Business Class Services Specialist (BCSS)

Scope

The Society of Cable Telecommunications Engineer's (SCTE) **Business Class Services Specialist (BCSS)** certification describes the knowledge of a technician who will install and troubleshoot business services for small to medium businesses. The successful certification candidate will have the business services knowledge to instill employer confidence, employee value, and impact the metrics of the customer experience. Topics include:

- HFC Networks
- Ethernet Services
- Networking Fundamentals
- Customer Service
- Performance Verification
- Fault Management
- Enterprise Voice
- Managed Services

I.   HFC Networks

Competency	Knowledge, Skills, and Abilities
A Understand system maps, schematics and network diagrams	1. Identify the common symbols found on cable system strand and design maps
	a. End of line readings
	b. Data boxes (tombstones)
	c. Route symbols
	d. Design symbols
	e. End of line readings
	f. Name three types of system maps; distinguish between the following
	i. Strand
	ii. Design
	iii. As-built
	2. Identify and describe the following active and passive devices, their corresponding map symbols, and level calculations
	a. Fiber optic node
	b. Amplifier
	c. Line extender

		d. Power supply
		e. Line splitters
		f. Directional couplers
		g. Taps
		i. Directional taps
		ii. Addressable taps
		iii. Power-passing taps
		h. In-line equalizers
		i. Reverse conditioners
		3. Fiber Documentation
		a. Key map
		b. Schematic
		c. Splice guides
		d. Color Codes
		e. Link Losses
		f. Map Symbols
B	Describe the core concepts and electrical principles such as ohms law, electrical wiring, grounding, bonding and surges	1. Explain why bonding is necessary
		2. Understand Ohm's law
		3. Explain the purpose and function of the following bonding hardware:
		a. Bonding blocks (ground block)
		b. Bonding wire (ground wire)
		i. Drop attachment
		ii. Ground electrode attachment
		4. Explain residential coaxial drop cable inspection process
		a. Identify proper bonding locations
		5. Describe the proper bonding techniques in the following special circumstances:
		a. Strip malls
		b. Telco closet (Common buss)
		6. Explain equipment environmental requirements such as grounding, temperature, dust control and rack unit space

Society of Cable Telecommunications Engineers

C	Explain the core coaxial cable principles; care, verification, attenuation and termination, to include advanced cable math, node to customer premises equipment (CPE) calculations; upstream power levels	1. Describe coaxial cable attenuation properties
		a. Be able to calculate the attenuation at both high and low frequencies to determine equalization needed
		b. Describe how to use loop resistance to calculate voltage drop
		2. Given device inputs/outputs, cable attenuation, and insertion losses, be able to calculate coaxial cable loss and expected signal levels
		3. Describe proper coaxial cable handling in the following situations:
		a. Bending radius
		b. Lashing
		c. Environmental damage
		4. Define return loss and its effects in the following situations:
		a. Structural return loss (SRL)
		b. Impedance mismatches
		5. Understand port to port isolation
D	Explain the core optical cable principles; care, cleaning, verification, attenuation and management	1. Optical fiber
		a. Composition
		b. Characteristics
		i Attenuation
		ii Wavelength
		c. Benefits
		d. Applications
		e. Safety
		6. Describe optical fiber attenuation properties
		7. Given device inputs/outputs, attenuation, and insertion losses, be able to calculate optical fiber loss budget and expected levels
E	State the process to troubleshoot to the first active device in an HFC network	1. Explain the steps in the troubleshooting process:
		a. Symptom analysis
		i Verify problem symptoms with customer
		b. Problem isolation
		c. Divide and conquer
		d. Problem resolution/repair
		e. Confirm problem resolution/repair

	2.	Diagnose equipment problems:
		a. Identify signal issues
		b. Interpret premises signal level readings (too high or low)
	3.	Set-top terminals/set-top box (STB)
		a. Self diagnostics
		i Power on self-diagnostics
	4.	Describe the process to troubleshoot forward and return path
		a. Unity gain
		i Amplifier output levels
		ii Tap output levels
		iii Cable loss
		iv Insertion loss
		b. Identify common causes of group delay
		c. MER
		d. BER
		e. Describe the effects of the following:
		i Bad splitters
		ii Poor cabling
		iii Bad amplifiers
		iv Long amplifier cascades
		f. Frequency response
		i Peak-to-valley (flatness)
		g. Define outage
F Review the DOCSIS 1.1/2.0+IPv6, 3.0 specifications from an RF level	1.	DOCSIS definition/CableLabs
	2.	DOCSIS versions and key differences
	3.	Modulation techniques
		a. QPSK, 16-QAM, 64-QAM, 256-QAM
		b. SNR and RF level requirements
		c. Bandwidth supported
	4.	IPv6 support with DOCSIS 2.0/DOCSIS 3.0
	5.	Basic cable modem troubleshooting
	6.	Load balancing of cable modems
	7.	DOCSIS 3.0 channel bonding

