SMART TECHNOLOGY SYSTEMS – STS

ETA Computer Networking Endorsement to the STS

Competency Requirements

There are **two** levels of expertise for those who install and integrate smart electronics technology into structural systems which are residential and light commercial properties. **STS** installation technicians are responsible for interconnecting electronics communications, data, computer, control or entertainment equipment and converging signals into one faultless system. The two levels for those installation technicians are the **Basic STS**, Basic Smart Technology Systems and the **Master STS**, Smart Technology Systems Master (STSma).

The **BASIC STS** installation technician is proficient in the design of pre-wiring and wireless architectures in residential/light commercial for entertainment, internet of things, and telecommunications equipment interconnections. This will include installation of network wiring for TV, satellite and antenna outlets, voice equipment outlets, audio and video, media streaming, and computer equipment in such a manner that all control and communication signals can be integrated at the home or business system controller and converged into one cogent local network bit stream, to either be used within the system or to be passed back and forth through the system gateway. He/she will be proficient in the many protocols used over diverse media to communicate with and control an array of electronics systems, in addition to the skills required for low voltage wiring installation. Prior CAT, DCI, DVE, FOI, FOT, FOT-OSP, TTT certification is highly recommended to be proficient in STS skills. The Basic STS installation technician will work from telecommunications wireless and wiring plans, installing cable fittings and selecting the specified cabling for each technology and identifying wireless equipment requirements. He/she will test, mark and document all cabling and will have the ability to troubleshoot and restore pre-existing cabling and wireless systems. A Basic STS installation technician typically will also be qualified in one or more of four (4) endorsement specialty areas listed below.

The **MASTER STS** (STSma) will be proficient in **all** of the core STS skills and knowledge including planning and designing the layout for electronics and communications equipment systems for new construction and retro-fit/remodeling. The MASTER STS is capable of designing the entire system and network for audio, video, data and control of security and environment to function in one local network bit stream converged at the system controller. He/she is also capable of troubleshooting, debugging and optimizing the system of planned installations or modifications. The MASTER STS has extensive knowledge of the operation and technology and is proficient in each of the basic and four endorsements of STS electronics.

STS CERTIFICATION PROGRAM overview:

- **Basic STS:**

The Basic **STS** installation technician can become certified with ETA® International by passing the knowledge examination assessments, based on the following **STS BASIC Skills & Knowledge Competency**.

In addition, **STS** certification holders can also acquire one or more of the four (4) endorsement certifications, as listed below:

1. **Audio-Video**
2. **Computer Networking**
3. **Environmental Controls**
4. **Security-Surveillance**

- **MASTER STS:**

The **MASTER STS** certification prerequisites include successfully completing the Basic STS certification requirements, plus earning **each** of the four (4) STS endorsements.
To qualify for the ETA **MASTER STS**, Smart Technology Systems Master, a technician must:

- Hold the STS Basic certification
- Hold each of the four (4) specialty endorsements
- Pass the separate Master STS examination

ETA STS Computer Networking Endorsement (STS-CN)

Skills and Knowledge Competencies

Refer to the **BASIC STS** Competencies as the foundation for these C.N. endorsement competencies. Some of the content may be familiar in the other STS endorsements also.

