

National Association of Broadcasters

ENGINEERING HANDBOOK

10th Edition

National Association of Broadcasters

ENGINEERING HANDBOOK

10th Edition

Editor-in-Chief

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Contents

Foreword	ix		
Notes and Acknowledgements	xi		
The Editors	xii		
Contributors to the 10th Edition	xv		
NAB Engineering Achievement Award Recipients	xliii		
SECTION 1: BROADCAST ADMINISTRATION, STANDARDS, AND TECHNOLOGIES			
1.1 The Electromagnetic Spectrum	3	1.9 NRSC Analog and Digital Radio Standards	111
<i>John Norgard, Air Force Research Laboratory</i>		<i>Stanley Salek, Hammett & Edison, Inc.</i>	
1.2 Broadcast-Related Organizations and Information	11	1.10 Worldwide Standards for Digital Radio	117
<i>Steven Mitchel, National Association of Broadcasters</i>		<i>Richard Morris, Commercial Radio Australia</i>	
1.3 FCC Organization and Administrative Practices	29	1.11 The ATSC Digital Television System	133
<i>Joan M.S. Dollarhite, National Association of Broadcasters</i>		<i>Jerry Whitaker, Advanced Television Systems Committee</i>	
1.4 Regulatory Compliance	43	1.12 NTSC Analog Television Standard	155
<i>Garrison C. Cavell, Cavell, Mertz, and Davis, Inc.</i>		<i>Staff, National Association of Broadcasters</i>	
1.5 Frequency Allocations for Broadcasting and the Broadcast Auxiliary Services	53	1.13 Worldwide Standards for Analog Television	191
<i>William R. Meintel, Meintel, Sgrignoli & Wallace</i>		<i>D.H. Pritchard & J.J. Gibson</i>	
1.6 Frequency Coordination for Auxiliary Services	77	<i>Updated by Aldo Cugnini, AGC Systems, LLC</i>	
<i>Dane E. Ericksen, Hammett & Edison, Inc.</i>		1.14 Worldwide Standards for Digital Television	205
<i>David P. Otey, AZCAR Technologies</i>		<i>Aldo Cugnini, AGC Systems, LLC</i>	
1.7 Distance and Bearing Calculations	89	<i>David Wood, European Broadcast Union</i>	
<i>Dane E. Ericksen, Hammett & Edison, Inc.</i>		<i>Hiroshi Asami, Ministry of Internal Affairs and Communications</i>	
1.8 Propagation Characteristics of Radio Waves	95	1.15 Digital Audio Standards and Practices	219
<i>Douglas Vernier, V-Soft Communications</i>		<i>Chip Morgan, CMBE, Inc.</i>	
		<i>Randall Hoffner, ABC, Inc.</i>	
		<i>Updated by Tim Carroll, Linear Acoustic, Inc.</i>	
		1.16 Video Standards and Practices	229
		<i>Jerry Whitaker, Advanced Television Systems Committee</i>	
		1.17 Data Broadcasting Standards and Practices for Television	239
		<i>Michael Dolan, Television Broadcast Technology, Inc.</i>	
		1.18 Emergency Alert System	247
		<i>David E. Wilson, Consumer Electronics Association</i>	

**SECTION 2:
TECHNICAL MANAGEMENT AND SAFETY**

2.1	Engineering Management	281
	<i>Dr. Sam Swan, University of Tennessee, Knoxville</i>	
2.2	Broadcast Engineering Documentation Management	295
	<i>David M. Baden, Radio Free Asia</i>	
2.3	Systems Integration and Project Management	313
	<i>John Luff, Media Technology Consultant</i>	
2.4	Human Exposure to Radio Frequency Energy	329
	<i>William F. Hammett and Robert D. Weller, Hammett & Edison, Inc.</i>	
2.5	Managing Workplace and Environmental Hazards	341
	<i>David Maxson, Broadcast Signal Lab</i>	
2.6	Electrical Shock—What to Do When It Occurs	353
	<i>Anne Devine, Medtronic Emergency Response Systems</i>	
	<i>Clifford D. Ferris, University of Wyoming</i>	
2.7	Broadcast Facility Security, Safety, Disaster Planning, and Recovery	363
	<i>Richard Rudman, Remote Possibilities</i>	
	<i>Thomas G. Osenkowsky, Radio Engineering Consultant</i>	

**SECTION 3:
AUDIO PRODUCTION AND STUDIO TECHNOLOGY**

3.1	Planning an Audio Production Facility	377
	<i>Roy W. Rising, ABC-TV</i>	
	<i>Steve Campbell, Aurora Media, LLC</i>	
3.2	Principles of Acoustics and Noise Control for Broadcast Applications	395
	<i>Howard L. Pelton, Ted N. Carnes, and Gary L. McAuliffe, Pelton, Marsh, Kinsella</i>	
3.3	Microphones for Broadcast Applications	431
	<i>Ty Ford, Ty Ford Audio & Video</i>	
	<i>Greg Silsby, Fellowship of Technical Ministries</i>	
3.4	Audio Recording	455
	<i>John Emmett, Broadcast Project Research, Ltd.</i>	
	<i>Michael Starling, National Public Radio</i>	
3.5	Studio Audio Equipment and Systems	479
	<i>Steve Campbell, Aurora Media, LLC</i>	
	<i>Martin Stabbert, Citadel Broadcasting Company</i>	
	<i>Mathew Lightner, Lightner Electronics</i>	
	<i>Jay Tyler, Wheatstone Corporation</i>	
3.6	Radio Station Automation, Networks, and Audio Storage	515
	<i>David T. Turner, ENCO Systems, Inc.</i>	

3.7	Digital Audio Compression Technologies	543
	<i>Schuyler Quackenbush, Audio Research Labs</i>	
	<i>Fred Wylie, Audio Processing Technology, Ltd.</i>	
3.8	Transmission Audio Processing	567
	<i>Frank Foti, Omnia Audio, A Telos Systems Company</i>	
	<i>Robert Orban, Orban/CRL</i>	
3.9	Radio Remote News and Production	589
	<i>Skip Pizzi, Microsoft Corporation</i>	
	<i>Jerry Whitaker, Advanced Television Systems Committee</i>	
	<i>Updated by Jim Boston, DTV Engineering</i>	
3.10	Telephone Network Interfacing	609
	<i>Steve Church and Rolf Taylor, Telos Systems, Inc.</i>	
3.11	Audio Contribution and Distribution Channels	645
	<i>Skip Pizzi, Microsoft Corporation</i>	

**SECTION 4:
RADIO TRANSMISSION**

4.1	Planning Radio Transmitter Facilities	665
	<i>John M. Lyons, The Durst Organization</i>	
	<i>W.C. Alexander, Crawford Broadcasting Co.</i>	
4.2	AM Transmitters and AM Stereo	679
	<i>Edward J. Anthony, Quincy, Illinois</i>	
	<i>Daniel L. Dickey, Continental Electronics Corp.</i>	
4.3	AM Broadcast Antenna Systems	711
	<i>Ronald D. Rackley, du Treil, Lundin & Rackley, Inc.</i>	
4.4	AM Antenna Coupling and Phasing Systems	739
	<i>Jerry Westberg, Broadcast Electronics, Inc.</i>	
4.5	Computer Simulation of Broadcast Antenna Systems	757
	<i>James B. Hatfield, Hatfield & Dawson, Consulting Engineers, Inc.</i>	
4.6	AM Antenna System Maintenance	763
	<i>John F. Warner, Clear Channel Radio</i>	
4.7	FM and Digital Radio Transmitters	777
	<i>Geoffrey N. Mendenhall, Harris Broadcast Communications Division</i>	
4.8	FM Stereo and SCA Systems	825
	<i>Eric Small, Modulation Sciences, Inc.</i>	
4.9	FM Broadcast Antennas	839
	<i>Peter Onnigain and Eric Dye</i>	
	<i>Updated by Dane Jubera and Slava Bulkin, Jampro Antennas.</i>	
4.10	FM Combining Systems	875
	<i>Robert A. Surette, Shively Labs</i>	
4.11	FM RF Transmission Lines	897
	<i>Kerry W. Cozad, Dielectric Communications</i>	
4.12	FM Translators and Boosters	907
	<i>Ron Castro, Results Radio, LLC.</i>	

4.13	AM and FM IBOC Systems and Equipment	921	5.15	Television Graphics	1255
	<i>Jeff Detweiler, iBiquity Digital Corporation</i>			<i>Jim Martinolich, Chyron Corporation</i>	
4.14	Radio Broadcast Data System	969	5.16	Digital Asset Management	1269
	<i>Scott A. Wright, Soneticom</i>			<i>Rod Fairweather, Harris Corporation</i>	
	<i>Updated by Thomas D. Mock, Wye Consulting</i>		5.17	ENG, SNG, and Remote Video Production	1285
4.15	AM–FM Field Strength Measurements	983		<i>Jim Boston, DTV Engineering</i>	
	<i>Donald G. Everist, Cohen, Dippell and Everist, P.C.</i>			<i>George Hoover, NEP Broadcasting, LLC.</i>	
SECTION 5: VIDEO PRODUCTION AND STUDIO TECHNOLOGY					
5.1	Planning a Video Production Facility	1001	5.18	Audio for Digital Television	1309
	<i>Ralph S. Blackman, Rees Associates, Inc.</i>			<i>Tim J. Carroll, Linear Acoustic</i>	
5.2	Principles of Light, Vision, and Photometry	1015		<i>Jeffrey Riedmiller, Dolby Laboratories</i>	
	<i>Jerry Whitaker, Advanced Television Systems Committee</i>		5.19	Intercom and IFB Systems	1331
5.3	Television Camera Systems	1029		<i>Andrew Morris, Consulting Engineer</i>	
	<i>Michael Bergeron and Stephen Mahrer, Panasonic Broadcast and Television Systems Company</i>		5.20	Lighting for Television	1343
5.4	Television Camera Supports and Robotics	1055		<i>Bill Marshal, Harvey, Marshal, Berling Associates</i>	
	<i>Peter Harman, Vinten</i>		5.21	Television Master Control Systems and Network Distribution	1363
5.5	Video and Audio Switching, Timing, and Distribution	1069		<i>John Luff, Media Technology Consultant</i>	
	<i>Birney Dayton, NVISION Inc.</i>			<i>Appendix by: Thomas Edwards, Public Broadcasting Service</i>	
5.6	Workflow, Metadata, and File Management	1081		<i>James M. DeFilippis, FOX Television</i>	
	<i>Bruce Deolin, Snell & Wilcox</i>			<i>Greg Coppa, CBS Television</i>	
	<i>Thomas Edwards, Public Broadcasting Service</i>		5.22	ATSC Encoding, Transport, and PSIP Systems	1391
	<i>Brad Gilmer, Gilmer & Associates</i>			<i>Matthew Goldman, TANDBERG Television, Inc.</i>	
	<i>Phil Tudor, BBC</i>			<i>Richard Chernock, Triveni Digital</i>	
5.7	Video Compression	1103		<i>Chris Lennon, Harris Corporation</i>	
	<i>Peter Symes, Grass Valley, Inc.</i>		5.23	Film for Television	1417
5.8	Video Recording	1117		<i>David J. Bancroft, Thomson</i>	
	<i>Steve Epstein, Broadcast Buyers Guide</i>		5.24	Closed Captioning Systems	1435
5.9	Video Servers	1133		<i>Jeff Hutchins, Accessible Media Industry Coalition</i>	
	<i>Karl Paulsen, AZCAR USA, Inc.</i>			<i>Alan Lambshead, Evertz Microsystems</i>	
5.10	Video Production Switchers and Special Effects Systems	1161	5.25	Data Broadcasting Systems and Applications for Television	1453
	<i>Jeff Moore, Ross Video</i>			<i>Peter Ludé, Sony Electronics, Inc.</i>	
	<i>Jeff Mazur, Disney-ABC Television Group</i>		SECTION 6: TELEVISION TRANSMISSION		
5.11	Postproduction and Nonlinear Editing	1187	6.1	Planning a Television Transmitter Facility	1469
	<i>Tim Claman, Avid Technology, Inc.</i>			<i>John M. Lyons, The Durst Organization</i>	
5.12	Format and Standards Conversion	1201	6.2	Analog Television Transmitters	1481
	<i>Jed Deame, Teranex Division, Silicon Optix, Inc.</i>			<i>Jay C. Adrick, Harris Broadcast Communications Division</i>	
5.13	Television Station Automation	1217	6.3	Multichannel Television Sound for NTSC	1519
	<i>Chris Lennon, Harris Corporation</i>			<i>Edmund A. Williams, Editor-in-Chief, 10th Edition NAB Engineering Handbook</i>	
5.14	Weather Radar Systems	1237		<i>Updated by Eric Small, Modulation Sciences, Inc.</i>	
	<i>Robert Beach, Radtec Engineering, Inc.</i>		6.4	Digital Television Transmitters	1535
				<i>Brett Jenkins, Thomson Broadcast & Multimedia, Inc.</i>	
				<i>Appendix by: John Freberg, Freberg Engineering, Inc.</i>	