		8. DOCSIS spectrum requirements
G	Analyze RF and optical signals to determine network health	1. Signal Level Meter (SLM)
		2. Display readouts of an analog channel features
		a. Full scan
		b. Adjacent channel level
		3. Identify the following digital display features:
		a. QAM Analyzer
		i Noise analysis
		ii Phase analysis
		iii CW interference/ingress
		iv Reflections/microreflections
		(a) Modulation Error Rate (MER)
		(b) Bit Error Ratio (BER)
		(c) Constellation analysis
		(d) DOCSIS stats
		(e) Protocol Analyzer
		4. Return test
		a. Signal generator (for example, DSAM, RSVP)
		b. Birth/service certificate
		5. Video and audio carrier measurements
		6. Maintenance
		a. Charging
		b. Known source- accuracy verification
		c. Channel plans
		7. RF Operating Parameters
		a. Definition
		b. Provide examples for
		i Downstream
		ii Upstream
		8. Optical testing
		a. Optical verification

II.   Ethernet Services

Competency	Knowledge, Skills, and Abilities
A Ethernet Overview: state the fundamentals of a network	1. Understand and be able to define a modern data "network"
	a. Purpose of networks-sharing resources, files and hardware
	b. Workgroups
	c. Client/Server
	d. Peer to Peer
	e. Define IEEE 802.2 standards
	f. Define IEEE 802.3 standards
	i CSMA/CD and CSMA/CA
B Describe fundamental Ethernet services	1. Define LANs, WANs, MANs and CANs
	a. Define Local Area Network (LAN) and its signaling methods
	i Baseband
	ii Full Duplex
	iii Half Duplex
	iv Simplex
	b. Define Metropolitan Area Network (MAN) and its signaling methods
	i DWDM
	ii CWDM
	c. Define Wide Area Network (WAN) and its signaling methods
	i ATM
	ii Frame Relay
	iii FDDI
	d. Define Campus Area Network (CAN)
	2. Identify and describe the different hardware needed for each network type.
	a. Hubs, Switches, Routers, Bridges and Repeaters
	b. T1(CSU/DSU), ISDNs(Terminal Adaptors), DSL Modems and Cable modems
	c. Transceivers - Media converters
	d. Brief introduction to MEF
	e. Bandwidth specifications

		i	10base 2-10Gbase
	f.	Network cable types	
		i	Coax
		ii	UTP cable
			(a) CAT3-6
		iii	Fiber
			(a) Multimode
			(b) Singlemode
	g.	Identify the TIA and their standards (568A and 568B)	
3.	Contrast various network topologies: Bus, Ring, Star, Mesh, Point to Point, Point to Multipoint and Hybrid		
	a.	Understand benefits of each topology	
	b.	Understand cons of each topology	
	c.	Define network backbones	
	d.	Define network segments	
4.	Explain various network devices		
	b.	Network adaptor	
		i	Various speeds 10/100/1000
	c.	Repeaters	
		i	Distance limitations for UTP cables is a star topology
	d.	Hubs	
		i	Multiport repeater and extends the distance of UTP cable
	e.	Bridges	
		i	Breakup collision domains
	f.	Basic switches	
		i	Multiport bridges-all ports are individual collision domains
	g.	Managed or multi-layer switches	
		i	Port trunking, VLANs and packet tagging
	h.	Routers	
		i	Understand various capabilities of routers
	e.	Understand how each of the network devices function and how they are applied in the network	

