processes.</i>	

Table 13. Primary Knowledge, Skills, and Abilities Required to Perform the above Task

KSA ID	Description	Competency
K0011	Knowledge of capabilities and applications of network equipment including routers, switches, bridges, servers, transmission media, and related hardware.	Infrastructure Design
K0029	Knowledge of organization's Local and Wide Area Network connections.	Infrastructure Design
K0049	Knowledge of information technology (IT) security principles and methods (e.g., firewalls, demilitarized zones, encryption).	Information Systems/Network Security
K0050	Knowledge of local area and wide area networking principles and concepts including bandwidth management.	Infrastructure Design
K0053	Knowledge of measures or indicators of system performance and availability.	Information Technology Assessment
K0061	Knowledge of how traffic flows across the network (e.g., Transmission Control Protocol [TCP] and Internet Protocol [IP], Open System Interconnection Model [OSI], Information Technology Infrastructure Library, current version [ITIL]).	Infrastructure Design
K0104	Knowledge of Virtual Private Network (VPN) security.	Encryption
K0111	Knowledge of network tools (e.g., ping, traceroute, nslookup)	Network Management
K0113	Knowledge of different types of network communication (e.g., LAN, WAN, MAN, WLAN, WWAN).	Infrastructure Design
K0137	Knowledge of the range of existing networks (e.g., PBX, LANs, WANs, WIFI, SCADA).	Infrastructure Design
K0160	Knowledge of the common attack vectors on the network layer.	Computer Network Defense
K0179	Knowledge of network security architecture concepts including topology, protocols, components, and principles (e.g., application of defense-in-depth).	Information Systems/Network Security
K0260	Knowledge of Personally Identifiable Information (PII) data security standards.	Data Privacy and Protection
K0261	Knowledge of Payment Card Industry (PCI) data security standards.	Data Privacy and Protection
K0262	Knowledge of Personal Health Information (PHI) data security standards.	Data Privacy and Protection
K0332	Knowledge of network protocols such as TCP/IP, Dynamic Host Configuration, Domain Name System (DNS), and directory services.	Infrastructure Design

KSA ID	Description	Competency
S0004	Skill in analyzing network traffic capacity and performance characteristics.	Network Management
S0035	Skill in establishing a routing schema.	Infrastructure Design
S0040	Skill in implementing, maintaining, and improving established network security practices.	Information Systems/Network Security
S0041	Skill in installing, configuring, and troubleshooting LAN and WAN components such as routers, hubs, and switches.	Network Management
S0056	Skill in using network management tools to analyze network traffic patterns (e.g., simple network management protocol).	Network Management
S0077	Skill in securing network communications.	Information Systems/Network Security
S0079	Skill in protecting a network against malware. (e.g., NIPS, anti-malware, restrict/prevent external devices, spam filters).	Computer Network Defense
S0084	Skill in configuring and utilizing network protection components (e.g., Firewalls, VPNs, network intrusion detection systems).	Network Management
S0170	Skill in configuring and utilizing computer protection components (e.g., hardware firewalls, servers, routers, as appropriate).	Information Systems/Network Security
A0052	Ability to operate network equipment including hubs, routers, switches, bridges, servers, transmission media, and related hardware.	Network Management
A0055	Ability to operate common network tools (e.g., ping, traceroute, nslookup).	Network Management
A0058	Ability to execute OS command line (e.g., ipconfig, netstat, dir, nbtstat).	Operating Systems
A0059	Ability to operate the organization's LAN/WAN pathways.	Network Management
A0062	Ability to monitor measures or indicators of system performance and availability.	Information Technology Assessment
A0065	Ability to monitor traffic flows across the network.	Network Management
A0159	Ability to interpret the information collected by network tools (e.g. Nslookup, Ping, and Traceroute).	Network Management

Table 14. T0125 Task Analysis

Proficiency	Task Statement	Importance
As Written within Framework	Install and maintain network infrastructure device operating system software (e.g., IOS, firmware).	Core
Entry	<i>Under direct and indirect supervision, install and maintain network infrastructure device operating system software, in accordance with standard operating procedures. (e.g., IOS, firmware).</i>	
Intermediate	<i>Install and maintain network infrastructure device operating system software (e.g., IOS, firmware).</i>	
Advanced	<i>Serve as Subject Matter Expert on network infrastructure device operating system software (e.g., IOS, firmware).</i>	