1.0 Signals

- 1.1 Telephone signaling (see STS-Basic Comp.7.1 & 7.2)
  - 1.1.1 Describe the characteristics of analog, digital & VoIP telephone systems
    - 1.1.1.1 POTS – Plain Old Telephone Service
    - 1.1.1.2 Digital – Cordless phones
    - 1.1.1.3 VoIP – Voice over Internet Protocol
  - 1.1.2 Identify basic features of telephone wiring systems
  - 1.1.3 Describe various dialing properties
    - 1.1.3.1 ISDN (Integrated Services Digital Network)
    - 1.1.3.2 DSL (digital subscriber line) (STS A-V 12.3.1)
- 1.2 Audio/ Video signals (see STS-Basic Comp.3.5 and STS A-V)
  - 1.2.1 Explain Sampling Rates
    - 1.2.1.1 Explain digital audio MP3 and MP4
  - 1.2.2 Discuss analog signal conversion to digital signal
    - 1.2.2.1 Discuss digital conversion to analog
  - 1.2.3 Explain audio-video file movement
    - 1.2.3.1 Codecs (encode/decode)
    - 1.2.3.2 MPEG formats (Moving Picture Experts Group)
    - 1.2.3.3 Buffering
  - 1.2.4 Describe the various types of digital video available on the internet, it's features & limitations of each
    - 1.2.4.1 Explain how YouTube™ and other streaming videos (services) work
    - 1.2.4.2 Identify two-way video processes and how they work
      - 1.2.4.2.1 FaceTime®
      - 1.2.4.2.2 Skype®
      - 1.2.4.2.3 Echo Show®
      - 1.2.4.2.4 nucleusLife®
      - 1.2.4.2.5 Go To Meeting®
  - 1.2.5 Explain HDAV - High Definition Audio Video and the different signal types
    - 1.2.5.1 RGB (red, green, blue) component video
      - 1.2.5.1.1 Describe RGB & H/V (horizontal/vertical) signal methods
    - 1.2.5.2 VGA (video graphics array)
    - 1.2.5.3 HDMI™ (High-Definition Multimedia Interface)
      - 1.2.5.3.1 Identify UHDTV 4K and 10K signals
- 1.3 Data Signals
  - 1.3.1 Explain how data is converted into electrical signals
  - 1.3.2 Explain serial & parallel data transfer
  - 1.3.3 Explain how modems negotiate a connection
  - 1.3.4 Differentiate between Bit Rate & Baud
  - 1.3.5 Identify how Li-Fi (Light Fidelity) can turn LED (light emitting diode) lamps into internet and broadcast data transmitters
    - 1.3.5.1 Explain types of optical wireless communications
    - 1.3.5.2 Visible light communications
    - 1.3.5.3 IR (Infrared) light communications
      - 1.3.5.3.1 Explain IrDA (Infrared Data Association) requirements

2.0 Hardware Basics

- 2.1 Computer system connectors-plugs
  - 2.1.1 Identify how the following are used:
    - 2.1.1.1 RJ-45 (registered jack) connector
    - 2.1.1.2 twisted-pair wires
    - 2.1.1.3 BNC (Bayonet Neill-Concelman) connector
    - 2.1.1.4 AUI (Attachment Unit Interface) 15-pin D-shaped connector

 © Copyright 2021, ETA® International, All Rights Reserved

2.1.1.5 UTP (unshielded twisted pair)
2.1.1.6 STP (shielded twisted pair)
2.1.1.7 Cat5e (Category 5e) cable
2.1.1.8 Cat6 (Category 6) & 6_A cable

2.2 Dip Switches
2.2.1 Explain dipswitch configurations & purpose
2.3 Slot Design
2.3.1 Identify computer bus standards
2.3.1.1 PCIe (Peripheral Component Interconnect Express) replacing older PCI
2.3.1.2 USB (universal serial bus)
2.3.2 Explain how an NIC (Network Interface Card) is used
2.4 Peer-to-Peer Configuration (Ad-hoc)
2.4.1 Compare node configurations in Peer-to-Peer design
2.4.2 Identify Star, Ring, Bus & Mesh configurations
2.4.3 Explain token ring networking
2.4.4 Explain packet transfer on the network
2.5 Differentiate between the PnP (Plug and Play) and UPnP (Universal Plug and Play) standards
2.6 X10 communication protocol
2.6.1 Explain X10 & the history behind X10
2.6.2 Identify X10 modules
2.6.3 Explain advantages of X10
2.6.4 Explain disadvantages of X10 over Ethernet
2.7 Servers
2.7.1 Describe how to set up a computer system server
2.8 Routers
2.8.1 Describe routers & placement in the network
2.8.2 Explain proper usage of routers in a network environment
2.8.2.1 Describe a residential gateway
2.9 Hubs
2.9.1 Explain how a network hub works
2.10 Switches
2.10.1 Describe switches & placement in a network environment
2.10.2 Explain proper usage of switches in a network environment
2.11 Bridges (Bridging)
2.11.1 Differentiate between a bridge, a router, a hub & a switch
2.12 Cable/DSL Modems
2.12.1 Describe the operation of cable and DSL modems
2.12.2 Explain PPPoE (Point-to-Point Protocol over Ethernet) and its security risk
2.12.3 Explain PPTP (Point-to-Point Tunneling Protocol)
2.13 Firewalls
2.13.1 Explain firewall technology
2.13.1.1 Describe how to implement firewalls in a network environment
2.13.2 Describe software firewalls
2.13.3 Describe hardware firewalls