6.5	DTV Single-Frequency Networks and Distributed Transmission	1563
	<i>S. Merrill Weiss, Merrill Weiss Group, LLC</i>	
6.6	Coaxial and Waveguide Transmission Lines	1595
	<i>Kerry W. Cozad, Dielectric Communications</i>	
6.7	Filters, Combiners, and RF Components	1613
	<i>Derek Small and Stephen Kolvek, MYAT, Inc.</i>	
6.8	Television Antenna Systems	1631
	<i>Tom Silliman and Ronald E. Lile, Electronics Research, Inc.</i>	
6.9	Television Field Strength Measurements	1653
	<i>Donald G. Everist, Cohen, Dippell and Everist, P.C.</i>	
6.10	Fiber-Optic Transmission Systems	1667
	<i>Jim Jachetta, Multidyne Video & Fiber Optic Systems</i>	
6.11	Satellite Earth Stations and Systems	1687
	<i>Sidney M. Skjei, Skjei Telecom, Inc. James H. Cook, Jr., Scientific-Atlanta, Inc.</i>	
6.12	Low Power TV and TV Translators	1725
	<i>Greg Best, Greg Best Consulting</i>	
6.13	Audio and Video over IP Networks and Internet Broadcasting	1735
	<i>Wes Simpson, Telecom Product Consulting</i>	
6.14	Cable Television Systems	1751
	<i>Paul Hearty, Ryerson University</i>	
6.15	Direct-to-Home Satellite Systems	1767
	<i>Leon Stanger, Consulting Engineer Jack P. Godwin, Gretna Green Associates Stephen P. Dulac, DIRECTV</i>	

**SECTION 7:
BROADCAST TOWERS**

7.1	Tower Safety and OSHA Requirements	1779
	<i>Phil Rayson, Radian Communications Services Corp. John Wahba, Turris Corporation</i>	
7.2	Tower Design, Erection, and Maintenance	1789
	<i>Thomas J. Hoenninger, Stainless, LLC</i>	
7.3	Lightning Protection for Tower Structures	1807
	<i>Edward A. Lobnitz, TLC Engineering for Architecture</i>	
7.4	Tower Lighting and Monitoring	1833
	<i>Richard G. Hickey, Flash Technology</i>	

**SECTION 8:
SIGNAL MEASUREMENT AND ANALYSIS**

8.1	Audio Signal Analysis	1845
	<i>Stanley Salek, Hammett & Edison, Inc. Thomas Kite and David Mathew, Audio Precision, Inc.</i>	
8.2	Digital Video Signal and Bitstream Analysis	1869
	<i>Dave Guerrero, Harris Corporation Danny Wilson, Pixelmetrix Corporation</i>	
8.3	Radio Frequency Signal Analysis	1895
	<i>Donald Markley, Markley & Associates</i>	
8.4	Digital Television Transmitter Measurements	1909
	<i>Linley Gumm, Consultant Gary Sgrignoli, Meintel, Sgrignoli & Wallace</i>	

**SECTION 9:
ANCILLARY BROADCAST SYSTEMS**

9.1	STL Systems for AM-FM-TV	1933
	<i>Earnest M. Hickin, Myton Associates, Inc. James H. Rooney, III, Microwave Radio Communications Updated by George Maier, Orion Broadcast Solutions, and Richard Miller, Microwave Radio Communications</i>	
9.2	AC Power Conditioning	1973
	<i>Jerry Whitaker, Advanced Television Systems Committee José R. Alvarez, Wavetech Associates</i>	
9.3	Facility Grounding Practice	1985
	<i>Richard B. Bernhardt, John-Winston Engineers & Consultants</i>	
9.4	Standby Power Systems	1995
	<i>Geoffrey A. Krenkel, John-Winston Engineers & Consultants</i>	
9.5	Transmitter Remote Control and Monitoring Systems	2005
	<i>Harold Hallikainen, hallikainen.com</i>	
	Index	2021

Foreword

In his introduction to the first edition of the *NAB Engineering Handbook*, published in 1935, NAB Managing Director James W. Baldwin wrote that its purpose was “for use as a guide in matters on which little or no authoritative collected information has heretofore been generally available in readily usable form.”

Is this still a valid basis for publishing a new edition of this book over 70 years later? After all, with the huge quantity of information available on the Internet and the explosion of high speed broadband Internet access, it’s quite likely that details on any desired subject can be found out there somewhere on the Net, given a powerful enough search tool, the time needed to conduct the search, and a way to verify the information found.

And that is the problem. So much information is on the Internet, finding just what is needed in a reasonable amount of time is a difficult (sometimes impossible) challenge, and the credibility of the information that is found may be unknown or questionable. For the broadcast engineer in today’s fast-paced business and technological environment, the mere known existence of online information alone is not enough; there must also be certainty of timely access to the information and there must be confidence in its veracity.

In 1982, author and futurist John Naisbitt recognized the impending dilemma of the Information Age in his book *Megatrends* when he wrote: “We are drowning in information and starved for knowledge.” With this perspective in mind, we are proud to present this new 10th edition of the *NAB Engineering Handbook*

and conclude that James W. Baldwin’s words from 1935 still apply today.

This new edition of the Handbook has been completely revised and updated from the 1999 9th edition with twenty-four new chapters that encompass the digital transition in broadcasting at all levels. There are new chapters that reflect how information technology has been adopted by broadcasters, how both radio and television operations benefit from the use of servers, LANs, the Internet, compression techniques, non-linear editing, digital transmission, metadata, and many other important and timely subjects.

The goal of the editorial staff on this project is to ensure that the information in the 10th edition represents what broadcast engineers need to know to be comfortable, competent, and effective in the rapidly changing broadcast technology environment.

The great 18th century English literary figure Samuel Johnson once insightfully remarked: “Knowledge is of two kinds. We know a subject ourselves, or we know where we can find information on it.” The *NAB Engineering Handbook* is where broadcast engineers know they can find the information needed to do their jobs. Please feel free to contact us with comments on how to continue to maintain this Handbook as a readily usable form of an authoritative collection of information on broadcast engineering topics.

Lynn D. Claudy
Senior Vice President, Science and Technology
National Association of Broadcasters

Notes and Acknowledgments

"In theory, there is no difference between theory and practice. But, in practice, there is." These words, attributed to Jan L.A. van de Snepscheut, computer scientist and author, ring true to broadcast engineers who make a living from implementing practical applications in real world operating environments using equipment designed "in theory" to do the job.

In this completely revised and substantially updated 10th edition of the *NAB Engineering Handbook*, we have used the phrase "what the engineer needs to know to do the job" as a motto for the authors when writing or revising a particular chapter.

While all the images in the handbook are in black and white many were originally in color and are reproduced in color in the compact disc (CD) that accompanies the book.

In this handbook of 104 chapters are 24 new chapters that bring the *NAB Engineering Handbook* fully into the digital era. Assisting the Editor-in-Chief, and working one-on-one with the 140 authors, were three Associate Editors who commissioned, assembled, edited, reviewed, formatted, and verified the material:

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The editors of the *NAB Engineering Handbook* thank the authors, co-authors, and contributors for the time and expertise that they have given to make this book an important part of a broadcast engineer's library and reference materials.

The preparation of this edition has taken nearly two years, a year longer than expected, but well worth the time and considerable effort to insure the material is accurate and up to date.

Of course, such an undertaking could not have been accomplished without the considerable support of other NAB Science and Technology staff members Lynn Claudy, Senior Vice President, Janet H. Elliott, Senior Director of Operations and Managing Editor for the 9th edition, and Dan Landrigan, NAB Publications Manager.

We hope you find this newest edition of the *NAB Engineering Handbook* useful in your work in broadcast engineering and operations.

Edmund A. Williams
Editor-in-Chief

The Editors



Edmund A. Williams
Editor-in-Chief

During his 50 year career in broadcasting, Mr. Williams has worked for Ohio State University Radio and Television, Ohio University Radio and Television, the Public Broadcasting Service, the National Association of Broadcasters, and the Advanced Television Test Center. He participated in the Emmy Award-winning PBS Captioning for the Deaf, Satellite Interconnection, and UHF Improvement Projects and developed a terrain-sensitive

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Mr. Williams is a Life Senior Member of the IEEE and serves on the Broadcast Technology Society AdCom as Technical Activities chair, is a Fellow and former Governor of the SMPTE, a Senior Member of SBE and SCTE, and Associate Member of the AFCCE. Mr. Williams retired from the Public Broadcasting Ser-

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Broadcasting Consultants worked as a consultant to broadcasters in many parts of the world. He chairs the ATSC Planning Committee and is a member of the ATSC Technology and Standards Group. He is also the Director of Education for SMPTE and an active member of several SMPTE technology committees.

Mr. Jones is author of *A Broadcast Engineering Tutorial for Non-Engineers* (Focal Press, 2005). He has presented papers at SMPTE, NAB, and other conferences and was principal author of *Digital Television Station and Network Implementation*, published in the 2006 Proceedings of the IEEE on Global Digital Television, for which he served on the ATSC board of editors. Mr. Jones holds a degree in Physics from the University of Nottingham, England. He is a Chartered Engineer, a Fellow of SMPTE, and a member of the SBE, the Institution of Engineering and Technology, and the Royal Television Society. He is a Governor of SMPTE and a manager of the SMPTE Washington DC Section. In 2004, he was awarded the ATSC Bernard J. Lechner Outstanding Contributor award. He can be reached at GJones@nab.org.



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David Layer is Director, Advanced Engineering in the Science & Technology Department of NAB. He has been with NAB since 1995, and has been very active in the radio standards setting area. He is also involved in NAB's technical conference planning and technical publication activities, and has been an author and contributing author for numerous technical publications, including IEEE Spectrum magazine and the

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Mr. Layer is a frequent presenter at broadcasting industry events around the world, having made presentations to numerous state broadcasting associations, trade associations and technical societies as well as at conferences in Switzerland, Chile, Brazil, Mexico, Puerto Rico, and Uruguay. Prior to joining NAB, he was the Associate Manager of the Transmission and Channel Processing department of COMSAT Laboratories. Mr. Layer is an Associate Member of AFCCE where he serves on the association's board of directors, and is a Senior Member of the Institute of Electrical and Electronics Engineers (IEEE). He served as the Chairman of the annual IEEE Broadcast Symposium from 2002 to 2004. He received a BSEE degree from the University of Maryland, and an MSEE degree from Purdue University, where he was also a teaching assistant. Mr. Layer has also served on the faculty of American University and Frederick Community College. He can be reached at dlayer@nab.org.



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Mr. Osenkowsky earned his Professional Broadcast Engineer Life Certification (CPBE) from the SBE, a Certified Master Engineer with Master RF Radiating Endorsement from NARTE, and holds a First Class Radiotelephone license from the FCC. He has presented papers at Broadcast Engineering Conferences held at NAB Conventions, SBE Annual Conventions, and state broadcasters annual conventions. He is a regular contributor to Radio World magazine, a private pilot, and amateur radio operator – N1IXJ. Reach him at Engineer_Tom_2000@Yahoo.com.

Contributors to the 10th Edition

Jay C. Adrick (Chapter 6.2) is Vice President, Technology, Harris Corporation Broadcast Communications Division. As a 42+ year veteran of the broadcast industry, Jay has led the teams that designed and built many of the leading broadcast facilities, including The Golf Channel, The Weather Channel, The Discovery Channel, National Public Radio, The Voice of America, Georgia Public Broadcasting, Iraqi Media Network, and many other broadcast facilities. At Harris, he led the product development for the Harris FlexiCoder, MasterPlus, and MonitorPlus products during the U.S. digital rollout.

Prior to joining Harris, he was Executive Vice President of Midwest Communications Corporation. He also taught broadcast communications at Xavier University in Cincinnati, Ohio, for eight years, served as the University's Director of Radio and Television, and was a founder of public radio station WVXU-FM. His broadcast career began in commercial radio and later included work at several television stations.

Mr. Adrick holds a Bachelor of Science degree in communication arts and a Master's degree in educational communications from Xavier University. He is a member of the Society of Broadcast Engineers, Society of Motion Picture and Television Engineers, and the Society of Telecommunications Engineers.

Mr. Adrick served on the Board of Directors and as Vice Chairman of the Advanced Television Systems Committee. He is currently a board member of the ATSC Forum. In addition, he has served on both of the FCC Media Security and Reliability Councils.

W. C. (Cris) Alexander (Chapter 4.1) is Director of Engineering for Crawford Broadcasting Company. He began his career in broadcasting in Amarillo, Texas, in the mid-1970s. Obtaining a FCC First Class Radiotelephone License, he worked in the engineering departments of AM, FM, and TV stations in that market before moving to Dallas/Fort Worth, Texas, where he worked first in television and then in radio, landing in

his present position with Crawford Broadcasting Company in 1984.

Cris is a graduate of the Cleveland Institute of Electronics Broadcast Engineering course. He is an SBE member, holds SBE Professional Broadcast Engineer (CPBE) and AM Directional Specialist (AMD) certifications and is Certification Chairman of the Denver SBE chapter. He is an associate member of the Association of Federal Communications Consulting Engineers (AFCCE). He is a partner in Au Contraire Software, Ltd., a provider of broadcast engineering software and database services.

