Third Edition

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Andy Ciddor

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Certified Technology Specialist

EXAM GUIDE

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Certified Technology Specialist

EXAM GUIDE

Third Edition

Andy Ciddor

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FOREWORD

What does it take to create an exceptional, integrated audiovisual experience? To deliver not only the kind of spectacle that wows people but also the type of collaboration space that makes companies more productive? It takes the right combination of content, space, and technology, but it also takes *you*. It takes trained professionals—integrators, designers, manufacturers, distributors, technology managers.

Building integrated audiovisual experiences also takes engagement with users—especially users who understand not only the strategic value of AV but also the fact that AV integration is a craft. It's guided by the science of sight and sound, activated by technology, and realized by dedicated specialists. AVIXA™, the Audiovisual and Integrated Experience Association, believes in the value of creating experiences through technology—experiences that lead to better outcomes, whether they're enhanced communication, entertainment, or education. To deliver these experiences and outcomes, our industry must continually master its craft. That means staying well-trained, using and understanding standards, and committing to professional certifications.

For more than 30 years, AVIXA has administered the Certified Technology Specialist™ (CTS®) program, which is recognized as the leading AV professional credential. There are three CTS credentials: general (CTS), design (CTS-D), and installation (CTS-I). There are currently more than 12,000 CTS holders, and more than 2,000 of them are CTS-D or CTS-I holders. The CTS program is accredited by the American National Standards Institute (ANSI) to meet the International Organization of Standardization (ISO) and International Electrotechnical Commission (IEC) ISO/IEC 17024:2012 certifications of personnel standards.

CTS is increasingly recognized globally as the most important, respected professional AV certification in the world. In 2018, through ANSI's acceptance as a signatory to the International Accreditation Forum (IAF) Multilateral Recognition Arrangement (MLA), the CTS program gained even greater international standing. Many government bodies only accept certifications that are accredited by an in-country accreditation body or an IAF MLA signatory. With ANSI's acceptance to the IAF MLA, AVIXA's certifications are now equivalent to those accredited by local accreditation bodies in dozens of countries around the world. Therefore, congratulations are in order. By pursuing your CTS certification, you are embarking on perhaps the most important journey toward mastering your craft—and the world is going to know about it.

This brings me to the matter at hand. In 2011, AVIXA and McGraw-Hill Education developed the first-ever *CTS Certified Technology Specialist Exam Guide*. You are about to dive into the third edition. To maintain its standing with ANSI and the international community, AVIXA is required to regularly evaluate its certifications, in conjunction with its Certification Steering Committee, to ensure it reflects real-world best practices, skills, technology, and more. As the job of a CTS evolves, the exam to become one evolves. As the exam evolves, so does this exam guide. Over the course of this regular

process, AVIXA's volunteer subject-matter experts and psychometricians tweak the exam to more accurately reflect the job of an AV professional in today's marketplace.

The most recent update reflects a refinement and maturation of the CTS exam. Much of what a CTS certified professional needs to know remains the same. The community of technologists who will benefit from this knowledge remains large. In addition to AV professionals, IT professionals, technology managers, end users, and others will find that the skills reflected in the CTS exam will serve them well in honing their craft and delivering exceptional AV experiences.

Note that AVIXA, in keeping with the accreditation requirements of the ISO/IEC 17024:2012 standard, does not require any training or education to obtain a CTS credential. You don't even need to read this book to take the exam, although it has been developed by industry experts and designed to reflect much of the content you'll find on the actual CTS exam. That said, this CTS exam guide is not the only way to help you prepare—and for some, it shouldn't be.

Although many prospective CTS holders will rely on this book to earn their CTS certification, others will benefit from collaborating with instructors and peers through classroom training such as AVIXA's CTS Prep course. AVIXA also offers CTS Prep Online, a comprehensive course that is free to AVIXA members and available to everyone. You may also benefit from taking the Essentials of AV Technology Online course and/or completing the self-assessment tests that AVIXA provides.

Again, none of this training is required to become CTS certified, but it's in your and the AV industry's best interest to develop the most highly educated workforce possible. AVIXA certifies more qualified AV professionals than anyone, and because of the commitment of people like you, the CTS certification is recognized across multiple industries and market segments for its credibility and integrity.

Again, congratulations on pursuing your CTS certification. We hope to be there with you as you pursue your career in this exciting field, including when you decide to attain an advanced CTS certification—either the CTS-D or CTS-I. For information about these programs and everything else AVIXA offers, visit www.AVIXA.org.

Best of luck.

David Labuskes, CTS, CAE, RCDD
Chief Executive Officer
AVIXA

ACKNOWLEDGMENTS

First, thanks to everyone in the AV industry for making this such a growing, dynamic, and successful field. It's a clear indication of how far and fast professional AV has come that thousands of the best and brightest recognize a need to certify their skills to each other and to the wider world. Ideally, you're next in line to be a Certified Technology Specialist (CTS).