3.0 Local Area Networks – LANs

3.1 Networking Basics (see STS-Basic Comp.4.0 et al)
3.1.1 Explain the purpose and features of the RS-232, RS-485, RJ-45 standards
3.1.1.2 Identify RS-232, RS-485 & RJ-45 connectors
3.1.2 Coax cabling
3.1.2.1 Explain Thin-net & Thick-net coax
3.1.2.2 Explain the lengths of transmission for both Thin and Thick- net
3.1.3 Fiber cabling
3.1.3.1 Explain fiber optics cable system technology
3.1.4 10/100/1000 Ethernet LAN
3.1.4.1 Discuss differences and speeds of T10, T100 and T1000 Ethernet
3.1.5 Windows® Based
3.1.5.1 Describe various operating systems for networks and the advantages of Windows®-based software

 © Copyright 2021, ETA® International, All Rights Reserved

- 3.1.6 Busses
  - 3.1.6.1 Explain bus usage purposes and speeds
  - 3.1.6.2 Explain PCI Express advantages
- 3.1.7 G.hn home network standard {ITU-T G.9960} describing PLN (Power-Line Networking) and BPL (broadband over power lines), also known as PLC (power line communication or power-line carrier), PDSL (power-line digital subscriber line), mains communication, and PLT (power-line telecommunications)
  - 3.1.7.1 Discuss PLN & its advantages over Ethernet & Home PNA (HPNA the home phoneline networking alliance)
  - 3.1.7.2 Explain FDM (Frequency Division Multiplexing)
  - 3.1.7.3 Explain why a subnet could be required

3.2 Network Software
- 3.2.1 Directories
  - 3.2.1.1 Described how directories are organized, named and utilized
- 3.2.2 Storage Methods
  - 3.2.2.1 List common storage methods utilized by computer networks
- 3.2.3 Compression Methods
  - 3.2.3.1 Explain compression methods and their usage in transmission and storage
- 3.2.4 Windows Media Center® for Windows 10™
  - 3.2.4.1 Explain WMC® playback and tuner applications & advantages
- 3.2.5 Building Control Software
  - 3.2.5.1 Identify currently available building and home control software.
- 3.2.6 Antivirus
  - 3.2.6.1 Explain how antivirus software is expected to operate
  - 3.2.6.2 Discuss any issues when using antivirus software