Cris lives with his family in the Denver area.

José Alvarez (Chapter 9.2) is the owner and founder of Wavetech Associates Inc., a 15-year year-old company specializing in power quality solutions for business. He is a 1983 graduate of the New Jersey Institute of Technology (NJIT), with a Bachelor of Science degree in Electrical Engineering.

Mr. Alvarez has been quoted and written about in journals such as *Business News New Jersey* and *Power Quality Assurance*. His 22 years of experience has led him into numerous applications, including the broadcast field where he has successfully applied power conditioning solutions.

Hiroshi Asami (Chapter 1.14) is Director-General of Hokuriku Bureau of Telecommunications, Ministry of Internal Affairs and Communication, Japan.

Mr. Asami was born in Japan, and received an MS in electrical engineering from Kyoto University in 1980, and an MS in engineering economic systems from Stanford University in 1985.

Mr. Asami joined the Ministry of Posts and Telecommunication in 1980, and has been engaged in standardization and regulations of telecommunication and broadcasting systems since then. He has been working for channel planning of digital broadcasting, and contributed significantly to the start of digital terrestrial

television in Japan in 2003. He was Director of Broadcasting Technology until 2005.

David Baden (Chapter 2.2) is currently Chief Technical Officer for Radio Free Asia where, in 1996, he was an organizational founding member of senior management. He began his career as a musician in 1974 and continued to perform until 1980. During that time he also worked as an engineer for various theatrical lighting, recording studios, and sound reinforcement companies in the Greater Washington, D.C. area. Over the course of his career he has been intimately involved with all aspects of technical documentation. Using CAD, which has replaced the drafting table, he has created and maintained technical documentation from the preliminary proposal to as-built stage for multiple projects worldwide.

In 1980, Mr. Baden was one of the founding principles at db Tech Inc., a company that designed, installed, and maintained professional recording studios and commercial sound reinforcement systems and manufactured specialized audio devices.

In 1984, Mr. Baden began his career in professional broadcasting as Technical and Production Services Supervisor for the Washington News Bureau of Radio Free Europe/Radio Liberty, Inc (RFE/RL). He was responsible for all broadcast systems as well as daily production operations. In 1989, as Deputy Director Broadcast Operations, USA, his responsibilities included all of RFE/RL's USA-based operations. In 1995, he relocated to Prague, Czech Republic as Manager of Technical Construction for the Prague Task Force. He was responsible for all technical systems design, integration, logistics, and physical facility construction for the RFE/RL Munich to Prague headquarters relocation.

Dave Bancroft (Chapter 5.23) is Manager, Advanced Technology, for divisions within the three Strategic Business Units of Thomson: Grass Valley, Technicolor, and Technology, and is based in Reading, United Kingdom. He coordinates the work of these business units in technology issues such as scanning and workflow for digital intermediate film production, color management in displays, digital cinematography, and HDTV broadcasting for Europe. He represents Thomson in the standards activities of the SMPTE and related organizations.

Mr. Bancroft began his career as a trainee engineer with the BBC, specializing in live television outside broadcasts. After leaving the UK, he held positions with RCA, Ampex Corporation, BTS, Philips, and Thomson, in Europe, Africa, and the United States, before returning to the UK.

Mr. Bancroft has a certification in broadcast engineering from the BBC. He is a Member of the Institution of Engineering and Technology, United Kingdom (IET), a Fellow of the SMPTE, a Fellow of the Royal Television Society, a Director of Council of the BKSTS Moving Image Society, UK, an International Governor of the SMPTE, and a Member of the Administrative Committee of the IEEE Broadcast Technology Society.

He is currently Chairman of the Study Group on Display Technologies in SMPTE. Mr. Bancroft has presented papers at NAB, IBC, SMPTE, and other broadcast conventions. He received the 2004 IBC Presidents Award for his paper on Universal Content Production, and the 2000 SMPTE Journal Award for his paper, "Recent Advances in the Transfer and Manipulation of Film Images in the Data and HDTV Domains." He contributed the HDTV standards chapter to the 2003 *Broadcast Engineer's Reference Book*, and the "Digital Picture Exchange (DPX)" file format chapter to the 2004 *File Interchange Handbook*, both published by Focal Press.

J. Robert (Bob) Beach (Chapter 5.14), Radtec, Inc., began his technical career in the computing research group of a major aircraft manufacturer, developing mathematical algorithms and the associated software for the analysis of structural vibration in aircraft and space vehicles. Subsequently, he became a project manager for a major computer manufacturer, managing the design, integration, and installation of very large computer systems. A number of those systems were developed for weather applications and weather agencies, both domestically in the United States and worldwide. For the last 10 years, he has provided both technical and system-level expertise for the design and implementation of weather radar systems.

Bob is a graduate of Iowa State University (BSEE), and in addition to the *NAB Engineering Handbook* section on weather radar, has written *The Practical Physics of Airport Weather Radar* for Air Traffic Technology International, and *Doppler Weather Radar: Benefiting from Innovation* for the World Meteorological Organization Bulletin.

Michael Bergeron (Chapter 5.3) is HD Camera Product Engineer for Panasonic Broadcast in Secaucus, New Jersey, supporting the studio camera systems. He started in production as a film camera technician at Abel Cine Tech in New York, in 1991. He became Service Department Manager in 1995 and served as Director of Engineering from 1997 to 1999. After two years in research & development at Bell Laboratories and two more years with the NYU Physics Department, Michael returned to broadcast/production in 2003.

While at Panasonic, Michael has been responsible for product development and support for HD system cameras and camcorders. He has been involved in the development and introduction of film cameras including the Aaton 35, XTR Prod and A-Minima, as well as the development of Panasonic HDTV cameras including the AJ-HVX200, AJ-HDX900, AK-HC1500 HD Box camera.

Michael holds a BS in physics from the University of Massachusetts, an MS in electrical engineering from New Jersey Institute of Technology, and is a member of SMPTE.

Richard B. Bernhardt, P.E., (Chapter 9.3) is Founder, President, and Senior Consultant of John-Winston

Engineers and Consultants, Allenhurst, New Jersey, and has successfully guided the business to be recognized internationally as a high-value technical services consultancy.

Mr. Bernhardt led multidiscipline teams of up to 25 involved in power project planning and budget development, technical infrastructure system design, and construction. Sample engagements include traditional planning, design, construction, and maintenance of industrial and institutional electrical distribution systems.

Mr. Bernhardt has developed plans and designs identifying multiple alternative capital and operational requirements for hospitals, data centers, industrial plants, and high technology manufacturing operations. Systems designed included on-site generation systems and UPS equipment, specialty grounding and surge protection, and industrial electrical distribution.

Mr. Bernhardt's project management of industrial and institutional electrical distribution systems include managed construction activities for individual projects with construction values up to \$15M, reviewed equipment submittals, conducted system performance testing, and commissioning, and he has developed operation and maintenance plans for electrical system operations.

Mr. Bernhardt holds a BS in engineering from New Mexico State University, 1981. His studies included civil and mechanical engineering coursework. His graduate studies in engineering economics at New Mexico State University in 1981 included the study of project economic evaluation. He received the Centennial Distinguished Alumni Award, New Mexico State University, 1996, for accomplishment in Utility Management Consulting.

Greg Best (Chapter 6.12) is President of Greg Best Consulting, Inc. His firm performs broadcast consulting services for a wide variety of customers and serves the RF communications industry in general. He earned his BSEE degree from the University of Missouri-Rolla and MSEE degree from Illinois Institute of Technology and is a Registered Professional Engineer.

Greg has 30 years of experience in the design, marketing, and product management of RF communications equipment. His corporate experience includes 16 years with the Broadcast Division of Harris where he was responsible for TV transmitter design and management. While there, he was responsible for coordinating the development of the Platinum Series VHF-TV transmitter, as well as many other VHF and UHF-TV transmitters. He also worked for Motorola on the original 800 MHz AMPS cellular phone system transmitter development and for IFR Systems Test and Measurement division developing 3 GHz spectrum analyzers.

Greg has published papers on TV transmitter multichannel sound and others on TV transmitter design architecture. He is a member of the Association of Federal Communications Consulting Engineers, IEEE, and SBE. Greg currently heads the IEEE DTV

RF Measurement Standards activities and serves as an Associate Editor for the *IEEE Transactions on Broadcasting*.

Ralph S. Blackman (Chapter 5.1) has been with Rees Associates, Inc., in Dallas, Texas, since 1978. Currently Vice-President, his responsibilities at Rees have included serving as the Broadcast Market Segment Leader, Project Director, Project Programmer/Planner/Designer, and Project Manager. He has been involved with over 120 of the 300 300-plus broadcast projects Rees has completed.

Mr. Blackman is a licensed architect, member of the American Institute of Architects, and is NCARB Certified, with over 30 years of experience, 25 of which have been dedicated to serving the broadcast industry.

After receiving his Bachelor of Environmental Design and Bachelor of Architecture degrees from the University of Oklahoma, Mr. Blackman continued his education by attending Management of Design & Planning Firm at the Graduate School of Design at Harvard University, and Cox School of Business at Southern Methodist University to study Mid-Level Management. He maintains licenses in over 25 states.

Over the years, Mr. Blackman has been invited to present several papers at NAB Convention Engineering Conferences and PBS Technology Conferences.

Jim Boston (Chapters 3.9, 5.17) is a California California-based consultant specializing in system test and architecture. and he has a BSEE from Cleveland State University.

Jim has been in the television industry for over 30 years. He has been in the trenches and at upper levels of technical management. His experience spans the range of television technical equipment from the camera lens to the RF plumbing headed out towards the television transmission tower. He has also worked in such ancillary areas such as C and Ku band uplinking and has been Engineer-in-Charge of large production trucks.

Jim is a frequent contributor to *Broadcast Engineering* magazine. He has authored the book "*DTV Survival Guide*," and co-authored the book "*TV on Wheels: The Story of Remote Television Production*," with George Hoover.

Vyacheslav (Slava) Bulkin, Ph.D., (Chapter 4.9) is currently Antenna Engineer with Jampro Antennas, Inc., in Sacramento, California, where he develops broadband TV and FM broadcasting antennas and feed systems.

Dr. Bulkin earned his MS in physics from Moscow State University, Russia, and his PhD in EE from Radio Industry Institute in Moscow, Russia, working on developing radar antennas systems.

Dr. Bulkin worked as Visiting Scholar at University of Illinois at Urbana-Champaign, developing time-domain domain-based computational techniques in electromagnetics.

He also worked as Visiting Scholar at Penn State University, University Park, Pennsylvania, developing

compositions of thin layered frequency selective surfaces materials.

Steve Campbell (Chapters 3.1, 3.5) began his career in commercial audio engineering in 1970 performing sound and projection engineering services and remodeling designs for movie theatres throughout the Rocky Mountain area. In 1977, while attending college, he worked in broadcasting as an assistant engineer at Montana State University's FM station and later as chief engineer for other stations in the state of Montana. In 1988, Steve became the Director of Engineering for Citadel Communications Corporation, and was principally concerned with studio construction and consolidation through the large growth period of Citadel.

Since 2002, he has been an independent broadcast consultant working on new broadcast development.

Steve holds a Bachelor's degree in electrical engineering, is a Registered Professional Engineer, and holds a General Class (previously First Class) Radiotelephone License from the FCC. His interests are commercial architecture and software development supporting broadcast engineering.

Ted N. Carnes, Ph.D., P.E., (Chapter 3.2) is Senior Acoustical Consultant for Pelton Marsh Kinsella, LLC, and is a registered Professional Engineer in the state of Texas.

Dr. Carnes has broad experience as an acoustical consultant in the fields of architectural acoustics which that includes the acoustics and noise control on all types of building systems, industrial noise control which that includes the acoustics and noise reduction in both production areas and office facilities, mechanical vibrations as it applies to HVAC and other types of equipment upon building structural systems, and environmental noise assessment of transportation systems on different types of buildings and developments. He also serves as an expert witness in the fields of acoustics and mechanical engineering.

Dr. Carnes has a B.S. in mechanical and aerospace engineering, and an M.S. in mechanical engineering from Oklahoma State University, and a Ph.D. in mechanical engineering from The University of Texas at Austin. He is a member of the American Society of Mechanical Engineers, the Audio Engineering Society, the National Council of Acoustical Consultants, and the American Society of Heating, Refrigeration and Air-conditioning Engineers professional organizations. He has written and presented a number of professional papers on acoustics and contributed to several books and standards on acoustics and noise control.

Tim Carroll (Chapters 1.15, 5.18) is President of Linear Acoustic Inc., a company he founded to offer innovative, customer-centric solutions for managing multi-channel surround sound audio and loudness issues in digital broadcasting—a goal that has been supported by the development of several acclaimed products

including the StreamStacker system, AutoNorm, upMAX 2251, OCTiMAX 5.1, and AEROMAX-TV.

Mr. Carroll was previously the Product Manager for the Professional Audio Division of Dolby Laboratories in San Francisco, where he helped define and develop Dolby Digital (AC-3), Dolby E, and Dolby Surround products for High Definition Television, DVD, Digital Radio, and Digital Cinema applications in the United States and abroad.