		i	Understand performance capabilities of each device
		ii	Understand connection methods used by each device
C Explore the bottom layers of a network	1. Explain the OSI and TCP/IP network models		
	a. Identify who created the OSI model and when		
	b. Where the TCP/IP model came from		
	c. Explain the reasons for a layered approach		
	d. Understand the 7 Layers of the OSI and the 4 Layers of the DoD models		
	2. Explain how encapsulation works		
	a. Identify how each layer encapsulates the data i.e. datagram at layer 4 and packet at layer 3 and frame at layer 2		
	3. Define various components of an Ethernet frame		
	a. Understand the various parts of the frame and their function:		
		i	Preamble
		ii	Start frame delimiter
		iii	Ethernet header - MAC address of sender and receiver
		iv	Payload
		v	Cyclic Redundancy Check (CRC)
	4. Discuss the OSI physical, data link and network layers		
	a. Define how the layers apply to the network topologies		
		i	Physical layer defines the cabling used and determines signaling method used
			(a) Hubs and Repeater operate at this layer
		ii	Data Link Layer defines interface used and Ethernet Addressing
			(a) Switches and Bridges operate at this layer
		iii	Network Layer deals with Logical addressing and Routing packets
			(a) Routers operate at this layer
	5. Layer 1 collisions		
D Explore the top layers of a network	1. Explain in detail how TCP/UDP operates		
	a. Define what layer of the OSI and TCP model that TCP and UDP operate at		

	b. Explain that TCP is connection oriented and is considered to be a reliable protocol
	i Breakdown the TCP datagram
	c. Explain windowing, flow control, handshaking acknowledgement, sequencing
	d. UDP is connectionless but provides performance benefits over TCP
	i No handshake required
	2. Explain the major functions of ICMP
	a. Understand ICMP is used for troubleshooting and managing a IP network
	i Most notably used with the ping and Traceroute commands.
	3. Identify the major role of the session layer
	a. Understand that this layer is responsible for starting, stopping, and maintaining communication sessions
	i HTTP, DNS, FTP, SNMP, Telnet, NTP and others
	4. Recognize typical uses for the presentation and application layers
	a. Understand that data translation, code conversion, encryption, and compression happen at the presentation layer
	i SSL, GIF, JPEG, MME, TLS, MD5 and others
E Overview of the Metro Ethernet Forum (MEF)	1. Identify what is the Metro Ethernet Forum (MEF) and why it exists
	a. Understand what the MEF does
	b. Describe the key standards the MEF controls
	2. Explain the key MEF interfaces
	a. Understand UNI Type 1 & 2 Interfaces
	b. Understand which services and utilities are available at the application layer
	3. Define the three major MEF service types
	a. Describe E-LINE service
	b. Describe E-LAN service
	c. Describe E-TREE service
	4. Compare the "leaky bucket" analogy to service profiles

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III.   Networking

Competency	Knowledge, Skills, and Abilities
A Explain the use of IP/IPv6 addressing	1. Segment identification
	2. IP Address format
	a. Octets
	b. Maximum possible addresses
	c. Static vs. DHCP
	3. Addressing plans
	4. DHCP address assignments (request offer and acknowledgement)
	5. IP Services
	6. Private address ranges
	7. Automatic Private IP Address (APIPA)
	a. Error detection
	8. IPv4 address classes
	a. Class A
	b. Class B
	c. Class C
	d. Class D
	e. Class E
	9. IPv6
	a. Address structure
	b. Connectivity
	c. Address format
	d. Zero compression
	e. Prefix
	f. IPv4 vs. Ipv6
	g. Binary Format
B Describe the use of subnetting and variable length subnet masks in cable network	1. Subnetting a Class C
	2. Subnetting a Class B
	3. Decimal Positional weighting
	4. Base-2 chart
	5. Reading a Binary Chart

		a.	Converting decimal to binary
		b.	Converting binary to decimal
	6. Heirarchical addressing		
	7. VLSM		
		a.	Calculating VLSM
	8. Supernetting		
	9. Casting		
		a.	Unicasting
		b.	Broadcasting
		c.	Multicasting
		d.	Anycasting
		e.	Address casting
	10. Private Networks		
C	Demonstrate the common utilities and related tools used to troubleshooting IP/IPv6	1. IP Tools	
		a.	tracert
		b.	Traceroute
		c.	ping
		d.	Ping plotters
		e.	whois
		f.	NS Lookup
		g.	Speed test
		h.	Pathping
		i.	DOS Commands
		j.	Netstat
		k.	ARP command
		2. Troubleshooting	
		a.	RF
		b.	Filter Problems
		c.	Networking
		d.	Verify DHCP operation
		e.	WAN IPs
		f.	Wi-Fi
		3. Demonstrate the use of name server lookup to troubleshoot name resolving	