3.3 Network Internet
- 3.3.1 Describe the TCP/IP, HTTPS(Hypertext Transfer Protocol Secure) , etc. protocols, where and how they are used in a small business or residential network system
  - 3.3.1.1 Differentiate between TCP (Transmission Control Protocol) and UDP (User Datagram Protocol)
  - 3.3.1.2 Identify ports used for HTTP (Hypertext Transfer Protocol), SMTP (Simple Mail Transfer Protocol) and IMAP (Internet Message Access Protocol)
    - 3.3.1.2.1 Define socket address
    - 3.3.1.2.2 List dynamic (private) ports
- 3.3.2 Internet Basics
  - 3.3.2.1 Summarize the functions of the internet, services available and usages in small business and residential networking systems
  - 3.3.2.2 Explain the network protocol for RADIUS (Remote Authentication Dial-In User Service)
- 3.3.3 Security
  - 3.3.3.1 Explain the basic principles of internet security services, anti-SPAM, antivirus, Spyware, etc.
- 3.3.4 Broadband Services
  - 3.3.4.1 Define & explain usage in small business/residential broadband networking
- 3.3.5 Modems
  - 3.3.5.1 Describe function and basics of modem operation
- 3.3.6 Email addresses
  - 3.3.6.1 Describe the components of e-mail addresses
- 3.3.7 DNS
  - 3.3.7.1 Explain DNS (Domain Name Service) and how it works
    - 3.3.7.1.1 URL **(**Uniform Resource Locator)
    - 3.3.7.1.2 ICANN (Internet Corporation for Assigned Names and Numbers)
  - 3.3.7.2 List the seven domain name qualifiers
    - 3.3.7.2.1 FQDN (fully qualified domain name)
- 3.3.8 IPv4 and IPv6
  - 3.3.8.1 Discuss the implementation of IPv6 and its design
  - 3.3.8.2 Explain the different forms of NAT (Network Address Translation)

3.4 Wireless Network Basics (see STS-Basic Comp.2.3, 3.8 et al)
- 3.4.1 802.11

 © Copyright 2021, ETA® International, All Rights Reserved

- 3.4.1.1 Explain the purpose & basic requirements of the 802.11 series of standards
  - 3.4.1.1.1 Ad-hoc mode
  - 3.4.1.1.2 Infrastructure mode
- 3.4.1.2 Explain CSMA/CA (Carrier Sense Multiple Access with Collision Avoidance)
- 3.4.1.3 Explain WPA (Wireless Protected Access) and WPA2
- 3.4.1.4 Identify how a SSID (Service Set Identifier) is used
- 3.4.1.5 Explain how to use a spectrum analyzer
  - 3.4.1.5.1 Familiarize oneself with RF spectrum frequencies

3.4.2 Bluetooth SIG®, formerly 802.15.1
- 3.4.2.1 Describe devices that can use Bluetooth® technology
- 3.4.2.2 Explain short-range radio transmissions for Bluetooth® technologies
  - 3.4.2.2.1 Identify the range of Bluetooth® classes 1 through 3
- 3.4.2.3 Explain the use of BLE (Bluetooth Low Energy®)
- 3.4.2.4 Define possible interference issues

3.4.3 Z-Wave® and Zigbee
- 3.4.3.1 Describe how smart building technology systems use Z-Wave® and Zigbee radio frequencies to develop mesh networks.
- 3.4.3.2 Explain how to set up a smart hub to control components within a building
- 3.4.3.3 Identify the advantages of mesh networks

3.4.4 Home/small building RF (HomeRF)
- 3.4.4.1 Explain SWAP (Shared Wireless Access Protocol) in transmission of data

3.4.5 802.15.4 wireless
- 3.4.5.1 Explain the purpose & basic requirements of the 802.15.4 series of standards
- 3.4.5.2 Differentiate between LoRaWAN™ technology and Zigbee technology

4.0 Cable TV – Satellite – Off-Air Antenna Signals

- 4.1 Explain how interfacing of the satellite programming signals can be accessed and displayed from a small building theater area
- 4.2 Explain how digital HD (high definition) programs can be picked up over airwaves
  - 4.2.1 Identify the ranges of antennas available to receive HD transmissions
- 4.3 Explain how HD programming can be switched via the computer

5.0 Distribution Systems

- 5.1 Describe the uses and selection of coaxial cables in networking and how they are selected using the computer network
- 5.2 Explain the advantages of plastic optical fiber cabling in small buildings
- 5.3 Describe methods of delivering content over CAT 5e and 6 cabling