Thanks to all the volunteer AV experts who have worked with AVIXA over the years to define what it means to be a CTS-certified professional and share their knowledge with the next generation of great technology minds.

I would like to thank Amanda Beckner, CTS, and Brad Grimes from AVIXA for giving me the opportunity to work on this project. Special thanks to Tim Green, Rachel Fogelberg, and Claire Yee at McGraw-Hill Education, who have supported and patiently mentored me on this voyage from magazine editor and technical writer to book author.

Like every twenty-first-century technical writer, I must acknowledge the contributions of Vannevar Bush and Ted Nelson, whose concept of hypertext made researching this work possible, and tip my hat to Jimmy Wales and his imperfectly-amazing Wikipedia project, which serves as such a valuable launching point for journeys into the unknown.

This book happened only because of my partner Val's encouragement and support, together with her "tolerance" of my late-night work habits and teleconference meetings.

To all of you, good luck on your CTS exam!

—Andy Ciddor

I first want to thank AVIXA's amazing volunteer AV experts and my AVIXA family for welcoming this former academic and student of Renaissance optics with open arms and for a boundless willingness to help. Special thanks to AVIXA's Tom Kehr, who always has patience with my persistent questions, to Amanda Beckner for trusting me with this project and providing me with a guiding hand, and to the many, many others for their invaluable assistance.

Many thanks to Andy Ciddor for his tireless dedication and his persistent demands for excellence. This book is a testament to your passion and commitment to the industry that you so dearly love and intimately know. Equal thanks to Tim Green at McGraw-Hill Education for keeping us on task and keeping a level head as we pushed to meet deadlines.

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—Zak Fisher, AVIXA

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PART I

The Certified Technology Specialist and the CTS Exam

- **Chapter 1** What Is a Certified Technology Specialist?
- **Chapter 2** The CTS Exam

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CHAPTER 1

What Is a Certified Technology Specialist?

In this chapter, you will learn about

- What it means to be a Certified Technology Specialist (CTS)
- Why you might choose to become a CTS
- The purpose of the CTS exam
- Eligibility criteria for taking the CTS exam
- The CTS exam application process

Before you prepare for the CTS exam, you will have arrived at the conclusion that you actually want to be a CTS. Earning the CTS designation can help advance your career in the professional audiovisual (AV) communications industry—whether you're just starting in professional AV or you've been working on AV projects for years.

This chapter starts by describing what your decision to study for the CTS exam can mean for your career. It then covers the background and purpose of the exam, from eligibility criteria to the application process. It is important to understand that there are reasons why the CTS exam is designed the way it is, and each reason contributes to the strength of the CTS credential.

What Does a CTS Do?

A CTS creates, implements, and services AV systems to support advanced communications and exceptional multimedia experiences. Whether for high-definition telepresence rooms or live corporate events, conference rooms or digital signage networks, distance-learning presentation or telemedicine applications, houses of worship or school auditoriums, a CTS provides the best, most cutting-edge AV solutions to meet the client's needs—both on time and within budget.

AVIXA created and administers the CTS program. Founded in 1939, AVIXA is the leading nonprofit association serving the professional audiovisual industry worldwide. For more than 30 years it has offered certification programs, as well as industry-specific and general business training and education for people seeking careers in professional AV.

AVIXA developed the CTS program as part of a process for certifying industry professionals. Individuals who hold the CTS credential demonstrate a commitment to excellence in the AV industry, as measured through an objective assessment of that person's AV knowledge and skills. Every year, AVIXA certifies more qualified AV professionals than anyone else in the industry.

Earning a CTS also demonstrates a commitment to ongoing professional growth in the AV industry. After you have earned your CTS, you must maintain certified status through continual education and training. This is achieved by acquiring renewal units by taking classes online, from AVIXA's classroom offerings, or at various other in-person events and trade shows.

There are currently two levels of CTS certification—general and specialized—and they include the following designations:

- **Certified Technology Specialist (CTS)** A general certification that covers common AV industry knowledge and skills required for people active in system design, installation, and operation
- **Certified Technology Specialist—Design (CTS-D)** A specialized certification that demonstrates the holder's more in-depth knowledge of AV system design skills
- **Certified Technology Specialist—Installation (CTS-I)** A specialized certification that demonstrates the holder's more in-depth knowledge of AV system installation and integration skills

AVIXA certifications are currently the only AV credentials to achieve accreditation to the International Organization of Standardization (ISO) and the International Electrotechnical Commission (IEC) ISO/IEC 17024:2012 standard, as administered in the United States by the American National Standards Institute (ANSI), and in India by the National Accreditation Board for Education and Training (NABET). ISO/IEC 17024:2012 is a standard designed to assure the public and the CTS certification holders that AVIXA applies best practices to the administration of the CTS program. These accreditations provide a higher level of confidence in the CTS certification program. ANSI and NABET serve as unbiased third-party sources to verify the competence of certification bodies to develop, manage, and maintain their programs.