Table 15. Primary Knowledge, Skills, and Abilities Required to Perform the above Task

KSA ID	Description	Competency
K0011	Knowledge of capabilities and applications of network equipment including routers, switches, bridges, servers, transmission media, and related hardware.	Infrastructure Design
K0029	Knowledge of organization's Local and Wide Area Network connections.	Infrastructure Design
K0049	Knowledge of information technology (IT) security principles and methods (e.g., firewalls, demilitarized zones, encryption).	Information Systems/Network Security
K0076	Knowledge of server administration and systems engineering theories, concepts, and methods.	Systems Integration
K0113	Knowledge of different types of network communication (e.g., LAN, WAN, MAN, WLAN, WWAN).	Infrastructure Design
K0160	Knowledge of the common attack vectors on the network layer.	Computer Network Defense
S0041	Skill in installing, configuring, and troubleshooting LAN and WAN components such as routers, hubs, and switches.	Network Management
S0150	Skill in implementing and testing network infrastructure contingency and recovery plans.	Business Continuity
A0052	Ability to operate network equipment including hubs, routers, switches, bridges, servers, transmission media, and related hardware.	Network Management
A0159	Ability to interpret the information collected by network tools (e.g. Nslookup, Ping, and Traceroute).	Network Management

Table 16. T0035 Task Analysis

Proficiency	Task Statement	Importance
As Written within Framework	Configure and optimize network hubs, routers, and switches (e.g., higher-level protocols, tunneling).	Core
Entry	<i>Under direct and indirect supervision, configure and optimize network equipment and configurations.</i>	
Intermediate	<i>Configure and optimize network hubs, routers, and switches (e.g., higher-level protocols, tunneling).</i>	
Advanced	<i>Plan, design and oversee the configuration and optimization of network equipment.</i>	

Table 17. Primary Knowledge, Skills, and Abilities Required to Perform the above Task

KSA ID	Description	Competency
K0010	Knowledge of communication methods, principles, and concepts that support the network infrastructure.	Telecommunications
K0011	Knowledge of capabilities and applications of network equipment including routers, switches, bridges, servers, transmission media, and related hardware.	Infrastructure Design
K0029	Knowledge of organization's Local and Wide Area Network connections.	Infrastructure Design
K0050	Knowledge of local area and wide area networking principles and concepts including bandwidth management.	Infrastructure Design
K0053	Knowledge of measures or indicators of system performance and availability.	Information Technology Assessment
K0061	Knowledge of how traffic flows across the network (e.g., Transmission Control Protocol [TCP] and Internet Protocol [IP], Open System Interconnection Model [OSI], Information Technology Infrastructure Library, current version [ITIL]).	Infrastructure Design
K0104	Knowledge of Virtual Private Network (VPN) security.	Encryption
K0108	Knowledge of concepts, terminology, and operations of a wide range of communications media (computer and telephone networks, satellite, fiber, wireless).	Telecommunications
K0111	Knowledge of network tools (e.g., ping, traceroute, nslookup)	Network Management
K0113	Knowledge of different types of network communication (e.g., LAN, WAN, MAN, WLAN, WWAN).	Infrastructure Design
K0137	Knowledge of the range of existing networks (e.g., PBX, LANs, WANs, WIFI, SCADA).	Infrastructure Design
K0332	Knowledge of network protocols such as TCP/IP, Dynamic Host Configuration, Domain Name System (DNS), and directory services.	Infrastructure Design
S0035	Skill in establishing a routing schema.	Infrastructure Design
S0041	Skill in installing, configuring, and troubleshooting LAN and WAN components such as routers, hubs, and switches.	Network Management
S0056	Skill in using network management tools to analyze network traffic patterns (e.g., simple network management protocol).	Network Management
S0077	Skill in securing network communications.	Information Systems/Network Security
S0162	Skill in applying various subnet techniques (e.g., CIDR)	Infrastructure Design
A0052	Ability to operate network equipment including hubs, routers, switches, bridges, servers, transmission media, and related hardware.	Network Management
A0055	Ability to operate common network tools (e.g., ping, traceroute, nslookup).	Network Management
A0058	Ability to execute OS command line (e.g., ipconfig, netstat, dir, nbtstat).	Operating Systems
A0059	Ability to operate the organization's LAN/WAN pathways.	Network Management
A0065	Ability to monitor traffic flows across the network.	Network Management
A0159	Ability to interpret the information collected by network tools (e.g. Nslookup, Ping, and Traceroute).	Network Management