Mr. Carroll was honored by the Academy of Television Arts and Sciences with an Emmy® for his work on the Dolby E system. He is also an inventor of several patent-applied-for technologies.

Mr. Carroll remains actively involved in the creation of digital broadcast standards and practices. He is a member of IEEE, AES, SBE, SMPTE, and BKSTS and is an active participant in the work of the ATSC. He was also a member of the NRSC DAB Subcommittee and the Evaluation Working Group that formulated NRSC-5, the FM IBOC digital radio standard.

Ron Castro (Chapter 4.12) is the Chief Technical Officer and part owner of Results Radio, LLC, a chain of small-market FM stations in northern California.

Ron began his broadcast career as an air personality and engineer in Pennsylvania in 1966 and later joined the U.S. Navy as a Communications Technician. After working in Honolulu and San Francisco, he became the owner of a small FM station in Santa Rosa, California.

Ron is an active ham radio operator (N6AHA), holder of an FCC Lifetime General Class Radiotelephone License, and a member of the Society of Broadcast Engineers.

Garrison C. Cavell (Chapter 1.4) has been involved in the broadcast industry since the early 1970's. His experience in radio and television runs the gamut from announcer to free lance production engineer to staff engineer, Chief Engineer, and Radio Station General Manager. He even participated in the ownership of a small small-market radio station. Along the way, he has designed and built radio and television systems, supervised their construction, assisted facility acquisition efforts, and served as a consultant on the technical aspects of government regulation in the broadcast, microwave, and cellular telephone industries. He participates in industry committees and speaks at industry forums, training sessions, and panel discussions.

Mr. Cavell is a member or associate member in several professional organizations, including the National Society of Professional Engineers (NSPE), the Institute of Electrical and Electronic Engineers (IEEE), the Society of Broadcast Engineers (SBE), the Virginia Society of Professional Engineers, the Royal Television Society, and the Society of Motion Picture and Television Engineers (SMPTE). He was formerly the President of the IEEE Broadcast Technology Society, the New Orleans chapter of the IEEE Communications Society, and a local chapter of the Virginia Society of Professional Engineers. He holds an Extra Class Amateur Radio

License and is an instrument instrument-rated private pilot.

Dr. Richard Chernock (Chapter 5.22) is currently Director of Technology at Triveni Digital, Princeton, New Jersey. In that position, he is developing strategic directions for metadata management, content distribution, and monitoring in emerging digital television systems and infrastructures.

Previously, Dr. Chernock was a Research Staff Member at IBM Research, investigating digital broadcast technologies. He is active in a number of the ATSC standards committees, particularly in the area of metadata and data broadcast. He chairs a number of ad hoc committees within ATSC whose work relates to metadata and transport issues. He is Vice Chair of the ATSC Technology Group on Distribution (TSG).

In a previous position, Dr. Chernock used transmission electron microscopy to study materials characteristics for advanced ceramics packaging and semiconductor technology at IBM. His ScD was from MIT in the field of nuclear materials engineering.

Steve Church (Chapter 3.10) spent the first part of his career as a Chief Engineer at stations WFBQ in Indianapolis, IN Indiana, and WMMS in Cleveland, Ohio. He was also a part-time talk-show host. In this dual role, he determined that broadcast telephone interfacing systems needed to be improved. As a result, he developed the first digital audio telephone interfacing product for the radio broadcasting industry, the Telos-10 on-air phone interface. After selling a few to friends and getting a positive reaction, he decided it had commercial potential and founded Telos Systems to manufacture and market it.

Twenty years later, Mr. Church remains head of Telos Systems, which has grown to include Zephyr ISDN/IP codecs, Omnia processing, and Axia IP-based studio equipment. He was the first to use MP3 in a telephone interface product.

Mr. Church is a co-inventor of Livewire, an Ethernet/IP technology for the transport and routing of professional studio-grade audio.

Tim Claman (Chapter 5.11) is Director of Product Design for Avid Technology, Inc., the leading manufacturer of media content creation tools.

During his six-year tenure at Avid, Tim has contributed to a number of product and technology areas, including Avid's nonlinear editing products, as well as the Avid Unity family of collaborative storage and asset management solutions. His unique perspective on media creation solutions stems directly from his 10-year career in film and television post production.

An accomplished sound editor, designer, and mixer, Tim has worked in a variety of environments, from full-service post production facilities like Pacific Ocean Post in Santa Monica to small boutiques such as the Crescendo! Studios in San Francisco. He has contributed to countless productions, including feature films (Oliver Stone's *The Doors*), episodic and cable TV

programs ("NYPD Blue"), and national commercials (Budweiser Frogs).

Kerry W. Cozad (Chapters 4.11, 6.6) joined Dielectric Communications in 1998 and presently holds the position of Senior Vice President, Broadcast Engineering.

Mr. Cozad is a native of Jonesboro, Georgia. He received his B.E.E. degree (with highest honors) from the Georgia Institute of Technology in 1981. He joined the Broadcast Division of Harris Corporation in June of 1981 and became the Lead Engineer for the Antenna Group in 1986. In this position, he was responsible for the electrical design of high power VHF, UHF, and multiplexed FM antennas. In 1988, he joined Andrew Corporation. As Engineering Manager for Broadcast Products, he was responsible for the design of high and low power broadcast transmission systems including UHF and VHF antennas, transmitting antennas for ITFS/MMDS services, HELIAX, coaxial cable products, and rigid transmission lines for broadcast services.

Mr. Cozad is a member of the IEEE and served for six years on the Broadcast Technology Society Administrative Committee, as well as serving for four years on the board of the Association of Federal Communications Consulting Engineers. He also served on the Technical Advisory Committee for the Wireless Cable Association (WCA) during the transition from analog to digital transmission for the ITFS/MMDS services.

Mr. Cozad has written several articles published in trade magazines in Europe, Asia, and the United States, and gives presentations regularly at the NAB Engineering Conference and local SBE conferences. He authored Chapter 19, "Coax/Transmission Line" in *The Electronics Handbook* by CRC Press.

Aldo Cugnini (Chapters 1.13, 1.14) is a consultant in the digital television industry, with expertise in broadcast systems, consumer electronics product development, market research and analysis, intellectual property analysis and defense, and industry standardization. His clients include the Association for Maximum Service Television, major consumer electronics companies, and electronic and print media companies.

Aldo held technical and management positions at Philips Electronics' Research and Consumer Electronics Divisions and at ACTV, an interactive-television developer. He was a leader in the development of the ATSC system and its progenitor, the "Grand Alliance" digital HDTV system. Earlier, he developed audio and RF systems at Broadcast Technology Partners, the CBS Technology Center, and was an RF specialist at RCA Broadcast Systems.

Aldo received BS and MS degrees from Columbia University, holds an FCC First Class Commercial Radiotelephone Operator's License, and holds six patents in the fields of digital television and broadcasting. He served on the Board of Directors of the Advanced Television Technology Center, and writes numerous industry reports, technical papers, and publications.

Aldo received a 1997 Engineering Emmy and *R&D Magazine's* 1998 R&D 100 Award. He was a finalist in

the 2005 IEEE-USA Congressional Fellowship program, and is a member of the Academy of Digital Television Pioneers, the Institute of Electrical and Electronics Engineers, and Eta Kappa Nu. He is a past member of the American Association for the Advancement of Science, the Audio Engineering Society, and is listed in *Who's Who in America*.

Aldo is a concert timpanist by avocation, and serves on the Board of Trustees of the Hanover Wind Symphony. He resides in New Jersey with his family.

Birney Dayton (Chapter 5.5) is currently the Chairman and CTO of NVISION, Inc., which he and two others founded in 1989.

Since 1968, Mr. Dayton has been active in the broadcast industry. He spent 4 years in television production and equipment maintenance while completing his BSEE at the University of Nevada, Reno. In 1973, he joined Grass Valley Group, Inc., and for the next 16 years he designed and managed the development of many products. From 1983 to 1989, he was VP of Engineering.

Over the last 30 years, Mr. Dayton has spent considerable time working on industry committees helping to advance the state of the art. He was involved in the development of SMPTE analog and digital component video standards, and was cochairman of the SMPTE High Definition Electronic Production working group. He also chaired the Systems Analysis Working Party of the Advisory Committee on Advanced Television Service.

Mr. Dayton has authored numerous industry papers, is a Fellow of the SMPTE, and holds 16 patents.

Jed Deame (Chapter 5.12) is Cofounder, Vice President, and General Manager of Teranex, a division of Silicon Optix. He developed the concept for the Teranex Video Computer, the first fully software-based real-time video supercomputer.

Mr. Deame began his career in television in 1982 while attending the University of Central Florida. He worked in a post production house as an engineer for four years while earning his Bachelor of Science degree in electrical engineering. He then worked at Lockheed Martin as a Video Systems Design Engineer, developing parallel processing architectures for real-time image processing applications.

Mr. Deame is a member of SMPTE, The Society of Information Display, and the Hollywood Post Alliance. He presents regularly at various conventions and technical symposiums around the world. He is also a contributing author for various home theater magazines.

Jeff R. Detweiler (Chapter 4.13) is Director of Broadcast Technology for iBiquity Digital Corporation, where he directs broadcast product development and the introduction and launch of its HD Radio™ brand of In-Band On-Channel (IBOC) technology to radio stations worldwide. He manages the technical relationships with broadcast equipment manufacturers

and coordinates the transfer of technology to iBiquity's licensees.

Mr. Detweiler has 27 years of experience in the radio industry. Prior to joining iBiquity Digital, he spent 12 years in sales management at QEI Corporation, last serving as Worldwide Sales & Marketing Manager. Prior to joining QEI, he was the Northeast Sales Engineer for Allied Broadcast Equipment. He served as Chief Engineer at Lake Erie Radio (WWWE and WDOK) in Cleveland, Ohio, from 1985 to 1987 and in the same capacity at Nassau Broadcasting (WHWH and WPST) Princeton, New Jersey, from 1983 to 1985.

Mr. Detweiler is a frequent presenter at NAB, IEEE, and other industry conferences and events and a frequent contributor to broadcast publications.

Anne Devine (Chapter 2.6) is Manager of Public Relations for Medtronic Emergency Response Systems in Redmond, Washington, where she has worked for more than five years in marketing communications and public relations. Before Medtronic, she was Director of Communications at the University of Washington School of Nursing for six years. She provided communications consulting and writing and editing services for several high-tech startups, including drugstore.com, where she was pharmacy editor.

Ms. Devine holds a Master of Arts degree from the University of Washington and a BSN from the University of Missouri. She has served on the boards of Women in Communications and the Public Relations Society of America, and is a member of the American Marketing Association and Women in Digital Journalism. She is a freelance writer on a number of topics and enjoys hiking and traveling with her family and black standard poodle.

Medtronic's Emergency Response Systems business unit, located in Redmond, WA, pioneered defibrillation technology over 50 years ago, and with more than 600,000 LIFEPAK defibrillators distributed worldwide, it is the world's leading provider of external defibrillators for the treatment of sudden cardiac arrest. Go to www.medtronicers.com or call 1-800-442-1142 for more information.

Bruce Devlin, MA, CEng, MIEE, (Chapter 5.6) is Vice President, Technology, Snell & Wilcox.

Bruce graduated from Queens' College Cambridge in 1986 and has been working in the broadcast industry ever since. He joined the BBC Research Department, where he worked on Radio-Camera systems before moving to France, where he worked on sub-band and MPEG coding for Thomson. He joined Snell & Wilcox in 1993, where he started the company's work on compression coding.

Bruce holds several patents in the field of compression, has written international standards, and contributed to books on MPEG and File Formats. He is coauthor of the *MXF File Format Specification* and an active contributor to the work of SMPTE and the AAF association. Bruce is a Fellow of the SMPTE (Society of Motion Picture and Television Engineers).

Daniel L. Dickey (Chapter 4.2) is Vice President of Engineering at Continental Electronics Corp. based in Dallas, Texas. He began his career in broadcasting in 1976, working at a 500W daytime AM station. He has over 25 years of experience designing AM transmitters from 1 kW to over 500 kW. In addition to working with AM transmitters, he has also led design teams for numerous FM and DTV transmitters. At Continental Electronics, his engineering team is responsible for the research, design, and development of all products manufactured by the company.

Mr. Dickey has a Bachelor of Science degree from the University of Missouri in Rolla, Missouri. He is a member of the IEEE Broadcast Technology Society.

Michael A Dolan (Chapter 1.17) is founder and President of Television Broadcast Technology, providing specialized professional encoders, test tools, and technical consulting in the field of digital television.

Mr. Dolan received a BSEE degree from Virginia Tech in 1979 and has worked for and founded various leading-edge computer graphics and real-time systems companies, including early foundational work in W3C technology and analog data broadcasting.

Mr. Dolan has been involved in digital television engineering for the past eight years, including data broadcast system architecture and digital receiver design and compliance. He currently chairs the ATSC Data Broadcasting Specialist Group (TSG/S13), chairs various groups in SMPTE and CEA, and is active in other data-related television standards activities.