D IP Management	1. The Network Operations Center (NOC)
	a. Understand the NOC's role
	2. Network Management System
	a. Simple Network Management Protocol (SNMP)
	i Understand the operation of SNMP
	ii Understand how SNMP is used to manage IP devices
	3. Management Information Base (MIB)
	a. Understand the structure of MIB data used in conjunction with SNMP
	4. Syslog Servers
E IP Protocols	1. Integrating customer network equipment with business product offerings
	2. Identify the types of tunnels used to transport cable data to the customer
	a. GRE
	b. MPLS
	c. IP
	3. Virtual Private Networks (VPNs)
	a. Differentiate the type of VPNs used to deliver business services
	b. L2TPv3 (Tunneling)
	c. PPTP (Point-to-Point Tunneling Protocol)
	d. IPsec
	4. Understand how hierarchical virtual private LAN (H-VLAN) service allows cable operators to deploy carrier class Ethernet services
	5. IP dynamic routing protocol
	a. Understand its role
	b. Features
F Quality of Service (QoS) and Class of Service (COS)	1. QoS and CoS
	a. Features
	b. Voice
	c. IP Voice
	d. IP Data
	e. Bandwidth
	2. VoIP Signaling Protocols

	3. IP Multimedia Subsystems
	4. Differentiate the features of SIP, RTP, RTSP, CoS and QoS
	5. DSCP

IV. Customer Service

Competency	Knowledge, Skills, and Abilities
A Identify the components of customer service	1. Define the term "soft skills"
	2. Contrast the difference between technical & soft skills
	3. Recognize key soft skills
	4. Describe the effects of great, average, and poor customer services (customer service triangle)
	5. Identify the ten rules for great customer service:
	a. Commit to quality service
	b. Know your products
	c. Know your customers
	d. Treat people with courtesy and respect
	e. Never argue with a customer
	f. Don't leave customers hanging
	g. Always do what you promise
	h. Assume customers are telling the truth
	i. Focus on making customers rather than sales
	j. Make it easy for the customer
B Understand the components that affect company image	1. Explain how attitude, appearance, conduct, and performance, on and off the job, play a role in projecting a professional and company image.
	a. Describe how a company image is formed
	b. Describe how your job performance effects your company's image
	c. Describe professional appearance, and how it contributes to company image
	d. Describe proper vehicle appearance, and how it contributes to company image
	e. Describe proper vehicle driving and parking, and how it contributes to company image
	2. Describe proper treatment of customer property
	3. Describe the steps to take for accidents involving customer property
	4. Describe what is meant by "doing the job right the first time"
C Identify the elements of communication and explain	1. Listening
	a. Describe why listening skills are important

		b. Name examples of good listening skills
how effective communications skills contribute to good customer interactions		2. Clarity of speech
		3. Empathy
		4. Probing
		5. Telephone etiquette
		a. Listening
		b. Voice inflections
		c. Background noise
		d. Ending a call
		i After-hours calls
		6. Explain the steps to take to effectively communicate with difficult customers
		7. Describe why the generational gaps between the technician and customer could create potential communication problems
		8. Why do we need to be sensitive to different personality types?
D	Identify the steps to self-management on the job	1. Explain how to use positive self-talk for maintaining a positive attitude and becoming self-motivated.
		a. Using the Self-Management Model
		b. Identify methods for managing stress on the job
		c. Don't Take It Personally
		2. Identify methods for managing time on the job
		3. Define the business class services professional's responsibilities, and taking accountability for one's actions
E	Explain how to establish partnerships with internal and external customers—using three stages—creating the partnership, leading the partnership, and creating opportunities.	1. Partnering with the customer
		a. Partnering Stage 1–Creating the Partnership
		i Building rapport communication skills
		ii Clarity
		iii Empathy
		iv Accuracy
		b. Stage 2–Leading the Partnership
		c. Stage 3–Creating Opportunities
		2. Explain the distinction between wants and needs and how to arrive at customer needs.
		3. Promoting Customer Retention

