A Preview of the Adaptive Media Systems Engineering Course

About the Author

Philip J. Cianci, CSTE, CBNT has been a member of the SBE since 2002. He is the author of High Definition Television – the Creation, Development and Implementation of HDTV Technology published by McFarland in January 2012. This thoroughly researched work traces the 40-year history of high definition television technology is from initial studies in Japan, through its development in Europe, and then to the United States, where the first all-digital systems were implemented. Cianci has published two books with Focal Press HDTV and the Transition to Digital Broadcasting in 2007 and Technology and Workflows for Multiple Channel Content Distribution: Infrastructure implementation strategies for converged production in 2009.

Introduction

This course addresses the challenges of a contemporary technologist who works in the broadcast or media industry and offers techniques to ease the transition from Broadcast Engineer to Media Systems Engineer. Each chapter provides practical suggestions and solutions for the digital era. Subjects include and introduction to media systems engineering, the role of the media systems engineer, the importance of professional societies and standards bodies, project management techniques, the planning process, process improvement, organizational efficiency and more.

Course Description

The advent of digital television and the transition to digital transmission, the implementation information technology (IT) laden broadcast infrastructures, and the evolution to file-based production, has precipitated challenges and the need for broadcast engineers to master a new set of technical skills. To matters a little more interesting (and challenging), the emergence of multiple delivery channels – which can be used both for consumer distribution and professional backhaul and contribution – have complicated matters even more. And with business moving from paper to electronic systems for maintaining business information, and with the need to automate the flow of this information and metadata through every area of operations, from rights management, ad sales, traffic, media management, content movement and play to air, the opportunity now exists to integrate all business, creative and media processes into a holistic workflow, streamlining operations to meet the needs of the any content, anywhere, at any time on any device media-multiverse.

As a result, new skills are needed, both technical and communication; teamwork and planning have now come to the fore. A new design philosophy requires the elimination of silos, and that a symbiosis of business, creative and technical considerations, requirements and harmony system integration and media and data flow is adhered to.

Course Content

1. Introduction
2. Media Systems Engineering - a New Technical Discipline
3. Adapt or die! The Adaptive Media Systems Engineer
4. Professional Societies, Trade Associations and Standards Bodies
5. Project Management Techniques
6. Team Building
7. The Planning Process
8. Adaptive Engineering and Design
9. The Installation and Commissioning Process - Making it so …
10. Process Improvement and Organizational Proficiency - Work Smarter, Not Harder!
11. Media Systems Engineering for the Real World
12. Glossary

Enrollment Information

SBE Member Price: $149
Non-Member Price: $209

Adaptive Media Systems Engineering Overview
Media Systems Engineering - a New Technical Discipline

Once upon a not too distant time ago, a broadcast systems design engineer was given an assignment and then after some time, emerged from their cave to install and commission their techno-creation. Software application developers and IT administration gurus were also surrounded by an aura of mysticism and solitude. These High Priests of the technical Secret Societies closely guarded Knowledge, and kept their "esoteric secrets" inaccessible to other uninitiated technologists.

In these simpler pre-DTV times, this individual-centric methodology actually worked fairly well. Consider an assignment to design a graphics (GFX) system in those long ago days - about all a broadcast engineer had to do was specify the latest and greatest computer platform, load it with storage and RAM, connect it to a VTR, install the software application and the GFX designer was ready to express their creative vision! Today this GFX system is connected to a tiered network, runs multiple applications, supplemented with numerous plug-ins, interfaces with a media asset management (MAM) system, and requires impenetrable security. No single broadcast engineer, computer scientist or information technologist has all the requisite expertise to get the job done, at least not at peak proficiency, taking the needs of all stakeholders into account and designing a system that performs at a level of five 9's reliability. What was a one person task has now grown into a project that includes the broadcast engineer along with network, computer, storage and security technologists.

This relatively ad hoc project management methodology eventually leads to communication issues and implementation problems with today's complex media systems. Command and control project management with one person in charge no longer works well enough. Multiple technology "systems of systems" require an enlightened solution. The answer is Adaptive Media Systems Engineering.

Evolving to a Media-Multiverse

In what today seems like a very long time ago in a predecessor universe, television was about broadcasting images and sound over the air waves to reception devices for an audience at home, or in a tavern. Along came cable TV, followed by satellite direct to home subscription services. As emerging delivery methods fiercely battled each other for eyeballs, the end-to-end production and air chain remained relatively unchanged. Even the creation, development, and implementation of high definition DTV did not alter the linear television production workflow and broadcast air-chain. (Fig 1.1)

Figure 1.1 Linear television production/broadcast chain - produce, transmit, consume.