Why Earn Your CTS?

Industry certifications are common across many of the trades that AV professionals encounter on the job. Like the CTS, these certifications demonstrate that holders have achieved a certain level of knowledge and expertise in their chosen fields. As AV professionals increasingly work more with architects, contractors, and others who hold industry certifications, their ability to present recognized CTS credentials to partners on the job can instill confidence and boost the value of their work.

Furthermore, CTS certification can instill confidence in clients, providing additional credibility that the work the CTS holder performs will meet an accepted level of professionalism and reliability. Increasingly, requests for proposals (RFPs) for AV projects

include requirements that the winning bidder employ CTS-certified professionals. Moreover, an increasing number of technology managers—individuals who might initiate an RFP for an AV project—are themselves CTS holders, increasing the likelihood they would prefer to hire CTS-certified consultants, integrators, and installers.

Finally, AVIXA studies suggest that CTS holders earn more than their peers. According to AVIXA's 2017 *Compensation and Benefits Survey,* more than half of professional AV firms offer higher base salaries to CTS holders than non-CTS holders with similar backgrounds in the AV industry. The CTS designation is also highly recognized and valued among the AV industry. According to AVIXA's most recent *Member Value Survey,* conducted in 2017 and reaching AVIXA members and nonmembers throughout the AV industry, the CTS credential was rated as the most important service AVIXA offers. Respondents also indicated very high satisfaction with the CTS credential and how they reflect the professionalism of the AV industry.

The Purpose of the CTS Exam

AV professionals who hold the CTS credential demonstrate their AV industry knowledge and skill through an objective assessment—the CTS exam. In following the standards set by international bodies and in support of a professional certification recognized for credibility and integrity, AVIXA's independent Certification Committee oversees a CTS exam that tests individuals against peer-developed standards and competencies.

The exam is designed independently of any course or curriculum, and it is developed and administered to be valid, reliable, defensible, and psychometrically sound. All exams are developed, reviewed, and maintained by a series of AV industry subject-matter experts (SMEs) guided by professional test development experts (psychometricians).

NOTE Psychometrics is the study of psychological measurement, including the measurement of knowledge, abilities, attitudes, personality traits, and educational assessment/analysis. In the context of the CTS exam, psychometric principles are applied to exam questions to ensure they correctly evaluate what they are intended to evaluate.

The CTS assessment criteria are based on an analysis of the job tasks performed by professionals in the AV industry as determined by AV industry SMEs guided by professional testing experts. They are not based on any training or education programs or any educational provider's programs. The specific knowledge areas addressed by the CTS exam, plus the scope of the knowledge and skills in each area, are described in Chapter 2.

The majority of the CTS exam addresses technical skills. However, the Certification Committee and SMEs from various AV job functions determined that the general requirements for a CTS holder should also include a basic understanding of the fundamental concepts of project management, estimating, and purchasing. This is based on the assumption that during the course of their work, CTS holders may be called upon to oversee projects, assist in estimating expenses, provide input on purchasing decisions, and handle other nontechnical tasks in support of their employer.

The inclusion of this type of content and the assessment of nontechnical skills through the CTS exam helps ensure that a CTS holder has not only the technical aptitude but also some basic business knowledge to help a project move successfully toward completion. Exposure to such nontechnical skill areas also helps CTS holders determine whether they would like to pursue specialty designations (CTS-D or CTS-I) to advance their careers and benefit their employers and clients.

NOTE While the majority of the CTS exam deals with technical skills and knowledge, SMEs from within the AV industry determined that so-called soft skills are also important to a successful certified AV professional. Therefore, questions about project management and other subjects not strictly related to AV technology are also part of the CTS exam.

Are You Eligible for the CTS Exam?

More often than not, the answer to this question is yes. It is strongly recommended that you have the skills and/or experience indicated in AVIXA's *CTS Exam Content Outline*. (See Chapter 2 for an outline of the CTS exam content.)

CTS candidates are not required to complete any particular course in order to take the CTS exam or qualify for certification, although there are many ways you can prepare for the exam and determine whether you are ready to take it. However, no single course contains all the information needed to pass the exam.

AVIXA itself offers a number of general courses that can help individuals prepare for each level of CTS certification. The exam guide you are currently reading has been specifically developed to address the content of the general CTS exam. The AVIXA Certification Committee also offers a *CTS Candidate Handbook,* an exam content outline with job-task analysis information, a glossary, practice exams, and other materials. You can find all the material online at the AVIXA website (www.AVIXA.org/cts).