		4. Explain how to develop strong relationships with internal customers or "links" within your organization supports good external customer service.
		5. Describe interactions:
		a. Between the "front office" and "back office"
		b. With other broadband premises professionals
		c. With the general public and non-customers
F	Outline the steps for explaining the service to the customer.	1. Define what it means to provide a premium level of service
		2. Define a service level agreement (SLA) and how this impacts the service provided
		3. Understand internal processes involved in preparing for a business class services installation (for example, time to complete pole permits, etc.)
		4. Describe customer expectations and doing whatever it takes to accomplish the task
		a. Be aware of the customer's level of understanding of the business
		b. Understand a sense of urgency regarding installing and restoring business class services
		5. Product knowledge-name the levels of business services products and describe how to address unique circumstances for level of service for each
		a. Government
		b. Healthcare
		c. Education
		d. Private sector
		6. Define what it means to provide a premium level of service
G	Outline the steps for handling challenging customer	1. Define conflict resolution
		2. Define problem resolution
		3. Explain the process to authorize customer compensations
		4. Describe how to handle challenging situations
		5. Describe the steps you can take to help ensure your personal safety on the job
H	Explain the steps for executing successful communications, presentations, and facilitations with customers and co-workers	1. Define adult learning principles, and how adults learn differently from each other
		a. Learning styles
		b. Differences in learning preferences between the generations in the workforce
		c. Influencing behavior change

	2. Explain considerations for successful presentations, facilitation, and training
	a. Presentation
	b. Facilitation
	c. Training
	i. List the steps in teaching a "craft skill"
	ii. Recognize difficulties in comprehension
	iii. Explain how to present technical information to non-technical people (for example, presenting a product Power Point presentation)
	3. Explain how to compose a business e-mail
	4. Explain how to dress for success
	5. Explain the steps to conducting a successful business meeting

V. Performance Verification

Competency	Knowledge, Skills, and Abilities
A Performance verification overview	1. Circuit life cycle
	a. Define the average circuit life cycle
	i Customer places order
	ii Circuit Provisioned
	iii SLAs and circuit performance verified
	iv Fault management
	v Network monitoring and management
	vi Circuit retirement
	2. Service Level Agreements (SLAs)
	a. Define Service Level Agreements
	i Explain contract negotiated between two parties, where one is the customer and the other is the service provider
	ii Includes mean time before failure (MTBF) and mean time to recovery (MTTR) thresholds
	iii Remedies (rebates) paid to customer by the service provider when SLAs are not met
	b. Identify key components of SLAs
	i Committed Information Rate (CIR)
	ii Committed Burst Size (CBS)
	iii Excess Information Rate (EIR)
	iv Excess Burst Size (EBS)
	v Round Trip Frame Delay (RTFD) aka Latency
	vi Frame Delay Variation (FDV) aka Jitter
	vii Frame Loss Ratio (FLR)
	viii Availability
	c. Common SLAs for different types of services
	i VoIP Services
	(a) Low RTFD
	(b) Low FDV
	(c) High Availability

			(d) Low CIR/CBS
		ii	IPTV Services
			(a) Low FDV
			(b) High Availability
			(c) Med-High CIR/CBS
		iii	HSIA Services
			(a) Low CIR, low/no CBS
			(b) Low EIR/EBS
			(c) No RTFD threshold
			(d) No FDV threshold
		iv	Ethernet Services
			(a) MTTR
			(b) FD/FDV
			(c) Loss
			(d) Throughput (CIR/EIR)
	3.	Performance Thresholds	
		a.	Describe MEF 23.1 performance thresholds
		i	Simplifies buying and selling of wholesale services
		ii	Specifies a 3 CoS Model and allows for subsets and extensions
			(a) H-VoIP and Backhaul Control
			(b) M-Near-Real-Time or Critical Data Apps
			(c) "L-standard " "best effort" services
		iii	Goal: Carrier Ethernet services that are interoperable and predictable to support subscriber applications
B Describe verification tests	1.	Compare performance verification tests	
	2.	ICMP ping & traceroute	
		a.	Understand limitations of ping for network performance verification
		i	Designed for fault isolation, not performance verification
		ii	Does not test throughput or SLAs
		iii	May be blocked by firewalls and routers (DDoS protection)
	3.	Bit Error Rate Test (BERT)	