6.0 Building Security-Surveillance Networking

- 6.1 Describe interconnection of a buildings network with alarm and security system equipment
- 6.2 Describe the sensors used in security systems for buildings
- 6.3 Explain how keypads are utilized on the network
- 6.4 Explain the need for and methods of implementing access control for selected portions of the building network system
- 6.5 Describe the operation and functions of the system control
- 6.6 Explain how program controllers may be configured

7.0 CCTV (Closed-Circuit TV)

- 7.1 Explain the use of Date/Time generators and discuss how they are integrated into the computer network
- 7.2 Describe alarm interface units and how they are integrated with the computer network
- 7.3 Explain how recorders may be used in the A/V, Environmental Control, CCTV or Security-Surveillance segments of the network system

8.0 Environmental Control Networking

- 8.1 Discuss the usage of the network to control building lighting
  - 8.1.1 Identify the various types of smart units available to control lighting
  - 8.1.2 Explain how Li-Fi works
    - 8.1.2.1 Identify how Li-Fi can be used to augment a building's network

 © Copyright 2021, ETA® International, All Rights Reserved

8.2 Discuss programming of the various subsystems of a building
8.3 Describe how sensors & actuators are integrated into the network
8.4 Explain how the computer and control programs mesh into the network
8.5 Describe methods of interfacing different subsystems of the network
8.6 Explain how HVAC (heating, ventilation, air conditioning) may be interfaced with a building's computer network
8.7 Describe how event recording and storage is accomplished

9.0 Management of Building Installations

9.1 Discuss aspects of inventory of products (hardware and software) in a business performing computer networking installations/servicing
9.2 Discuss finance aspects of developing a building system
9.3 List steps in scheduling the customer/builder approval of plans; acquiring system components; scheduling installation and testing and final completion of system
9.4 Explain how additional modern appliances and machines may be incorporated into the network control & management system

10.0 System Design

10.1 Explain the interaction with builder/customer in defining system needs
10.1.1 Identify required switches to be managed/unmanaged
10.1.2 Identify any building PoE requirements
10.2 Identify how local permitting, local AHJ (authority having jurisdiction), building code, electrical codes and energy code requirements might affect a system design
10.3 Explain how to diagram the planning sequences needed prior and during installation
10.4 List implementation steps of the installation

11.0 Customer Orientation and Documentation

11.1 Explain the importance of seeking customer preferences in the design, functions and timetable for installation of the system
11.2 List potential customer requirements that must be met prior to completion of the installation and final documentation and orientation documentation

End of SMART TECHNOLOGY SYSTEMS Computer Networking Endorsement Competency

Certified Basic Smart Technology Systems Endorsement Advisory Board:

Richard Agard, RESIma, CAT, AST, IND, PVI, FOI	ragard@aol.com
John Baldwin, CETsr,	jbaldwin@hickorytech.net
Clifton Beck	clifton.beck@johnstonesolutions.com
John Bosnack	hoosierwifiguy@gmail.com
Paul Brinkmann, ESNT	pbrinkmann@scvts.net
Chuck Brooks, RESI	chuck@eitprep.com
Doug Carner, AVFA	doug@forensicprotection.com
Joseph Delio, CETma, CETms-RF	jdelio@iwatsi.com
John Dings, CET, RESI, CSM, CSS	dings.john@gmail.com
Marilyn Fernandez, FOI, RESI, WNT, B-VOIP, TCM	marimoan1129@gmail.com
Michael Goshen, CST, NST, ITS	goshen@michaelgoshen.com
J.B. Groves, III, FOT-OSP, FOT, ITS, et al	jbgroves@wcjc.edu
Lawrence Hardman, CST, NCT, WNT, B-VOIP, RESI, FOT	hardmanle@gmail.com
Eric Ingram, M.S., CETsr, FOT	
Ed Kirkpatrick, PVI, CSS	ekirkpatrick@eta-i.org
Rick Pinkava, CST	rick.pinkava@cvcc.k12.oh.us
Charles Poole, CETsr, FOI, RESI, CSM, CSS	poolec@michigan.gov
Randy Reusser, CETsr, RCDD, CSS	
John Rooks, FOI	john.rooks@ieee.org