Table 18. T0065 Task Analysis

Proficiency	Task Statement	Importance
As Written within Framework	Develop and implement network backup and recovery procedures.	Core
Entry	<i>Demonstrate knowledge of network backup and recovery procedures.</i>	
Intermediate	<i>Develop and implement network backup and recovery procedures.</i>	
Advanced	<i>Design and manage network backup and recovery procedures.</i>	

Table 19. Primary Knowledge, Skills, and Abilities Required to Perform the above Task

KSA ID	Description	Competency
K0010	Knowledge of communication methods, principles, and concepts that support the network infrastructure.	Telecommunications
K0011	Knowledge of capabilities and applications of network equipment including routers, switches, bridges, servers, transmission media, and related hardware.	Infrastructure Design
K0029	Knowledge of organization's Local and Wide Area Network connections.	Infrastructure Design
K0050	Knowledge of local area and wide area networking principles and concepts including bandwidth management.	Infrastructure Design
K0053	Knowledge of measures or indicators of system performance and availability.	Information Technology Assessment
K0061	Knowledge of how traffic flows across the network (e.g., Transmission Control Protocol [TCP] and Internet Protocol [IP], Open System Interconnection Model [OSI], Information Technology Infrastructure Library, current version [ITIL]).	Infrastructure Design
K0071	Knowledge of remote access technology concepts.	Technology Awareness
K0104	Knowledge of Virtual Private Network (VPN) security.	Encryption
K0108	Knowledge of concepts, terminology, and operations of a wide range of communications media (computer and telephone networks, satellite, fiber, wireless).	Telecommunications
K0111	Knowledge of network tools (e.g., ping, traceroute, nslookup)	Network Management
K0113	Knowledge of different types of network communication (e.g., LAN, WAN, MAN, WLAN, WWAN).	Infrastructure Design
K0137	Knowledge of the range of existing networks (e.g., PBX, LANs, WANs, WIFI, SCADA).	Infrastructure Design
K0138	Knowledge of Wi-Fi.	Telecommunications
K0159	Knowledge of Voice over IP (VoIP).	Telecommunications
K0180	Knowledge of network systems management principles, models, methods (e.g., end-to-end systems performance monitoring), and tools.	Network Management
K0200	Knowledge of service management concepts for networks and related standards (e.g., Information Technology Infrastructure Library, current version [ITIL]).	Enterprise Architecture
K0332	Knowledge of network protocols such as TCP/IP, Dynamic Host Configuration, Domain Name System (DNS), and directory services.	Infrastructure Design
S0004	Skill in analyzing network traffic capacity and performance characteristics.	Network Management
S0035	Skill in establishing a routing schema.	Infrastructure Design
S0041	Skill in installing, configuring, and troubleshooting LAN and WAN components such as routers, hubs, and switches.	Network Management

KSA ID	Description	Competency
S0056	Skill in using network management tools to analyze network traffic patterns (e.g., simple network management protocol).	Network Management
S0077	Skill in securing network communications.	Information Systems/Network Security
S0084	Skill in configuring and utilizing network protection components (e.g., Firewalls, VPNs, network intrusion detection systems).	Network Management
S0150	Skill in implementing and testing network infrastructure contingency and recovery plans.	Business Continuity
S0162	Skill in applying various subnet techniques (e.g., CIDR)	Infrastructure Design
S0170	Skill in configuring and utilizing computer protection components (e.g., hardware firewalls, servers, routers, as appropriate).	Information Systems/Network Security
A0052	Ability to operate network equipment including hubs, routers, switches, bridges, servers, transmission media, and related hardware.	Network Management
A0055	Ability to operate common network tools (e.g., ping, traceroute, nslookup).	Network Management
A0058	Ability to execute OS command line (e.g., ipconfig, netstat, dir, nbtstat).	Operating Systems
A0059	Ability to operate the organization's LAN/WAN pathways.	Network Management
A0062	Ability to monitor measures or indicators of system performance and availability.	Information Technology Assessment
A0065	Ability to monitor traffic flows across the network.	Network Management
A0159	Ability to interpret the information collected by network tools (e.g. Nslookup, Ping, and Traceroute).	Network Management