	a. Explain the theory of how BERT works
	i Out of service test
	ii Simulates live network traffic
	iii Must use a test pattern
	iv Bit for bit comparison is made between the transmitted and received data
	b. Explain limitations of BERT to identify network performance issues
	i Identifies that a bit was corrupted but does not find where or why
	c. Define the term psuedo-random bit pattern
	i Long patterns without an easily identifiable repeating bit sequence
	ii Knowledge of how pattern written: as a binary exponent 2Exx
	(a) Exponent identifies how many bits are used to create the bit sequence
	(b) Pattern starts at binary 1 and continues up until maximum of exponent is reached
	(c) Pattern repeats
	(d) Simulates live data but allows test meter to know what the next binary sequence in the pattern should be
	d. Define the term fixed bit pattern
	i Easily identifiable repeating bit sequences
	ii Ratio indicates how many ones there are versus the number of zeros (1:1, 1:2, etc.)
	e. Understand common DS1/Ethernet BERT patterns
	i All 0's pattern
	(a) Used when testing T1 B8ZS circuits to find misoptioned line coding
	ii All 1's patterns
	(a) Used to stress T1 repeater output power
	iii 2.00E+23
	(a) Pseudo random pattern commonly used for testing Ethernet circuits
	iv 2.00E+31
	(a) Pseudo random pattern commonly used for testing Ethernet circuits
	v DALY 55

	(a) Fixed 55 octet pattern, best test for video over DS1 links
	vi 3 in 24 (fixed)
	(a) Stresses timing recovery
	4. RFC2544
	a. Explain the four standard tests performed
	i Throughput
	ii Frame Loss
	iii Latency
	iv Back-to-Back
	b. Explain the fifth test not defined on the original RFC
	i Frame/Packet Delay Variation (JItter)
	c. Explain key RFC-2544 limitations
	i Benchmarking methodology
	ii Defines standardized tests and reporting mechanisms (tables and charts)
	iii Intended for device manufacturers and customers to validate performance claims
	iv Not intended for network testing but became de facto standard for testing network circuits
	v Does not address SLA specific items such as multiple flows, CBS, EBS Color Mode or Availability
	5. Y.1564
	a. Explain history of Y.1564
	i Formerly known as Y.156sam, achieved formal consent in the ITU SG 12
	b. Describe main benefit of Y.1564 to service providers and customers
	i Verification methodology for end users or service providers to ensure SLA's are being met
	c. Describe test methodology
	i Obtain a copy of your companies Service Level Agreement (SLA) for each service you will be testing
	ii Create Band Width Profiles (BWP) for each service offering
	iii Define Service Acceptance Criteria (SAC) for each SLA

		iv	Configure Traffic Shape test parameters
		v	Create a Service Table that matches SLA under test
		vi	Perform Y.1564 test
		vii	Create performance verification "birth certificate"
	6. Y.1731		
		a. Describe benefits of Y.1731 to service providers	
		i	Provides in-band performance verification testing
		b. Describe performance measurements	
		i	Frame Delay (1 way/2 way)
			(a) DMM, DMR
		ii	For one-way, cover clock synchronization
			(a) 1DM
		iii	Frame Delay Variation
			(a) DMM, DMR
		iv	Frame Loss Ratio
			(a) LMM/LMR
		v	Availability
		c. Define MEP/MIP/MEG	
		d. identify MEG levels	
C Performance Issues	1. Identify circuit performance issues		
		a. Frame Delay (Latency)	
		i	VoIP latency <150ms is generally desirable, >300 ms echoes and other impairments occur
		b. Frame Delay Variation (FDV)	
		i	High FDV requires use or larger VoIP/IPTV jitter buffers, which increase latency and channel change (zap) time
		c. Frame Loss	
		i	High frame loss results in TCP/IP retransmits that result in lower effective data rate
		ii	High frame loss results in macroblocking, pixelation and freezing in IPTV
		iii	High frame loss results in dropped calls or popping sounds

	d.	Availability
	i	Frame loss above SLA thresholds result in circuit unavailability which in turn results in customer rebates
	e.	Throughput issues
	i	Data rate vs. Information Rate vs. Line Rate misunderstandings
	f.	MTU issues with large packets
	i	Packets with large MTUs must be split up if passed to router that will not support large MTUs
	g.	Small packet overhead for encapsulated traffic
	i	Reduces effective throughput
	h.	Asymmetric Routing
	i	Firewalls may block incoming packets with invalid port numbers
	i.	Policy Configuration Errors
	i	Network equipment profiles monitor and limit to SLA
	ii	New service offerings may be configured improperly
	iii	If traffic policing policies are configured wrong the customer receives less bandwidth than they are paying for
	iv	Customer may get more than they are paying
	v	If multiple customers are configured wrong, trunk may be oversubscribed and prone to congestion or dropped traffic