Mr. Dolan is an SMPTE Fellow and holds several patents in computer web technology.

Joan Dollarhite (Chapter 1.3) is Director, Legal Operations, for the National Association of Broadcasters in Washington, D.C.. She is responsible for fulfilling legal research requests from NAB attorneys and other staff members. This work includes document retrieval from the FCC, other federal agencies, and the courts. She maintains the NAB Legal Library comprised of books, periodicals, and online and reporter services.

Joan assists in preparation of the department's operating budget as well as the budgets for the department's participation in the NAB Show and the Radio Show. She is the designated conference planner for Legal Operations and takes care of the logistic and administrative responsibilities associated with the conventions.

Joan drafts monthly reports updating the Executive Committee and Board Members on NAB Legal activities and legal developments occurring within the industry. She is the lead staff person for the department on NAB's I-Team, tasked with designing, updating, and maintaining legal sections of NAB website.

Joan graduated with honors from the University of Maine with a BA in broadcasting and has a law degree from New York Law School. She joined NAB in 1998 after working in radio news, public access, and cable television. Her legal background includes litigation, family law, and legal recruiting, as well as a year spent

on Capitol Hill monitoring telecommunications legislation.

Stephen P. Dulac (Chapter 6.15) is currently Director, Standards and Regulatory, in the Set-Top Box Engineering organization of DirecTV Inc., El Segundo, California. Since 1997, he has been with the company in system engineering roles supporting U.S. service launches including HDTV, local channel rebroadcasts, DVR, interactive services, and home networking.

Mr. Dulac received a BS degree in electrical engineering and an MSEE degree in telecommunications engineering from the University of California, Los Angeles (UCLA), in 1985 and 1987, respectively. Joining Hughes Aircraft Company in 1986 as a Masters Fellow, he contributed to many company projects as it evolved into Hughes Electronics and most recently into the DirecTV Group. At subsidiary Hughes Communications from 1986–1991, his responsibilities included the first digital satellite link budget analyses applicable to the DirecTV network. At Hughes Space and Communications from 1992–1994, he was Lead Payload Engineer for the Solidaridad system of communications satellites. From 1994–1997, he held the position of Director, Conditional Access, supporting the development and launch of the DirecTV Latin America service.

Mr. Dulac coauthored a paper, "Adjacent Satellite and Ground Station Interference," for the *Society of Motion Picture and Television Engineers (SMPTE) Journal* in December 1989. He led the authoring and adoption in 2000 of the CEA/EIA-805 standard for delivering data services across HD analog component interfaces. A Senior Member of the Institute of Electrical and Electronics Engineers (IEEE), he coauthored a paper, "Satellite Direct-to-Home," for the January 2006 *Proceedings of the IEEE Special Issue on Global Digital Television*. He holds three patents.

Thomas Edwards (Chapter 5.6, 5.21 Appendix) is the Senior Manager, Interconnection Engineering, for the PBS Interconnection Replacement Office. He is currently responsible for the engineering management of the PBS Next Generation Interconnection System (NGIS), including work on the development of an MXF Application Specification for video file distribution to public television stations, and development of the NGIS file transfer and station edge server systems. Thomas is also the author of Internet RFC 4539 "Media Type Registration for SMPTE MXF."

Before joining PBS in 2002, Mr. Edwards was the Streaming Media Product Manager at Cidera, where he developed a broadband desktop video channel for technical employees delivered using IP-over-satellite. He was also responsible for streaming media production and delivery at the Internet service provider DIGEX as well as his own streaming media company, The Sync.

Mr. Edwards holds a Master's degree in electrical engineering from the University of Maryland, and is a member of IEEE and SMPTE.

John Robert Emmett, PhD, MIBS, MRI, (Chapter 3.4) joined the Engineering Department of Thames Television in London after gaining a PhD at Durham University and BSc (Hons) in applied physics. He started the UK audio equipment manufacturer EMO Systems. While at Thames Television, he worked on subjects as diverse as film archive formats and psychoacoustics, and along the way gained six international patents as sole inventor. Jointly with Lee Lighting, he received a Technical Oscar for developing the flicker-free Lighting Ballast.

Dr. Emmett continued as R&D Manager with Pearson Television, and is currently Technical Director and Chief Executive of Broadcast Project Research, a new independent studio based research group. In conjunction with Channel Four Television in the UK, BPR was responsible for developing the "Gordon" Photoepilepsy Monitor.

Dr. Emmett, representing the UK as principle digital audio expert to the IEC, is perhaps best known for his work on digital audio and video standards. At present he chairs the EBU digital audio advisory group, which was responsible for the Broadcast Wave Format.

Dr Emmett also keeps closely in touch with the international academic community and he chaired the IEE Broadcast Summer School in the UK for many years.

Steve Epstein (Chapter 5.8) is the owner/editor of BroadcastBuyersGuide.com. He began his broadcasting career 1978 in Woodward, Oklahoma. A graduate of Broadcast Center in St. Louis, he has held positions as Announcer, Master Control Operator, Chief Engineer, and Director of Operations at broadcast and production facilities throughout the Midwest.

Steve served as Technical Editor of *Broadcast Engineering* magazine and several other Intertec (now Prism Business Media) publications, writing and editing many of the features and columns. He has also written software for switcher control, departmental workflow, and automation systems as well as other broadcast engineering related tasks. He has served as a consultant to a variety of facilities and manufacturers in broadcast and related industries.

Steve holds a Professional Broadcast Engineer Certification from the SBE and a First Class Radiotelephone License from the FCC. He has presented papers at Broadcast Engineering Conferences held at NAB Conventions, SBE Annual Conventions, and ghost-written numerous papers that are included in conference proceedings from conventions around the world. He is an instrument-rated private pilot.

Dane E. Ericksen, P.E., CSRTE, 8VSB, CBNT, (Chapters 1.6, 1.7) received a BSEE from California State University, Chico, in 1970. His first job was an inspector for the San Francisco FCC office. He rose to Senior FM/TV/CATV Specialist, operating one the FCC Enforcement Unit monitoring trucks.

In 1982, Mr. Ericksen joined Hammett & Edison, Inc., Consulting Engineers, and is a senior Consulting

Engineer designing broadcast and broadcast auxiliary services stations licensed by the FCC, except standard broadcast.

Mr. Ericksen is a fifth-term SBE national director, has chaired the SBE FCC Liaison Committee since 1987, and has responsibility for national-level SBE filings with the FCC. He has served on the SBE Certification Committee for over 20 years, and was Chapter Chairman, Vice Chairman, and Secretary of SBE Chapter 40, San Francisco.

Mr. Ericksen is an SBE Fellow and recipient of the 1999 SBE Engineer of the Year award. He is a registered Professional Engineer (electrical) in the State of California.

Mr. Ericksen has written technical articles for broadcasting trade journals, and writes a column for the SBE *Signal* regarding regulatory issues affecting BAS spectrum. He served on the NAB/SBE Engineering Conference Committee for eight years and on the ANSI/IEEE C95.1 Committee for five years. He is a regular participant in NAB Broadcasting Engineering Conferences.

Mr. Ericksen has served as Chairman of ATSC Technology & Standards Group S3 Specialist Group on Digital ENG since November 2003, which deals with standards for the 2 GHz TV BAS data return link channels and for Digital ENG communications.

Mr. Ericksen resides in Sonoma, California.

Donald G. Everist (Chapters 4.15, 6.9) is a graduate electrical engineer from the University of Illinois. He is a Registered Professional Engineer in the District of Columbia and is President of the firm of Cohen, Dippell and Everist, P.C., located in Washington, D.C.

Mr. Everist has been in the consulting engineering business with this firm or its predecessors for over 45 years. During this time, he has performed numerous AM, FM, and DTV interference and allocation studies, including microwave and other communication systems and field strength surveys worldwide for AM, FM, and TV broadcast stations. He has prepared exhibits and documentations for submission before the Federal Communications Commission (FCC) and international forums. He has also served as a U.S. delegate to several international (ITU) conferences.

Mr. Everist is a member of the Institute of Electrical and Electronic Engineers (IEEE); the National Society of Professional Engineers (NSPE); the Illinois Society of Professional Engineers, and a member and past president of the Association of Federal Communications Consulting Engineers (AFCCE).

Rod Fairweather (Chapter 5.16), Harris Corporation, studied electronic engineering at Edinburgh University, and obtained his MBA at Imperial College, London.

After joining BBC TV as an engineer, Rod moved into studio directing, where he built up extensive live directing experience with the BSkyB, GMTV, and ITN facilities. He joined VH-1 as Senior Producer for the launch of the UK version of the channel

before traveling extensively to launch channels and to train operational staff.

Rod joined Harris Corporation to set up and run a major multichannel broadcast operation before moving into product management of broadcast software.

Rod is the author of *Basic Studio Directing*, published by Focal Press.

Ty Ford (Chapter 3.3) formed his own company, Ty Ford Audio & Video, in 1986, and simultaneously began reviewing professional audio equipment for Radio World. He is recognized internationally as a specialist in the field of microphones and preamplifiers. He writes feature stories and equipment reviews for *Radio World*, *TV Technology*, and *Pro Audio Review*. He keeps an online review archive at www.tyford.com.

Mr. Ford passed his First Class Radio Telephone Operator's License test in 1969. He spent 17 years as a Chief Engineer and Production Director at top twenty market radio stations in Baltimore and Washington. He was recognized by the NAB as a significant contributor to NAB publications and conventions. He has given seminars about audio production and rewrote the *NAB Guide to Radio Copy Writing*.

Frank Foti (Chapter 3.8) is the Founder and President of Omnia Audio, an innovative signal processing company, located in Cleveland, Ohio. He leads a talented team that researches and designs audio processing for every form of broadcasting: FM/AM/TV, HD Radio, DAB/DRM, Music Mastering, and Netcasting. He is working diligently towards implementing discrete 5.1 surround audio for FM radio using the HD Radio system and the Internet. He is a frequent presenter at NAB, AES, SBE, and state broadcaster association conventions and has written for all of the broadcast trade publications.

Mr. Foti, in an earlier life, was "in the trenches" of day-to-day radio as Chief Engineer for a number of successful radio stations in the United States, including WMMS/WHK (Cleveland), KSAN/KNEW (San Francisco), and the well-known Z-100, WHTZ-FM (New York City), which he designed and built in 1983. Outside the world of broadcast audio, he is deeply involved in the world of 1/8th scale live steam railroading.

John D. Freberg (Chapter 6.4 Appendix) heads The Freberg Engineering Company in Homewood, Illinois, and has a broad and varied background in electronic media and communications technology. As Manager of Technical Operation at CBS's WBBM-TV in Chicago, he is actively integrating digital television and advanced networking as part of the construction of a new television facility from the ground up. He also directed the engineering departments at several AM and FM stations. As a Project Manager for Tribune Company, he was involved in the implementation of advanced network infrastructures and information systems.

John received his Bachelor's degree from Northern Illinois University in De Kalb, Illinois. In 1997, he completed his Master of Science in communication systems at Northwestern University in Evanston, Illinois.

In addition to pursuing a dual-track career in broadcast engineering and information systems, John has taught courses in advanced network management at Northwestern University, and is currently on the faculty of Lewis University in Romeoville, Illinois. His current course assignments include electronics, engineering, and communications technology.

John is active in industry developments as a member of several IEEE Societies, including the Broadcast Technology Society, and is currently serving on the G2.2 RF Standards Committee. He is a member of the Society of Broadcast Engineers and the Society of Cable Telecommunications Engineers. He has written articles and presented seminars for the NAB Engineering Conference, *Broadcast Engineering* magazine, and other organizations.

James "Brad" Gilmer (Chapter 5.6) is President of Gilmer & Associates, Inc, a management and technology consulting firm in Atlanta, Georgia, providing services to a wide variety of clients in the television industry.

Brad graduated Summa Cum Laude with a major in business management from Georgia State University, and is a member of Beta Gamma Sigma.

Brad started his broadcasting career in Albuquerque, New Mexico, first as Assistant Chief Engineer at KRKE Radio, then as a transmitter engineer at KGGM-TV. He was Director of Engineering and Operations at Turner Broadcasting Systems in Atlanta and was responsible for implementing digital facilities serving the U.S., Asian, and Latin American markets, for the first installations of broadcast automation systems at TBS, TNT, and Cartoon networks, and some of the industry's first large multichannel, multilanguage network launches in Atlanta, London, and Asia.

Brad is Executive Director of the Advanced Authoring Format Association, which developed the Advanced Authoring Format (AAF), and participated, along with the Pro-MPEG Forum and the SMPTE, in co-development of the Material eXchange Format (MXF). He served as cochair of the Pro-MPEG Forum's File Interchange working group. He also serves as Executive Director of the Video Services Forum (VSF), an association focused on delivering video over packetized networks.

Brad is Editor-in-Chief of the *File Interchange Handbook* (Focal Press), author of the monthly "Computer and Networks" column in *Broadcast Engineering* magazine. He is a frequent presenter at broadcast conventions including SMPTE, VidTrans, NAB, and IBC.