NOTE A job task analysis (JTA) is a study conducted to identify the knowledge, skills, and abilities necessary for professional competence in a particular field. Such an analysis is often conducted to determine the content and competencies that should be included in a certification or exam. AVIXA's independent Certification Committee conducts periodic JTAs to make sure the CTS exam and certification process aligns with the real-world skills required of certified AV professionals.

The online materials can help you prepare for the CTS exam, but they are not intended to include all potentially useful sources of information. Inclusion on the AVIXA list of preparatory materials does not constitute an endorsement by the Certification Committee. The Certification Committee does not endorse any particular reference as being completely accurate and encompassing, and it recommends that applicants use multiple resources in the process of preparing for the exam.

The CTS Exam Application Process

To apply for the CTS exam, visit the AVIXA website (www.AVIXA.org/cts). There, you can obtain the free *CTS Candidate Handbook* and current CTS candidate application.

CTS applications may be submitted in one of several ways:

- Completed online at the AVIXA website
- Printed and mailed
- Scanned and e-mailed
- Faxed

Candidates must provide required documentation and payment as noted on the application. All signatures must be submitted by the applicant as provided in the CTS application. This includes agreeing to the CTS Code of Ethics and Conduct, which is printed in the *CTS Candidate Handbook.*

After you send the required documentation, meet eligibility requirements, and have your payment approved, AVIXA will e-mail you an eligibility acceptance letter within ten business days of receiving the application. This message includes a unique candidate ID number and testing instructions. If an application is not accepted, you will receive an e-mail letter of explanation. Applications that are incomplete, or for which payments have been denied, will delay approval.

NOTE Be sure to include all required documentation with your application to avoid denial and/or delay.

Once approved for eligibility, you will be notified by e-mail within one business day of AVIXA submitting the approval information to the third-party exam company, Pearson VUE. After another 24 hours, you may contact Pearson VUE to make an appointment to take the CTS exam. Visit the Pearson VUE website (www.pearsonvue.com/AVIXA) and click Locate a Test Center to find an exam location near you.

Any questions about the CTS exam should be directed to the following:

AVIXA, Attn. Certification Office
11242 Waples Mill Rd., Suite 200, Fairfax, VA 22030
Phone: 1.800.659.7469 or +1.703.273.7200
Fax: +1.703.691.2756
certification@AVIXA.org
www.AVIXA.org

Chapter Review

A CTS performs general technology solutions tasks in the process of creating, implementing, and servicing AV systems. The CTS certification demonstrates to individuals, employers, trade partners, and customers that the CTS holder meets an established, peer-reviewed benchmark of expertise in AV-specific and basic business-general topics.

The CTS exam is the vehicle by which CTS holders assess their expertise, through a method of documenting their knowledge within the AV industry. The CTS exam is based on an analysis of the tasks that AV professionals perform, focusing on "best practices" within the AV industry.

This chapter briefly described the background and purpose of the CTS exam and how to register to take it. Candidates should now have a better understanding of the purpose and objectives of the exam and whether obtaining a CTS certification could help advance their career in the AV industry.

CHAPTER 2

The CTS Exam

In this chapter, you will learn about

- The scope of the CTS exam
- How the CTS exam changes over time
- How to study effectively for the exam
- What types of exam questions to expect
- Question-evaluation strategies for successful test-taking
- What to expect on exam day

As you learned in Chapter 1, the AVIXA CTS exam is part of a professional certification process that is designed to evaluate a person's level of knowledge of general audiovisual (AV) job tasks. The exam covers a wide range of AV-related topics, and it is based on an analysis of typical job tasks performed by people currently working in the AV industry.

This chapter describes the content addressed within the CTS exam so that you can better prepare for taking the exam. It also covers how the exam is conducted so you will know what to expect when you arrive to take the exam.

Keep in mind that AVIXA will always provide the most up-to-date information on the CTS exam online, so be sure to check AVIXA's website (www.avixa.org/cts) for the latest information on exam procedures and requirements.

The Scope of the CTS Exam

To create the CTS exam, a group of volunteer AV subject-matter experts (SMEs), guided by professional test development experts, participated in an AV job task analysis (JTA) study. The results of this study form the basis of a valid, reliable, fair, and realistic assessment of the skills, knowledge, and abilities required for competent job performance by AV professionals.

The original JTA study for creating the American National Standards Institute (ANSI)–accredited CTS exam was conducted in December 2006. Follow-up studies, as required by ANSI, were conducted in 2012, and most recently in 2017, to revalidate the exam and identify areas where it might be updated to reflect current AV jobs, skills, knowledge bases, and best practices (see the next section, "The CTS Exam Over Time").