VI. Fault Management

Competency	Knowledge, Skills, and Abilities
A Understand fault isolation methodology fundamentals	1. Circuit life cycle
	a. Define the average circuit life cycle
B Explain top-down vs. bottom-up fault isolation techniques	1. Understand three methods of fault isolation
	a. Top down
	b. Divide and conquer
	c. Bottom up
	2. Customer communication
C Understands Fault Management Tools: Describe various isolation tools such as ICMP ping, Traceroute, Print Route and Packet Capture	1. Internet Control Messaging Protocol (ICMP)
	d. Explain ICMP operation
	2. ICMP usage and applications
	a. Packet INternet Groper (ping)
	i Describe operation
	ii Understand limitations of ping for fault isolation
	b. ICMP traceroute
	i Describe operation
	ii Understand limitations of traceroute for fault isolation
	3. Print & Print Route
	a. Describe operation
	b. Explain why Print & Print Route is helpful
	i Helps troubleshoot network problems
	c. Understand how to invoke via CLI
	i Windows
	ii Linux
	4. Packet Capture
	a. Describe benefits
	b. Name common packet capture software
D Understands Fault Management Protocols	1. Simple Network Management Protocol (SNMP)
	a. Describe operation
	b. Describe SNMP advantages
	c. Understand SNMP Versions

		d.	Describe SNMP Components
		e.	Describe SNMP Push vs. Pull theory
		f.	Understand the three different types of nodes:
		g.	Define SNMP Communities
		h.	Understand SNMP Traps
			i Performance degradation over thresholds
	2.	Syslog	
		a.	Describe operation
	3.	Explain major differences between the SNMP and Syslog protocols	
E Understand the 802.3ag/ah, MEF-16 E-LMI protocols	1.	Operations Administration and Management (OAM)	
		a.	Define OAM
		b.	Explain need for OAM Protocols
		c.	Name the OAM layer components
	2.	IEEE 802.1ag Protocol	
		a.	Define IEEE 802.1ag
		b.	Define connectivity fault management (CFM)
	3.	IEEE 802.3ah Protocol	
		a.	Define IEEE 802.3ah
	4.	MEF-16 E-LMI	
		a.	Define MEF-16 E-LMI
F Explain the multi-domain network model; define MEs, MEGs and MIPs	1.	Multi-Domain Network Model	
		a.	Define MDNM
	2.	Understand ME, MEG, MEP and MIP roles	
		a.	Recognize connectivity message types
	3.	List fault management functions	
G Understand and be prepared to use Y.1731 protocol tools	1.	Define ITU-T Y.1731	
	2.	Describe the operation of the following:	
		a.	Connectivity Check Message (CCM)
		b.	Alarm Indication Signal (AIS)
		c.	Remote Defect Indication (RDI)
		d.	Ethernet Link Trace (ELT)
		e.	Loopback (LBK)
		f.	Lock (LCK)

	g. Test (TST)
	h. Frame Loss Measurement (FLR)

VII. Enterprise Voice

Competency	Knowledge, Skills, and Abilities
A Understand PBX systems	1. Understand PBX systems
	a. Describe basic PBX components
	b. Identify KTS, PBX, Hybrid and IP-PBX telephone systems
	c. Recognize basic PBX system components
B Understand Structured Wiring	1. Recognize different cable types
	a. Twisted pair, coaxial, and optical
	b. Associated standards, for example, TIA/EIA CAT5e, or higher
	2. Explain structured cabling concepts
	3. Practice proper RJ-45 jack and plug termination
	4. Practice proper 66 and 110 block termination
C Describe Time Division Multiplexing (TDM) principles	1. Explain analog signal limitations
	2. Define digital pulse code modulation
	3. Understand how time division multiplexing works
D Explore Integrated Services Digital Network (ISDN) Primary Rate Interface	1. Define the acronym ISDN
	2. Recognize how ISDN differs from conventional POTS lines
	3. Identify different interface types of ISDN
	4. Discuss various ISDN channels
	5. Define ISDN equipment types
	6. Explain ISDN call setup and tear down messages
E Explain the SONet Technology	1. Define SONET
	2. Explain advantages of SONET
	3. Differentiate synchronous, asynchronous and plesiochronous signals
	4. Diagram SONET multiplexing hierarchy
	5. Discuss different SONET network topologies
F Describe TDM Circuit Emulation	1. Explain TDM Circuit Emulation
	2. Define the term Pseudo Wire and how it works
	3. Discuss TDM over IP and DOCSIS
	4. Diagram the various architectures of BSoD
G Discuss and describe Voice	1. Define the term "trunk"