Brad is a Fellow of the SMPTE, has been an active participant within the SMPTE since 1984, and a Manager of the Atlanta Section.

John P. Godwin (Chapter 6.15) is currently with Gretna Green Associates, Los Angeles, California, a consultancy in electronic media and telecommunications. His

personal research interests include exploring applications for the High Altitude Platform Service (HAPS). He received a BA degree in physics from DePauw University, Greencastle, Indiana, and MSE degrees in aerospace engineering and in computer, information, and control engineering from the University of Michigan, Ann Arbor.

Mr. Godwin was a Laboratory Manager with Hughes Communications, a satellite-based communications carrier, in the 1980s, and part of the DirecTV startup team formed in 1991. He contributed to system architecture and management including the satellites, broadcast centers, consumer electronics, and conditional access. He held the position of Senior Vice President, Engineering, from 1994 to 1997 during the DirecTV service launch. From 1997 to 2002, he was Senior Vice President, New Technologies, providing strategic planning and architecture enhancements. He led the workflow activities of DirecTV-Japan and provided oversight for a substantial company investment in XM Satellite Radio. From 2002 to 2004, he was Chief Technology Officer at Movielink, LLC, an online movie rental and distribution service owned by major movie studios.

Mr. Godwin was one of three DirecTV managers accepting the company's Emmy Award for Pioneering Achievement in Direct Broadcast Television. He is a member of the Space Technology Hall of Fame. He holds six patents.

Matthew Goldman (Chapter 5.22) has been Vice President of Technology, Compression Systems, for TANDBERG Television Inc. since 2004.

Mr. Goldman has been involved digital television (DTV) systems developments since 1992, particularly in the Moving Picture Experts Group (MPEG) where he helped create the MPEG-2 Systems standard, the baseline transport technology used in terrestrial broadcasting, digital cable, direct broadcast satellite, and DVD-video. He also served as project editor for the MPEG-2 DSM-CC standard, the control signaling used in video-on-demand systems and for DTV data downloads and carousels. He was a co-developer of the ATSC Program and System Information Protocol (PSIP) standard used by DTV receivers to navigate and tune to broadcast DTV services. He is an active member of the SMPTE, SCTE, the Consumer Electronics Association, and the ATIS IPTV Interoperability Forum.

Until 1996, Mr. Goldman was a Consulting Engineer at Digital Equipment Corporation, and from 1996 to 2000, he was Director of Engineering, Advanced Systems Development, at DiviCom Inc. From 2001 to 2003, he was a technology consultant specializing in DTV system solutions, including the definition of a compressed-domain high definition program splicer for the FOX Broadcasting Company.

Mr. Goldman received his BS (high honors) and MS degrees in electrical engineering from Worcester Polytechnic Institute. He holds six patents related to digital video transport. He is a senior member of the IEEE, SMPTE, and the Academy of Digital Television Pio-

neers. He has presented papers at the NAB Convention, the SMPTE Technical Conference, the SCTE Cable-Tec Expo, Supercomm, TelecomNext, the International Broadcasting Convention (IBC), and the Hollywood Post Alliance Retreat. He has been published in the *IEEE Proceedings* and has been a contributing writer to trade magazines.

Dave Guerrero (Chapter 8.2) is Vice President and General Manager for Videotek® Test and Measurement, Broadcast Communications Division, Harris. He brings to the company more than 30 years of real-world experience in the broadcast industry and applies his substantial knowledge and expertise to new product development.

Dave's long and diverse career includes extensive hands-on experience in live and studio audio and video productions. Before joining Videotek in 2002, Dave held progressively responsible positions with various broadcast radio and television stations, culminating in the prestigious role of Engineer-in-Charge of network-level remote productions for all U.S. broadcast networks.

Dave is a highly respected authority in the area of television production and has supervised the engineering for coverage of numerous high-profile events, including the Macy's Thanksgiving Day Parade, the State of the Union Address, multiple Super Bowls, and the 1988, 1996, and 2002 Olympics.

Dave holds an FCC General (formally First) Class Radiotelephone License, is an active member of SMPTE, AES, SBE, and IEEE and has earned two Emmy® Awards for his contributions in the area of engineering expertise.

Linley Gumm (Chapter 8.4), now retired, spent nearly 40 years designing RF test equipment for Tektronix, Inc. A major effort was to lead the RFA300A (8-VSB signal analyzer) project, where he learned the intricacies of testing the 8-VSB signal.

Mr. Gumm is an inactive professional engineer in the state of Oregon and an IEEE member. He holds a BSEE from Washington State University, an MSEE from the University of Washington, and has 22 United States patents. He is currently active on the IEEE standards committee, creating RF measurement standards for DTV.

Harold Hallikainen (Chapter 9.5) was one of the founders of Hallikainen & Friends in 1974. The company started as a contract engineering firm, then quickly moved into manufacturing, specializing in broadcast transmitter telemetry and control. In 1995, he joined Dove Systems where he does embedded system design for Dove and several other manufacturers.

Mr. Hallikainen studied electronic engineering at Cal Poly, San Luis Obispo, California. He has written over 100 articles on FCC Rules and maintains a website devoted to FCC Rules. He has taught electronics part time at Cuesta College in San Luis Obispo for 25 years.

William F. Hammett, P.E., (Chapter 2.4) has over 20 years of experience measuring, calculating, and mitigating RF exposure conditions at radio and TV stations, satellite and radar facilities, cell sites, and industrial plants. He authored the book *RF Radiation—Issues and Standards*, published in 1997 by McGraw-Hill. He is a frequent speaker on the topic and has presented papers at three NAB Engineering Conferences.

Mr. Hammett graduated from Dartmouth College magna cum laude in 1977 and earned a Master of Science degree from the University of Illinois in 1978. He has worked at Standard Oil of California and Dean Witter Reynolds and is a principal with Hammett & Edison, Inc., Consulting Engineers.

Mr. Hammett is a Registered Professional Engineer in California (Mechanical and Electrical) and other states.

Peter J. Harman (Chapter 5.4) currently holds the position of Product Marketing Manager for the Lightweight Vinten brand worldwide. He began his career with Vinten Broadcast Limited in 1972, having served his mechanical apprenticeship with Corning Medical, then a UK subsidiary of the US Corning group. He has held positions within Vinten Broadcast Limited as Development Engineer, Design Engineer, Customer Support Manager, Quality Manager, and Marketing & Training Manager.

Mr. Harman has earned professional qualifications within Quality Management (Associate Member IQA), Marketing (Member IDM), and Training (Associate Member CIPD). He also holds national diplomas in Performance Coaching and Business Excellence and regularly contributes articles to many international magazines and professional publications.

James B. Hatfield, P.E., (Chapter 4.5) was a founding partner of Hatfield & Dawson Consulting Engineers in 1973. He is registered as a Professional Engineer in the states of Washington, Oregon, and Hawaii.

Mr. Hatfield has written numerous papers over the years on the analysis and adjustment of AM directional arrays using Method of Moment techniques. These papers have been presented at IEEE BCT, NAB, Applied Computational Electromagnetics Society meetings, and published in their journals. He has authored chapters on this subject in the *NAB Engineering Handbook* and *The Electronics Handbook*. He is a charter member of the Applied Computational Electromagnetics Society, ACES.

Mr. Hatfield serves on the IEEE International Committee on Electromagnetic Safety (ICES) Standards Coordinating Committee SCC28, Non-Ionizing Radiation, and its subcommittees SC-1, SC-2, SC-4, and SC-5 of SCC28. SC-4 was charged with revision of IEEE C95.1-2005, *Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz*. He is current chair of the SC4, C95.1-1991 Interpretations Working Group, and a member of the SC4 Engineering Working Group RFR Literature Review and Risk Assessment Working Group.

Dr. Paul Hearty (Chapter 6.14) is Associate Dean of the Faculty of Communication & Design and Director of the Rogers Communications Centre of Ryerson University in Toronto, Ontario, Canada. He joined Ryerson University in 2003. His role there is to enhance the Rogers Communication Centre's capacity and agenda for in-house and collaborative research.

Dr. Hearty received his PhD from Queen's University in 1981. He joined Industry Canada's Communications Research Centre in 1980. He founded several labs, including the Advanced Television Evaluation Laboratory, which carried out tests of High Definition Systems as part of the joint U.S.–Canada DTV standardization effort.

Dr. Hearty joined General Instrument (now Motorola Broadband) in 1994. He led the digital HDTV Grand Alliance group responsible for the video subsystem and served in the group overseeing development and standardization of the overall system. He spearheaded the deployment of General Instrument's technology for digital compression, multiplexing, and satellite transmission in Canada.

In 2001, Paul joined DemoGraFX, a company developing advanced video compression technology. In 2002, he started his own company, assisting clients in assessing, developing, and marketing advanced digital technologies.

Dr. Hearty has been active in many standards bodies, including the FCC Advisory Committee on Advanced Television Service, the Advanced Television Systems Committee, and the International Telecommunications Union. He chaired the Society for Cable Telecommunications Engineers' Digital Video Subcommittee, which sets standards for digital cable in North America since its inception in 1996, and currently is cochair of Canada's Digital Television Technology Group (DTV-TC), a government-industry-university advisory group.

Richard G. Hickey (Chapter 7.4) entered the field of technical sales in 1983. His entry into the world of Aviation Obstruction Lighting occurred in 1996 by joining the staff of Flash Technology in Franklin, Tennessee. In his tenure at Flash, he has held the positions of High Intensity Sales Manager, Product Manager, International Sales Manager, and Inside Sales Manager.

Richard has designed lighting systems within the parameters established by the FCC/FAA, ICAO, DGAC, Transport Canada, and the NEC for various high-profile sites around the world.

Richard has spoken at many broadcast industry events and SBE meetings in 36 states and Canada. His advice and input are sought for a wide-ranging assortment of lighting challenges, including the Egyptian Minister of Aviation, the Suez and Panama Canals, wind turbines in Austria and Germany, a U.S. observatory in the Antarctic, and the former World Trade Center Towers in New York. His favorite projects, however, have been the many broadcast tower configurations with which he has worked across the United States.

Thomas J. Hoeninger (Chapter 7.2) is a member of Stainless LLC and currently holds the positions of Vice President of Operations and Chief Engineer. He has been designing, analyzing and modifying towers for Stainless for 18 years. Prior to this, he worked for FMC and Symons Corporation designing complex structures and concrete forming systems.

Tom holds a BSCE and an MSCE from Drexel University and is a Licensed Professional Engineer in 26 states. He is actively involved in the TIA TR14.7 subcommittee, which maintains the TIA 222 structural standard for antenna support structures and antennas. He is also actively involved in the ASTM A01.02 subcommittee, which maintains the ASTM standards on structural steel for bridges, buildings, rolling stock, and ships.

Tom performs peer reviews of submitted articles to be published in the *AISC Engineering Journal* and has presented papers at the NAB convention and PBS conferences.

George Hoover (Chapter 5.17) serves as Senior Vice President and Director of Engineering for all divisions of NEP Broadcasting, Inc., including the mobile, studio, and video screens groups in the United States and England and has been a member of the NEP Broadcasting family since 1993. He possesses substantial television technical engineering expertise and design skills, and he plays a vital role in long-term strategic planning for NEP and its clients.

Prior to joining NEP, Mr. Hoover was General Manager of the Public Broadcasting Authority (New Jersey Network) of the state of New Jersey from 1982 to 1993. Prior to NJN, he was a partner in Video East; a Philadelphia-based mobile unit company. He was with RCA Broadcast Systems in the mid-seventies.

Mr. Hoover attended Florida State University. He earned a Sports Emmy® for the 1996 Summer Olympics in Atlanta as technical team supervisor and a second Emmy® as Producer of the PBS Super Band series with Amad Jamal. He published a book with coauthor Jim Boston in 2003 entitled *TV on Wheels, The Story of Remote Television Production*.

Mr. Hoover is a member of the Society of Motion Picture and Television Engineers, Omicron Delta Kappa, and the American Institute of Architects.

Jeff Hutchins (Chapter 5.24) retired in 2006 as Chairman of the Accessible Media Industry Coalition, a trade association of companies that provide services such as captioning and video description to make media programs accessible to people with hearing and/or vision impairments.

Prior to this, he was an owner and the Executive Vice President, Planning and Development, of VITAC, a Pittsburgh-based company providing complete captioning services nationwide. He also was Director of Systems Development at the National Captioning Institute (1980–86); and from 1973 to 1980 was producer of *The Captioned ABC News* and an executive for The Caption Center, WGBH-TV, in Boston.

He has been honored as one of the pioneers who helped implement closed captioning. He was the author of the closed-captioning specifications adopted by the FCC in 1992, and the principal author of the EIA-608 standard.

Mr. Hutchins currently is a member of the Boards of Trustees of the Western Pennsylvania School for the Deaf (in Pittsburgh, Pennsylvania) and the American Community School in Beirut, Lebanon.

He has a Bachelor of Science degree in broadcasting and film from Boston University.

Jim Jachetta (Chapter 6.10) is the Senior Vice President of Sales and Marketing at MultiDyne Video & Fiber Optic Systems. His responsibilities include sales, marketing, product management, and developing new markets for the expanding MultiDyne product line.