Table 20. T0232 Task Analysis

Proficiency	Task Statement	Importance
As Written within Framework	Test and maintain network infrastructure including software and hardware devices.	Core
Entry	<i>Under direct or indirect supervision, test and maintain network infrastructure including software and hardware devices.</i>	
Intermediate	<i>Test and maintain network infrastructure including software and hardware devices.</i>	
Advanced	<i>Create plans for testing network infrastructure including software and hardware devices and direct their maintenance.</i>	

Table 21. Primary Knowledge, Skills, and Abilities Required to Perform the above Task

KSA ID	Description	Competency
K0010	Knowledge of communication methods, principles, and concepts that support the network infrastructure.	Telecommunications
K0011	Knowledge of capabilities and applications of network equipment including routers, switches, bridges, servers, transmission media, and related hardware.	Infrastructure Design
K0029	Knowledge of organization's Local and Wide Area Network connections.	Infrastructure Design
K0049	Knowledge of information technology (IT) security principles and methods (e.g., firewalls, demilitarized zones, encryption).	Information Systems/Network Security
K0050	Knowledge of local area and wide area networking principles and concepts including bandwidth management.	Infrastructure Design
K0053	Knowledge of measures or indicators of system performance and availability.	Information Technology Assessment
K0061	Knowledge of how traffic flows across the network (e.g., Transmission Control Protocol [TCP] and Internet Protocol [IP], Open System Interconnection Model [OSI], Information Technology Infrastructure Library, current version [ITIL]).	Infrastructure Design
K0076	Knowledge of server administration and systems engineering theories, concepts, and methods.	Systems Integration
K0093	Knowledge of telecommunications concepts (e.g., Communications channel, Systems Link Budgeting, Spectral efficiency, Multiplexing).	Telecommunications
K0104	Knowledge of Virtual Private Network (VPN) security.	Encryption
K0108	Knowledge of concepts, terminology, and operations of a wide range of communications media (computer and telephone networks, satellite, fiber, wireless).	Telecommunications
K0111	Knowledge of network tools (e.g., ping, traceroute, nslookup)	Network Management
K0113	Knowledge of different types of network communication (e.g., LAN, WAN, MAN, WLAN, WWAN).	Infrastructure Design
K0137	Knowledge of the range of existing networks (e.g., PBX, LANs, WANs, WIFI, SCADA).	Infrastructure Design
K0138	Knowledge of Wi-Fi.	Telecommunications
K0159	Knowledge of Voice over IP (VoIP).	Telecommunications
K0160	Knowledge of the common attack vectors on the network layer.	Computer Network Defense
K0180	Knowledge of network systems management principles, models, methods (e.g., end-to-end systems performance monitoring), and tools.	Network Management
K0274	Knowledge of transmission records (e.g., Bluetooth, Radio Frequency Identification (RFID), Infrared Networking (IR), Wireless Fidelity (Wi-Fi), paging, cellular, satellite dishes, Voice over Internet Protocol (VoIP)), and jamming techniques that enable transmission of undesirable information, or prevent installed systems from operating correctly.	Telecommunications
K0332	Knowledge of network protocols such as TCP/IP, Dynamic Host Configuration, Domain Name System (DNS), and directory services.	Infrastructure Design