Trunking	2. Discuss why trunks are used
	3. Contrast trunking physical attributes to the local loop
	4. Explain the three main types of trunks
	5. Compare PSTN to SIP trunking
H PacketCable	1. 1.0/1.5
	2. PCMM
	3. 2.0
	4. Devices
	a. EMTA
	b. CMS
	c. MGC
	d. EDVA
	e. IMS Core
	f. CSCF (P-, S-, I-)
	g. Enterprise SIP gateway (ESG)
	5. Enterprise features
	a. Multiple call appearances
	b. Shared call appearances
	c. Hunt groups (how apply)
	d. Call park
	e. Paging
	f. Billing codes
	g. Remote office
	h. Fixed mobile convergence
I Codec	1. Define codec
J Voice over IP Protocol (VoIP)	1. Define VoIP
	2. Define Session Initiation Protocol (SIP)

VIII. Managed Services

Competency	Knowledge, Skills, and Abilities	
A. Managed Services Overview	1. List the requirements of successful managed services	
		a. No single point of failure
		b. Reliable uptime and performance
		c. Predictable user experience
		d. Clear communication to what the customer will receive
		e. Outline of customer service accessibility in the event of issues
		f. Service monitoring by dedicated NOC staff
		g. Billing to service integration is clearly defined
B. Explain how to set up, maintain, and troubleshoot e-mail services	2. SMTP Server	
	1. Data Storage	
		h. End user mailbox storage
		a. Redundant
		b. Server or HTTP based
		c. End users in the storage group consuming space
		d. Allocating space per user
	2. DNS Records	
		a. Mail is routed using DNS entries
		b. MX Records
		c. Lower number more efficient
		d. Two servers
		e. A or AAAA used for host name resolution
	3. SPAM Filter	
		a. Spam filters set as the primary points of delivery
		b. Definitions updated every four hours or less
		c. Determine customer expectations regarding SPAM
	4. e-MAIL Operations	
		a. Perform SMTP queue reviews
		b. Availability Disk Space is not < 10%

	c. End user access to quarantine may accidentally release SPAM
	d. Purge queued SPAM every 7 days
	5. e-MAIL Troubleshooting
	a. Routing of email protocols
	b. Secure Access Control
	c. Size Limits, 10MB is common
	d. Connectivity
C. Explain how to set up, maintain, and troubleshoot web services	1. Define Managed Web Services
	a. Website used for marketing and information sharing
	b. Acknowledgment is required between hosting provider and customer
	c. Employ staff trained in web servers
	2. Managed Web Services Components
	a. Server
	b. Security
	c. Bandwidth
	d. Backup
	3. Managed Web Services Troubleshooting
	a. Access
	b. Application performance
	c. Scaling bandwidth proportionally with demands
	d. Access services from another network
D. Recognize the proper set up to troubleshoot and maintain content filtering	1. Define Managed Content Filtering
	a. Protection of web browsing and preventing of inappropriate content
	b. openDNS.com enables content filtering
	c. Careful selection of content appliance
E. Explain how to set up, maintain, and troubleshoot virus and firewall systems	1. Describe Managed Virus and Firewall Systems
F. Explain how to set up, maintain, and troubleshoot video conference systems	1. List Managed Video Conference Systems considerations
	a. Intra-company vs. inter-company?
	b. Multiple person conference vs. one to one calls?
	c. Recording of call requirement?

	d. Voice only support on the multi way video?
	e. Can your existing broadband support the additional heavy load due to video?
	f. SD vs. HD requirements?
	g. Is my own network ready for video? QoS?
	h. Is presence indication required?
	2. Describe Managed Video Conference Systems
	a. Number of cameras
	b. Enabling users
	c. Cost
	d. Operator assistance/monitoring
	e. Problem resolution time period
	f. Implementing users and camera/end points
	g. Network upgrades
G. Managed Internet Services	1. Describe the following
	a. Symmetrical Internet
	b. Asymmetrical Internet
	c. Hosted
	i DNS
	ii RDNS
	d. Border Gateway Protocol (BGP) services
	e. Cost considerations
	f. Peering with multiple ISPs
H. Managed Hospitality Services	1. Hospitality video solutions/delivery
	a. Equipment
	b. Services
	2. Hospitality Internet solutions/delivery
	a. Equipment
	b. Services
	3. SIP trunks as a hospitality solution
	4. Cost considerations