Although the air-chain was relatively unaffected, the advent of DTV brought with it a new method of technical specification to the broadcast engineering domain. Whereas analog systems were defined in terms of voltage and power levels, modulation technology and depth, digital television produced bit streams that were often defined using a programming language like syntax referred to as "Pseudo C." (Table 1.1)

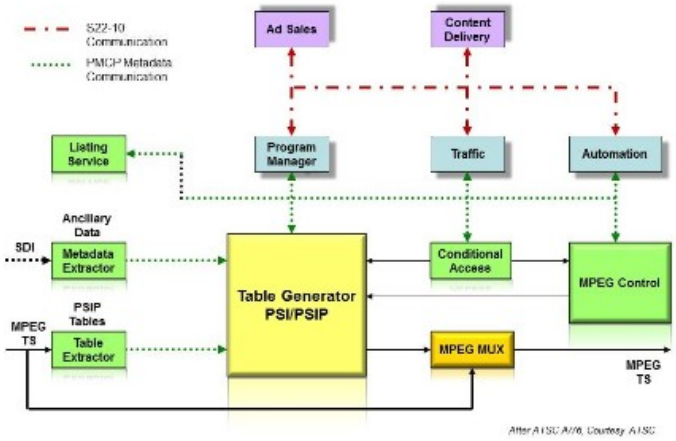
Syntax	No. of Bits	Format
next_start_code() {		
while(!bytealigned())		
zero_bit	1	'0'
while(nextbits()!='0000 0000 0000 0000 0000 0001')		
zero_byte	8	'00000000'
}		

Table 1.1 Example of Pseudo C definition of MPEG-2 "Next Start Code" from A/53: ATSC Digital Television Standard

Talk to me

As operations became increasingly dependent on computer based broadcast, creative and business systems, many organizations avoided many interoperability issues by sticking with tried and true methods. Analog workflows and processes remained in place as the infrastructure increasingly became more digital, and ad sales, and right management processes continued to communicate via excel spreadsheets with information being manually entered or "cut & paste" copied into systems, such as traffic, automation, and asset management systems.

An attempt to automate digital communication of information between systems was made by the ATSC in November 2004 with the development of the A/76 ATSC Programming Metadata Communication Protocol Standard (PMCP) [1] which "defines a method for communicating metadata related to PSIP (Program and System Information Protocol)... based on a protocol utilizing XML message documents generated in accordance with PMCP XML Schema ..." In 2008, SMPTE followed with SMPTE- 2021, the Broadcast Exchange Format (BXF) [2] [3] which also uses XML. The scope of each methodology is illustrated in Figure 1.2.



Enlarge

Figure 1.2 The scope of ATSC PMCP and SMPTE BXF communication among broadcast systems. After ATSC A/76

XML is a specification published by the World Wide Web Consortium (W3C). An XML file contains the data, while the XML schema is a structural blueprint for presenting or interpreting the data in the XML file. PMCP XML data can be exchanged as files, or as live 'sockets' communicating using TCP/IP or UDP/IP protocols. This was a foreign language to most broadcast engineers at the time. As a result, broadcast engineers and technicians were now faced with a need to understand alien software methodologies in order to design and support digital, computer based broadcast systems and to acquire expertise with Pseudo C, XML, and IT communication protocols if they were to have complete knowledge of the production/broadcast signal chain. It was time for old dogs to learn new tricks. But it got worse, er... more challenging...that is, more interesting.

The Media Multiverse

Since 2005 or so, the realm of television broadcasting has expanded in a fashion analogous to the Big Bang that created our universe. In line with the implications of relativity and modern string theory, television broadcasting now spanned a Media Multiverse where, ideally, all content is delivered over any transmission platform, at anytime, anywhere; a three screen scenario, where a large television display was viewed from distances greater than three feet; a personal computer, where the "user" is less than 18" from the screen; and mobile, untethered personal communication devices.

Early attempts to leverage this new distribution opportunity for repurposed TV content led to siloed, brute force production methodologies, where a dedicated production infrastructure created and formatted content for a particular distribution channel and reception device. (Fig. 1.3)

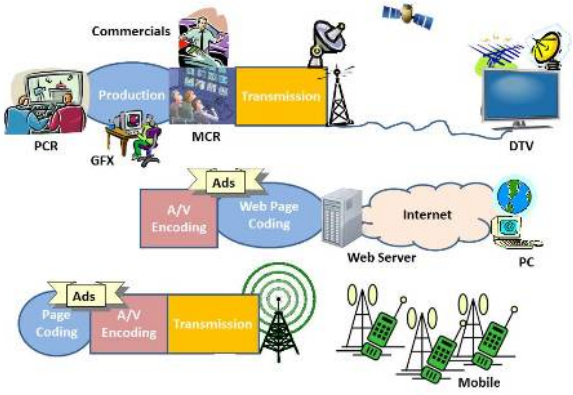


Figure 1.3 Brute force, independent production workflows for each distribution channel.