 © Copyright 2021, ETA® International, All Rights Reserved

Suggested Additional Computer Networking Resource and Study Material:

National Electrical Code®, 2020; National Fire Protection Assn., Sept.,2019; www.nfpa.org
Commercial Low-Voltage Wiring; Brooks, Stroud; ISBN 978-1581220858; Marcraft, ETG Brand; 2012
Cabling: The Complete Guide to Copper and Fiber-Optic Networking, 5E; Oliviero & Woodward; ISBN 978-1118807323; Sybex, Inc.; 2014; softcover; 1284 ppg**.** Available through ETA 800-288-3824, www.eta-i.org
Introduction to Low Voltage Systems, 2E; DiPaola & DiPaola; ISBN 978- 1111639532; Delmar Cengage Learning; 2012; (with Lab Manual, ISBN 978-1111639549)
Residential Wiring and Smart Home Technology; Rockis & Rockis; ISBN 978- 0826918338; ATP; 2018
Cybersecurity Essentials, 1st Ed; Charles J. Brooks, Christopher Grow, Philip Craig, Donald Short; ISBN 978-1119362395; Sybex; Oct.2018; 784 pgs
Telecommunications and Data Communications Handbook; Ray Horak; ISBN 978-0470041413; Wiley-Interscience; September 2007; Paperback; 791 ppg**.**
Sound Systems: Design and Optimization: Modern Techniques and Tools for Sound System Design and Alignment, 3E; Bob McCarthy; ISBN 978-0415731010; Routledge; 2016; 600 ppg**.**
Practical Home Theater: A Guide to Video and Audio Systems (2018 Edition); Mark Fleischmann; ISBN 978-1932732191; Quiet River Press, LLC; October 2017; 284(Xperi owned ppg**.**
RESI library; Charles J. Brooks with Max Main, eITPrep LLP, Marcraft: **5 texts in Basic, A&V, CN, EC, and S&S;** ISBNs various; 2007 - 2009;
Residential Integration Series library; Cengage Learning Delmar; **4 texts in Basic, P.M., Certification, and Integration;** ISBNs various; 2006 - 2008;

Many webpages and links are available searching online, some examples are:

http://www.eta-i.org/smart_home.html
https://hdbaset.org/what-is-hdbaset/hdbaset-solution-for-audiovisual/
https://www.dolby.com/us/en/home/index.html
https://www.xperi.com/markets/home-solutions/?utm_source=top_nav
https://www.icann.org/
http://www.integrahometheater.com/index.php
https://hometheaterreview.com/integra-dtc-98-home-theater-processor-reviewed/
https://hometheaterreview.com/home-theater/
https://hometheaterhifi.com/
https://www.digitaltrends.com/home-theater/ultimate-surround-sound-guide-different-formats-explained/
https://www.z-wave.com/
https://www.zigbee.org/
https://www.bluetooth.com/
https://www.nfpa.org/
https://www.wi-fi.org/
https://lora-alliance.org/
http://www.marcraft.com/RESI.html
https://www.tiaonline.org/
http://www.iec.ch/
https://www.nema.org/pages/default.aspx
https://www.iccsafe.org/
https://www.electronicdesign.com
https://standards.ieee.org/standard/
http://resources.rohde-schwarz-usa.com/c/white-paper-testing-?x=zQSHFI

Call (1-800-288-3824) or contact ETA (eta@eta-i.org) for other white papers, pdfs, power points, etc...
Including **STS Domain 1 training at Education Forum 2019 JB Groves III March 4-6, 2019**

ETA certification programs are accredited through ICAC, complying with the ISO/IEC 17024 standard.

ICAC International Certification Accreditation Council

 © Copyright 2021, ETA® International, All Rights Reserved