Jim began his career as a technician in 1982 while earning a Bachelor of Science degree in electrical engineering from Polytechnic University in Brooklyn, New York. After college, he worked for Micro Corp designing Hybrid Micro-Electronics for military video guidance systems. While working full-time at Micro Corp he earned a Master of Science degree in electrical engineering and communications from Polytechnic.

Jim took a position in 1986 at MultiDyne Video & Fiber Optic Systems as a Design Engineer. He was part of the team that developed a high-end, broadcast quality, RS-250C Short-haul fiber optic product line. He also contributed to the design of the TS12 Video Test Signal Generator; VDA8505 Field Video DA and Equalizer; AB200 Automatic Bypass; VLD-2 Video Loss, Black, White Detector, and DTV100/200 Series SDI Fiber Transport. In 1994, he became Vice President of Engineering and Product Development at MultiDyne.

Jim is a member of the Society of Motion Picture and Television Engineers, the National Association of Broadcasters, and The Alternative Board. On weekends he volunteers as a sound technician at his local church.

Brett Jenkins (Chapter 6.4) is the Vice President of Engineering for Thomson Broadcast & Multimedia, Inc., which is part of the Grass Valley business unit within Thomson. He heads the research, product development, and systems engineering groups for Thomson Broadcast & Multimedia's U.S. headquarters located in Southwick, Massachusetts.

Prior to his current position, Brett was responsible for modulator and exciter technology development for broadcast products for the company. He was the lead U.S. engineer in a global team responsible for the development of Digital Adaptive Precorrection technology. Thales received a technical and engineering excellence Emmy® award for pioneering this technology in 2003.

For the past several years, Brett has been active in many broadcast industry groups involving Digital Television. He has authored and presented technical papers and tutorials on various digital communications topics.

Brett received a BSEE with honors from the University of Massachusetts, Amherst, in 1992 and an MBA from Boston University in 2005. He is a member of the Institute of Electrical and Electronics Engineers (IEEE) and the Society of Motion Picture and Television Engineers (SMPTE).

J. Dane Jubera (Chapter 4.9) is presently Senior Antenna Engineer at Jampro Antennas, Inc., where he has spent over a decade designing antennas for FM and television broadcast applications.

Mr. Jubera earned his BS in electrical engineering from Wayne State University, Detroit, Michigan. He has worked in the broadcast and cable television industries throughout his career.

Thomas Kite (Chapter 8.1) is Principal Engineer at Audio Precision, Inc., in Beaverton, Oregon. He has written much of the signal processing code for the System Two Cascade/2700 and APx500 line of products. Before joining the company in 1999, he worked at Hewlett-Packard Labs in Palo Alto, California, and Xerox Labs in Webster, New York.

Mr. Kite received his Bachelor's degree in physics from Oxford University, England, in 1991, and his Master's and PhD degrees in electrical engineering from the University of Texas at Austin in 1993 and 1998, respectively.

Mr. Kite regularly gives technical seminars and presentations. He is a member of the Audio Engineering Society (AES), and sits on the AES digital audio measurement standards committee.

Stephen Kolvek (Chapter 6.7) joined MYAT, Inc. in September, 1991, as an Electrical Engineer for transmission line products. His broadcast experience career began with work on complex hybrid feed systems. Over the years at MYAT, he has been involved in directing new product development and design changes. He is currently responsible for developing and implementing MYAT Quality Control Systems, Engineering Design Control Procedure, Corrective Action and Preventive Action Procedure, Nonconforming Product Procedure, and Contract Control Procedure for Government Applications.

Mr. Kolvek is also responsible for directing and administration of the Drafting Department operations and infrastructure and the RF Test Laboratory and R&D Facilities, and interfaces closely with manufacturing, production, and assembly departments. His knowledge of transmission line theory, RF combiners, and feed systems have aided MYAT in developing 7-3/16" 75 Ohm Coaxial transmission line and related accessories, MYAT EStar N-Way power combiners, *SpectraLine* Broad Band Rigid Coaxial transmission line systems, *SpectraGuide* Rigid Elliptical Wave Guide, and custom components specific to customer applications.

Mr. Kolvek received a BSEET degree in 1987 from DeVry Institute of Technology in Chicago, Illinois, and an Advanced Electronics Engineering Diploma from DeVry Technical Institute, Woodbridge, New Jersey.

He is coauthor of a patent for the MYAT EStar power combiner.

Geoffrey A. Krenkel (Chapter 9.4) is a Senior Associate at John-Winston Engineers and Consultants, Inc., for which he provides professional consulting services mainly in the field of electrical power engineering. He is a Licensed Professional Engineer in the state of New Jersey.

Mr. Krenkel received his Bachelor of Science degree from Rutgers College of Engineering in the curriculum of electrical and computer engineering. He is a Fellow of the IEEE. His memberships include The Industry Applications Society and The Power Engineering Society. His early career achievements include telecommunications design for the government/military and later broadcast system engineering design for major cable networks and traditional broadcast facilities.

Alan Lamshead, BEng, PEng, (Chapter 5.24) is Vice President of Engineering for Evertz Microsystems, and an acknowledged leader in the fields of HDTV, post production and production with over 25 years of experience. Since joining Evertz in 1979, he has led the design of post production and time code and closed captioning products.

In 1999, he pioneered encoding of Film Transfer metadata into 1080p/24 High Definition video with Sony and Laser Pacific Media Corporation. In 2003, he worked with Industrial Light and Magic and other manufacturers to advance this technology to 4:4:4 HDTV acquisition for the shooting of *Star Wars Episode III*. He led the Evertz team in the development of specialized HDTV products for James Cameron, Pace Technologies, and others in the high definition production and post production field.

Alan's list of industry standard production products include the Tracker Telecine Logging and Configuration system with HD9025TR-HD Film Footage Encoder and new 4:4:4 based HD9045TR. He designed the HD9155Q-AUD-HD Production Afterburner/Downconverter and worked with many of Evertz's other post-production accessories, including HD and SD Graticule Generators.

Alan is Lead Designer of Evertz's ECAS, High Definition Fiber-optic Enabled Camera Adapter System and downconverter accessory for HD production workflows for Sony and Panasonic HD and SD camcorders. He designed this system for use with current and future markets, including HDSDI with embedded audio and time code, NTSC/PAL, SDI, and IEEE1394A downconverted video.

Alan is active on SMPTE engineering committees and is author of several SMPTE recommended practices. He has presented papers at local chapter and national SMPTE conferences and is a widely recognized expert in the field of HDTV time code and sync issues, HDTV production, HDTV metadata and film to tape transfers.

Alan graduated from McMaster University in Hamilton, Ontario, with a BEng in electrical engineering in

1972, and was licensed as a Professional Engineer in Ontario in 1988.

Chris Lennon (Chapters 5.13, 5.22) works at Harris Corporation as Director of Integration and Standards in the Software Systems group and has worked in the broadcasting industry for over 20 years, the majority of that time on the software systems side. He has managed a wide array of products and led several large-scale projects at broadcast facilities around the world. He has also led the development of well over 100 interfacing/integration projects between broadcast systems.

Mr. Lennon is an Ontario Scholar, and earned his degree in commerce and computer science at McMaster University in Hamilton, Ontario, Canada. He resides in the United States as a dual citizen of both the United States and Canada.

Mr. Lennon is Chair of the SMPTE S22-10 Working Group, whose task is to standardize communications between Traffic, Automation, and Content Delivery Systems. He is also an active participant in the ATSC, where he was one of the early instigators of the effort that became PMCP, enabling PSIP-related data to flow between broadcast systems.

Matthew Lightner (Chapter 3.5) is the President of Lightner Electronics, Inc, a broadcast integration company that he founded in 1995. He also serves as the Broadcast Engineering consultant for the Pennsylvania Association of Broadcasters. At the PAB he is responsible for the Alternative Broadcast Inspection Program and he maintains the state Emergency Alert System.

Matt gives credit to his father for getting him interested in electronics. When he was only 7, he was helping in his father's part-time TV repair and satellite business. At the age of 15, a friend who worked as an announcer at a local radio station asked him to repair their cart machines. Curious as to what a cart machine was, he agreed to look at them and the rest is history. After he graduated from high school he was promoted to Chief Engineer of WVAM/WPRR radio in Altoona, Pennsylvania. Matt then engaged in contract engineering, which grew into Lightner Electronics, Inc., and has since designed and built over 60 radio studios and the radio broadcast facilities for AccuWeather.

When Matt gets a break from his busy schedule he enjoys spending time with his friends and family, traveling, and playing music.

Ronald E. Lile (Chapter 6.8) is currently the TV Antenna Engineering Manager for Electronics Research, Inc. He earned a Bachelor of Science degree in electrical engineering in 1979 from the University of Missouri at Rolla, Rolla, Missouri, after serving in the U.S. Air Force.

Mr. Lile's work experience includes radar, commercial flight simulators, and communications systems from HF to UHF. While with Texas Instruments, he participated in the development of one of the first microprocessor controlled automatic antenna tuning

units for marine applications. Prior to joining Electronics Research, he worked for a telecommunications company designing UHF power amplifiers, wide area network control and monitoring systems, plus he served as Regulatory Engineer interfacing with the FCC, ICC, UL, and customers. While with this company, he held positions as Systems Engineering Manager, Regulatory Compliance Manager, and Director of Customer Support Services.

Mr. Lile is a Member of the IEEE Antennas and Propagation Society and Broadcast Technology Society, and a Fellow in the Radio Club of America. He has an FCC First Radiotelephone License, is an amateur radio operator and a Life Member of the ARRL. He also holds a membership in the Quarter Century Wireless Association and actively participates in the Amateur Radio Emergency Service and RACES for Southern Indiana.

Edward Lobnitz, PE, (Chapter 7.3) serves as Consulting Principal at TLC Engineering for Architecture in Orlando, Florida. A foremost authority on lightning protection, he was a principal organizer and Chairman of the Lightning Protection Institute's Professional Division and a speaker at numerous LPI and United Lightning Protection Association events. He is a principal member of the National Fire Protection Association's (NFPA 780) Lightning Protection Standards Committee and has served on several other NFPA committees as a principal member.

As a highly honored Fellow in the Florida Engineering Society, Ed is the recipient of the FES Outstanding Service Award, the Young Engineer of the Year Award, and the Central Florida Engineer of the Year Award. He served an eight-year stint on the State Board of Professional Engineers, including two years as chairman, and chaired the NCEES committee that wrote the National Electrical Examination for Professional Engineers. He is the recipient of the National Council of Examiners for Engineering and Surveying Distinguished Service Award. In 1987, he was recognized by the Florida Board of Professional Engineers for outstanding contributions to the profession. He is also a Senior Member of the National Society of Professional Engineers and the Institute of Electrical and Electronic Engineering.

A Lay Leader at the First Methodist Church of Orlando, he is cofounder of the Central Florida Chapter of Engineering Ministries International. Ed joined TLC, then called Tilden Lobnitz Cooper, in 1967, and was CEO from 1981–1991.

Peter Ludé (Chapter 5.25) is Senior Vice President of Engineering for the Broadcast and Business Solutions division of Sony Electronics, based in Silicon Valley, and has been involved in broadcast engineering and production for over 30 years. In this role, he is responsible for engineering and business development for Sony's media and business electronics groups. Previously, he served as Chief Technology Officer at iBlast, the pioneering datacasting network, and before that was a systems integration executive for cutting-edge

broadcast projects, including DBS, digital cable, and DTV.

Mr. Ludé was the founder of Ludé Broadcast Engineering in San Francisco, which was eventually acquired by Sony. He is an active member of IEEE, SBE, and is an SMPTE Fellow. He is a frequent speaker and panelist on topics of digital communications systems and content distribution, and currently serves as Editorial Vice President for the SMPTE.

Mr. Ludé is a graduate of the College of San Mateo, and lives in San Francisco with his wife, Lani, and two young children. In his occasional spare time, he plays bluegrass music, makes Pinot Noir wine, and hunts mushrooms.

John A. Luff (Chapters 2.3, 5.21) is an independent consultant specializing in television technology, facility planning, and system design. He has 40 years of experience in broadcasting, post production, facilities management, remote production, project management, technical consulting, and system design. He is a consultant and lecturer on emerging media technologies, and a graduate of the Honors College of Ohio University. He is a Fellow of the Society of Motion Picture and Television Engineers.

Mr. Luff was founder and President of Synergistic Technologies Inc., purchased in 2000 by AZCAR USA, Inc. He served at AZCAR until 2006 as Senior Vice President Business Development.

Mr. Luff was responsible for the design, project management, and construction of the first progressive scan network origination center at ABC in New York and HDTV mobile unit used for Monday Night Football and the Super Bowl in 1999/2000. Since 1985, he has been involved in the planning and management of coverage of major news events around the world, including the Hong Kong Handover, the "Pro Democracy Movement" in Beijing in 1989, American Political Party Conventions from 1980 through 1996, and summits and elections across Eastern Europe.

Mr. Luff writes a regular column for *Broadcast Engineering* magazine, and is writing a book on Centralized Broadcast Operations for Focal Press.