With these new "Digital Media" distribution channels being in their early adopter infancy, emphasis was placed on the linear TV distribution channels. And rightly so; nearly 100% of the revenue stream was produced by commercial advertising, retransmission agreements and carriage fees.

After a short while it became apparent to aware broadcast engineers that an integrated production environment could vastly improve efficiency and enable content to be repurposed and released more rapidly. (Fig 1.4)

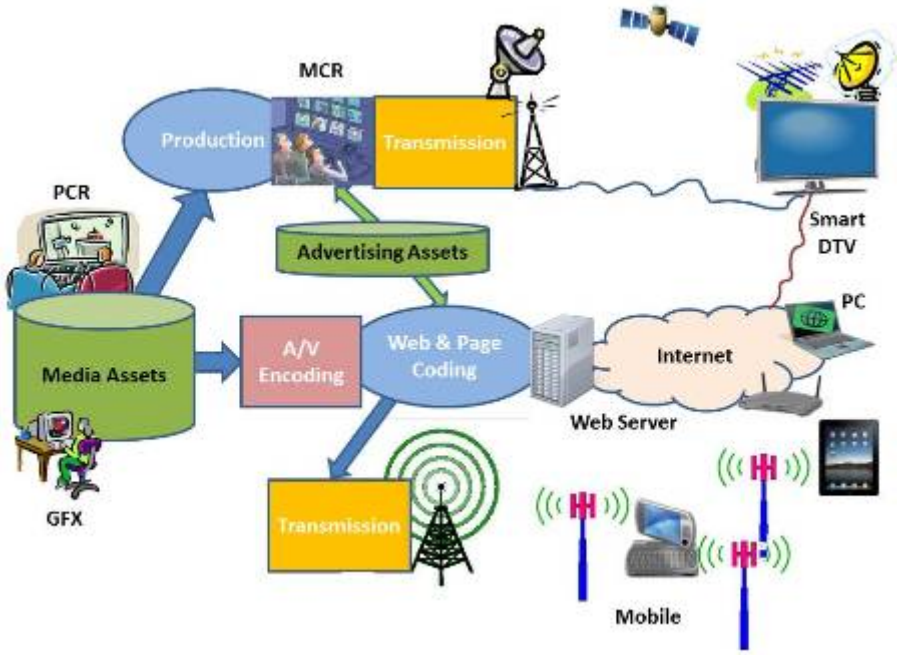


Figure 1.4 Integrated broadcast production and distribution operations. It should be noted that while linear programming distribution may require two compression codecs, Internet and mobile will require a unique codec for each distribution affiliate. So, VOD, TVE, EST and mobile distribution can push the number of discrete content packages to over 25 combinations; add in International distribution and the number easily can double.

In this implementation scenario, audio, video and graphics content is aggregated in a central asset management system that is accessible by production operations for each screen. Existing content and program elements are reused whenever possible. Advertising is sold in cross platform packages that include TV, web and mobile, and played to air, placed on web pages or delivered to mobile devices in an appropriate compression format. The various devices involved are orchestrated to transparently and automatically reformat transcode, assemble and distribute finished content to each of the three screens.

Media Systems Engineering

Though attaining this ideal conceptual infrastructure and integrated workflow is asymptotic, in order to come as close as possible to a perfected implementation, many skills are needed to create an infrastructure that will support content production and distribution across the media multiverse. (Fig 1.5) And if personnel are available with the required skills and experience, how would the design and construction be undertaken; is it a broadcast engineering, information technology or application development project?

Under the "Heroic" paradigm, one Uber-Technologist would possess the following skill set:

- Broadcast Engineer: baseband audio & video, compression codecs, SDI routing
- Network Architect: Routing protocols, network topology, network technology (Ethernet, TCP/IP), switches, routers
- Computer Technologist: system architecture, operating systems, graphics processing units, storage systems, RAID, Fiber Channel, Storage Area Networks, tape archives
- Application Expert: application development and installation; data communication
- Database Administrator: installation, configuration, and maintenance
- Library Sciences: asset management, cataloging, taxonomy, ontology
- Security: Network Intrusion Detection and Prevention Systems (IDS/IPS), virus scan, user system access (LDAP and Active Directory), security keys, data encryption