KSA ID	Description	Competency
S0004	Skill in analyzing network traffic capacity and performance characteristics.	Network Management
S0035	Skill in establishing a routing schema.	Infrastructure Design
S0040	Skill in implementing, maintaining, and improving established network security practices.	Information Systems/Network Security
S0041	Skill in installing, configuring, and troubleshooting LAN and WAN components such as routers, hubs, and switches.	Network Management
S0056	Skill in using network management tools to analyze network traffic patterns (e.g., simple network management protocol).	Network Management
S0077	Skill in securing network communications.	Information Systems/Network Security
S0084	Skill in configuring and utilizing network protection components (e.g., Firewalls, VPNs, network intrusion detection systems).	Network Management
S0162	Skill in applying various subnet techniques (e.g., CIDR)	Infrastructure Design
A0052	Ability to operate network equipment including hubs, routers, switches, bridges, servers, transmission media, and related hardware.	Network Management
A0055	Ability to operate common network tools (e.g., ping, traceroute, nslookup).	Network Management
A0058	Ability to execute OS command line (e.g., ipconfig, netstat, dir, nbtstat).	Operating Systems
A0059	Ability to operate the organization's LAN/WAN pathways.	Network Management
A0062	Ability to monitor measures or indicators of system performance and availability.	Information Technology Assessment
A0065	Ability to monitor traffic flows across the network.	Network Management
A0159	Ability to interpret the information collected by network tools (e.g. Nslookup, Ping, and Traceroute).	Network Management

Table 22. T0126 Task Analysis

Proficiency	Task Statement	Importance
As Written within Framework	Install or replace network hubs, routers, and switches.	Core
Entry	<i>Under direct or indirect supervision, install or replace network hubs, routers and switches, according to standard operating procedures.</i>	
Intermediate	<i>Install or replace network hubs, routers, and switches.</i>	
Advanced	<i>Design, plan, direct and/or install or replace network hubs, routers, and switches.</i>	

Table 23. Primary Knowledge, Skills, and Abilities Required to Perform the above Task

KSA ID	Description	Competency
K0010	Knowledge of communication methods, principles, and concepts that support the network infrastructure.	Telecommunications
K0011	Knowledge of capabilities and applications of network equipment including routers, switches, bridges, servers, transmission media, and related hardware.	Infrastructure Design
K0029	Knowledge of organization's Local and Wide Area Network connections.	Infrastructure Design
K0050	Knowledge of local area and wide area networking principles and concepts including bandwidth management.	Infrastructure Design
K0093	Knowledge of telecommunications concepts (e.g., Communications channel, Systems Link Budgeting, Spectral efficiency, Multiplexing).	Telecommunications
K0104	Knowledge of Virtual Private Network (VPN) security.	Encryption
K0111	Knowledge of network tools (e.g., ping, traceroute, nslookup)	Network Management
K0113	Knowledge of different types of network communication (e.g., LAN, WAN, MAN, WLAN, WWAN).	Infrastructure Design
K0137	Knowledge of the range of existing networks (e.g., PBX, LANs, WANs, WIFI, SCADA).	Infrastructure Design
K0138	Knowledge of Wi-Fi.	Telecommunications
K0159	Knowledge of Voice over IP (VoIP).	Telecommunications
K0179	Knowledge of network security architecture concepts including topology, protocols, components, and principles (e.g., application of defense-in-depth).	Information Systems/Network Security
K0332	Knowledge of network protocols such as TCP/IP, Dynamic Host Configuration, Domain Name System (DNS), and directory services.	Infrastructure Design
S0004	Skill in analyzing network traffic capacity and performance characteristics.	Network Management
S0035	Skill in establishing a routing schema.	Infrastructure Design
S0040	Skill in implementing, maintaining, and improving established network security practices.	Information Systems/Network Security
S0041	Skill in installing, configuring, and troubleshooting LAN and WAN components such as routers, hubs, and switches.	Network Management
S0056	Skill in using network management tools to analyze network traffic patterns (e.g., simple network management protocol).	Network Management
S0084	Skill in configuring and utilizing network protection components (e.g., Firewalls, VPNs, network intrusion detection systems).	Network Management
A0052	Ability to operate network equipment including hubs, routers, switches, bridges, servers, transmission media, and related hardware.	Network Management

KSA ID	Description	Competency
A0055	Ability to operate common network tools (e.g., ping, traceroute, nslookup).	Network Management
A0058	Ability to execute OS command line (e.g., ipconfig, netstat, dir, nbtstat).	Operating Systems
A0059	Ability to operate the organization's LAN/WAN pathways.	Network Management
A0062	Ability to monitor measures or indicators of system performance and availability.	Information Technology Assessment
A0065	Ability to monitor traffic flows across the network.	Network Management
A0159	Ability to interpret the information collected by network tools (e.g. Nslookup, Ping, and Traceroute).	Network Management