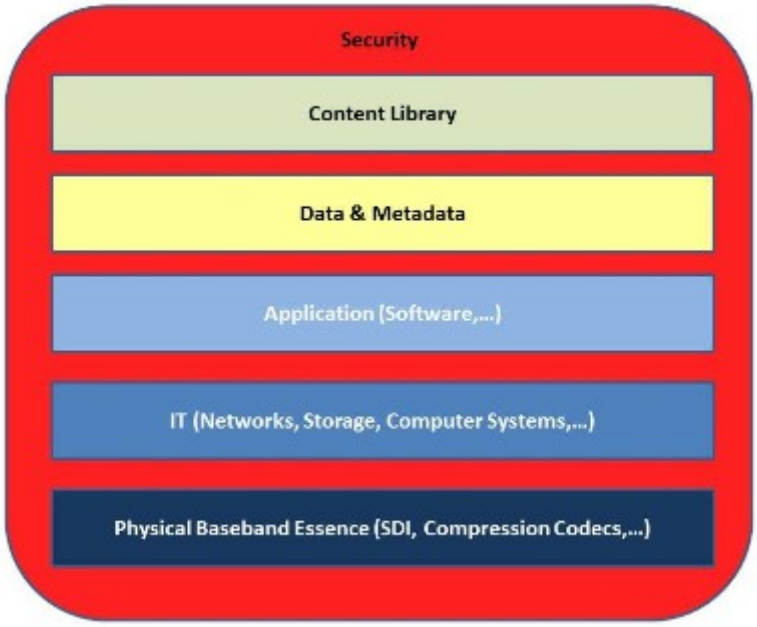


Figure 1.5 Media Systems infrastructure technology stack

Inherent in these skills is the knowledge and expertise to tune the system to perform at maximum efficiency. This Uber-Technologist is a mythical creature - an obvious impossibility! No one person has all this expertise and experience. Therefore the design and commissioning of media systems will require a team consisting of members possessing expertise in a technical area relevant to each sub-system. This team of specialists could go off on their own and design and implement a media multiverse supporting system, but the odds are that chaos will erupt as each "expert" tries to bend the team, and system design, to their vision. Something of a project facilitator, rather than manager, is needed to coordinate the interactions of the team, and insure that the best technical solutions are arrived at.

But if this team and its "coach" retreat to their design-cave, as priest and acolytes were to do in an earlier era, then install and roll out their creation to the user community, the odds are that the users will be enthusiastic at first, but in time find that the system does not fit their way of doing things, i.e. workflows. In fact, it could make their jobs take longer. This will inevitably lead to business concerns and ultimately questions about why the system was installed at all. We want our return on investment (ROI)?!

Tomorrow, Tomorrow & Tomorrow...

Something more is needed. Waterfall and Agile Project Management methodologies don't fit well enough for managing the design, installation and commissioning of complicated media multiverse, integrated production and distribution infrastructures. In addition, the job descriptions of all broadcasting and media technical personnel are expanding as new technologies are introduced, as production needs, number of distribution channels and variety of reception devices increases.

A contemporary broadcast engineer needs to evolve to a Media Systems Engineer through continual education. Project managers must become coaches, guiding all-star teams to victory. Organizations need to adopt new production, technical and operational methodologies and project management techniques.

Contemporary times offer an opportunity for the experienced media technology professional to revitalize his or her vocational calling and regain a child's thirst for knowledge. Think of this as you thought of your career when you began it. Be excited that you get to enjoy the discovery of new knowledge. One key to eternal youth is the perception of the world as a wondrous place with endless secrets to reveal. The evolution of television broadcasting to the new media multiverse offers this stimulation on a daily basis.

References

1. A/76 ATSC Programming Metadata Communication Protocol Standard
   http://www.atsc.org/cms/standards/a_76b.pdf
2. An introduction to the Broadcast Exchange Format (BXF), AVID
   http://www.avid.com/static/resources/common/documents/bxf_wp.pdf
3. The impact of BXF 2.0, Chris Lennon' Broadcast Engineering Magazine, 2010,
   http://broadcastengineering.com/infrastructure/impact-bxf-0310

Additional Reading

- UML Unified Modeling Language http://en.wikipedia.org/wiki/Unified_Modeling_Language
- AMWA MS06 Specification http://wiki.amwa.tv/index.php/MS06_Specification#UML_notation

The biggest challenge in the evolution of broadcast operations to digital technology is:

- [ ] Teaching old dogs new tricks
- [ ] Coordinating and integrating multiple tech disciplines
- [ ] Having to deal with IT personnel
- [ ] There aren't any challenges - it's just business as usual

For a broadcast engineer to evolve to a Media Systems Engineer they will have to:

- [ ] Enhance and extend their technical skills
- [ ] Improve and practice better communications
- [ ] Consider the new technologies an opportunity to learn, not a threat
- [ ] All of the above

DTV bit streams standards are specified using

- [ ] Voltage levels
- [ ] Digital timing diagrams
- [ ] Pseudo C
- [ ] C++

XML is specified by:

- [ ] The FCC
- [ ] SMPTE
- [ ] ATSC
- [ ] W3C