Mr. Luff's clients include the ABC Television Network, the European Broadcasting Union, Sinclair Broadcasting, Corporation for Public Broadcasting, Panasonic Broadcast and Television Systems, Nex-Star Broadcasting, Turner Entertainment Networks, WQED, Pennsylvania Public Television Network, CNN, Gamecreek Video, Acme Television, North Carolina Public Television, Cornerstone TeleVision, and others.

He lives and works in Pittsburgh, Pennsylvania.

John M. Lyons (Chapters 4.1, 6.1) has been involved in the communications industry for over 40 years, from WNYE at Brooklyn Technical High School to his present position as Assistant Vice President and Director of Broadcast Communications at The Durst Organization.

Mr. Lyons has held engineering positions at New York City broadcast stations WRFM, WWRL, WOR,

WAXQ, WLTW, WXLO, and WEBR-TV. He constructed ZDK Radio in St. John's, Antigua, BWI, where he also served as Director of Engineering. He also served as Chairman of the Master FM Broadcasters Committee at the Empire State Building for a total of 12 years.

Mr. Lyons joined DSI Communications where he was the Senior Project Manager responsible for communications and broadcast facility build-outs. In 1994, he assumed a consulting position at the Sony Worldwide Radio Networks, working to establish and set the standards for the nationwide satellite-programming network.

Mr. Lyons was responsible for the design of the Clear Channel backup FM transmitting site at 4 Times Square. This facility is also capable of point-to-point microwave, spread spectrum, broadband, two-way, STL/TSL, RPU TV broadcast, and ENG services. In the fall of 2005, Lyons was elevated to his present position and is responsible for the communications needs of the entire 10 million square foot Durst portfolio, including interfacing to the NYPD/NYFD/EMS systems.

Steve Mahrer (Chapter 5.3) is Director of Engineering for the Business Development Group of Panasonic Broadcast & Television Systems Company. His responsibilities include managing the technologies used in Panasonic products designed for the broadcast and production marketplaces. These technologies include imaging and display, video compression and recording, and file systems and networking. The recent move to high definition and the increasing pace of the convergence of the IT and broadcast industries have made this an "interesting" experience.

Prior to joining Panasonic in 1991, Mr. Mahrer was employed at NBC's Technical Development group at 30 Rockefeller Plaza, New York, where he worked on small-format tape integration, automation, and early high definition work. The high definition work included assistance with testing at the ATTC in the late 1980s. He was awarded two patents for embedded data signaling during his work at NBC.

Before joining NBC, Mr. Mahrer was employed in 1974 by the RCA Broadcast System Group in Gibbstown, New Jersey, working on the development of CCD ENG and traditional studio camera design, including Triax system variants. In 1984 he was transferred to the United States from RCA (Jersey) Ltd., a European manufacturing facility located in the British Channel Isles. His work there included the custom design and reengineering of RCA equipment intended for the European, African, Australian, and Asian markets and included the many variants of PAL, SECAM, and NTSC.

George Maier (Chapter 9.1) started Orion Broadcast Solutions in 1997 to answer the need for outsourced transmission engineering and marketing support. The company specializes in system design, FCC licensing, and project management for ENG, SNG, terrestrial microwave, VHF and UHF, studio routing and terminal

equipment, and IT-based studio systems. The Orion client base includes broadcast networks, major groups, and individual stations. In the marketing area, Orion has worked with numerous equipment manufacturers to develop new products and strengthen existing lines.

Mr. Maier has been involved in broadcast transmission systems for most of his career and has worked for a number of well-known companies, including Telco Systems, Inc., *Television Broadcast* magazine, Artel Video Systems, ADC Telecom, NORTEL Networks, Harris Corporation, M/A-COM Inc., and Lucent Technologies.

Mr. Maier is Senior Member of the SBE and holds a CSTE certification as well as FCC General Class Radiotelephone and Amateur Extra Licenses. He also serves on the SBE National Frequency Coordination Committee, and is the Director of Monthly Programs for local SBE Chapter 11

Donald L. Markley, P.E., (Chapter 8.3) is Senior Consultant to and President of D. L. Markley & Associates in Peoria, Illinois. He is a graduate of Bradley University in Peoria, Illinois, having earned Bachelor of Science and Master of Science degrees in electrical engineering. Prior to fulltime consulting, Don was a tenured Associate Professor at Bradley.

Don is the Technical Facilities Editor for *Broadcast Engineering* magazine with over 200 articles published since 1967. He has earned Honors from Tau Beta Pi and Sigma Tau in Engineering, Eta Kappa Nu for Electrical Engineering, and Phi Kappa Phi Graduate School Scholarship. He was honored as 1992 IEEE Illinois Valley Chapter Engineer of the Year.

Don is an amateur radio operator K9WFG and has spoken at many conferences sponsored by various organizations.

William G. Marshall (Chapter 5.20) is a Principal at Harvey Marshall Berling Associates. He has over 25 years of experience in the design of audio and video facilities for theatrical, broadcast, industrial, and educational television facilities and architectural lighting design services for hotels, amusement parks, arenas, restaurants, and military and government buildings and projects. Prior to forming Harvey Marshall Berling, he directed facilities design for Imero Fiorentino Associates, Caribiner International, and Jack Morton Worldwide.

Mr. Marshall has been involved in video and film broadcast, corporate, and educational production facilities that include General Electric, J.C. Penney, American Express, AT&T, Proctor & Gamble, Northwest Mutual Life, J.P. Morgan Trust, Merrill-Lynch, Philip Morris, State Farm, and Sony. Broadcast clients include WNET, NBC-Chicago, HBO, the Manhattan Studio Center, Unitel, Teletronics, the Dallas Communications Complex, and Chelsea Studio/All Mobile Video. Educational studio facilities include the University of Iowa, Northwestern University, and the City University of New York.

Mr. Marshall provides lectures on teleconference lighting to many trade groups and has been responsible for broadcast and teleconference lighting of the U.S. Senate Chamber, U.S. House of Representatives, the Military Airlift Command at Scott AFB, and the Joint Chiefs of Staff conference room at the Pentagon. He worked on teleconferencing facilities designs for Western Electric, the U.S. Department of Defense, AT&T Bell Labs, ISACOMM, and Andersen Consulting. He has also designed hybrid architecture and video lighting systems for Marble Collegiate and Trinity Church in New York.

Jim Martinolich (Chapter 5.15) is VP of Product Development at Chyron, where he helped move Chyron's focus from "big iron" to open-platform software-based solutions. He has worked in all aspects of television technology for over 20 years, from video games to missile guidance systems.

Jim earned a Bachelor of Science degree in electrical engineering from Rensselaer Polytechnic Institute in Troy, New York, and an MSEE from Polytechnic University in Brooklyn, New York. His first job and "graduate degree in television" was working at CBS Laboratories on early video disc development. From there, he worked for Atari on video games and home robotics, and for Chyron as an analog design engineer on the VP-2 and Scribe. Later, he designed video and infrared imaging systems for various military and space applications, including the B-52, Tomahawk cruise missile, and the Space Station. At California Microwave, he helped develop one of the first digital satellite news-gathering systems built on DVB standards.

Jim hold several patents, has presented papers at NAB Broadcast Engineering Conferences, the SBE, and other regional technical conferences. He has contributed articles on the subject of broadcast graphics to several magazines and journals in the United States and Europe.

David Mathew (Chapter 8.1) is Technical Publications Manager at Audio Precision, Inc. in Beaverton, Oregon. He has been with Audio Precision since 1999. An Emmy-awarded sound engineer, he has worked in audio recording studios and in film sound as chief engineer, recording engineer and production mixer.

Mr. Mathew has written technical articles for Recording Engineer/Producer, Studio Sound, Pro Sound News, and other trade organs, and has authored user manuals for Audio Precision, Mackie, Audio Control Industrial, and Abekas.

Mr. Mathew is a member of the Audio Engineering Society and holds an FCC General Radiotelephone license.

David P. Maxson (Chapter 2.5) is a founding partner of Broadcast Signal Lab and has been providing broadcasters with engineering services since the company was formed in 1982. He is the former Vice President, Director of Engineering of Charles River

Broadcasting Company, Boston's long-time classical music broadcaster, where he served for 20 years.

David's experience as a corporate executive and independent service provider has exposed him to a broad spectrum of engineering issues, including facility design, construction, operation, and safety management. With a Bachelor of Science degree in broadcasting, David's career has led to certification by the Society of Broadcast Engineers, and he is a member of the Institute of Electrical and Electronics Engineers. He holds an FCC First Class License with radar endorsement, and is also a licensed construction supervisor.

David is a regular presenter of technical papers at NAB conferences on topics ranging from datacasting technology, to RF safety signs and exposure management, to measurements of IBOC signals. He developed an authoritative, ANSI-compliant set of RF safety signs available on RFSigns.com. As his company's representative to the National Radio Systems Committee, he actively participated in the development of the NRSC-5 IBOC standard. He is coauthor of *The IBOC Handbook*, published by Focal Press.

Jeff Mazur (Chapter 5.10) is the Senior Director of Technology for ABC Entertainment, which includes the Los Angeles-based Primetime On-Air Promotions Department. He has written over 50 articles and several books on broadcasting, electronics, and computers.

Jeff attended the University of Michigan in Ann Arbor and earned a BS degree in physics from UCLA. He has several Emmy® awards for Technical Achievement and is also a member of the Academy of Television Arts & Sciences. He has FCC General Radiotelephone and Amateur Radio Extra Class Licenses. He can be reached at jeff.mazur@abc.com.

Gary L. McAuliffe (Chapter 3.2) is a Partner and Principal Consultant at Pelton Marsh Kinsella, LLC, and has been involved in the architectural and technical systems design and construction of facilities for broadcasters, industry, institutions, and government for over 30 years.

Mr. McAuliffe has broad experience in radio, television, and allied industries. His experience includes work at TV and radio stations, in mobile television, systems integration companies, and professional services firms. His work involves the design of studio facilities for government, education, and commercial users, television trucks, television planning for stadiums and arenas, private satellite networks, and cable television systems. His recent work includes microwave and television transmission facility planning for what will become the world's tallest building—the Burj Dubai in Dubai, United Arab Emirates.

Mr. McAuliffe is a member of the Society of Motion Picture and Television Engineers, the Audio Engineering Society, and the Stadium Managers Association, and is a regular contributor to *Stadia Magazine*.

William Meintel (Chapter 1.5) holds a degree in electrical engineering and has 37 years of experience in the communications field. After graduation, he was employed by the Federal Communications Commission, first as a Field Engineer and then in the Mass Media Bureau's Policy and Rules Division. While in Policy and Rules, Bill served as the division's computer expert, directed the development of several major computer modeling projects related to spectrum utilization and planning, and represented the United States at international spectrum planning conferences.

Bill entered private practice in 1989, and has been heavily involved in technical consulting, computer modeling, and spectrum planning for the broadcast industry. In April 2005, he merged his consulting practice into the firm Meintel, Sgrignoli, & Wallace.

In the spectrum planning area Bill has, among other things, coauthored a report for the NAB on spectrum requirements for Digital Audio Broadcasting (DAB), created a plan for independent television broadcasting for Romania, and has been extensively involved in spectrum planning for digital television (DTV) in the United States and internationally. He developed the software used by both the U.S. television industry and the FCC for DTV spectrum planning as well as that now used by the FCC for processing analog and digital television applications (OET-69 Longley-Rice analyses). He has published several articles and presented numerous papers related to spectrum planning.

Bill is currently Vice President of the IEEE Broadcast Technology Society, editor of its Newsletter, and a member of the Engineering Honor Society Tau Beta Pi.

Geoffrey N. Mendenhall, P.E., (Chapter 4.7) has spent most of his 42-year career in the broadcast industry. He started as a broadcast technician while attending high school, then worked for several Atlanta radio and TV stations while earning his electrical engineering degree from Georgia Tech. In 1973, he joined the Harris Broadcast Division as an electrical engineer, designing directional antenna phasing equipment followed by the MS-15 FM exciter. Later, he became Vice President of Engineering at Broadcast Electronics, where he led the development of the FX series of analog exciters and a full line of AM/FM radio transmitters.

Mr. Mendenhall rejoined Harris in 1993, as Vice President—Radio Product Line Manager, where his team successfully launched DIGIT, the world's first digital FM exciter, the first 2-megawatt, solid-state AM transmitter, and CD-Link, the first uncompressed, 950-MHz, digital STL. In 1995, Geoff assumed overall responsibility for the development of all Harris radio and television transmission products. He is now leading the teams designing next generation digital radio products including the new FlexStar HDx exciter and HT-HD+ common amplification transmitter.

Mr. Mendenhall has authored over 40 technical papers. In 1999, he received the NAB Radio Engineering Achievement Award recognizing his many innovations and contributions to the broadcast industry. He holds five U.S. patents for broadcast equipment.

Mr. Mendenhall is a Registered Professional Engineer. He is a member of the Association of Federal Communications Consulting Engineers (AFCCE) and a Senior Member of the IEEE.

Richard Miller (Chapter 9.2) currently is Manager of the Systems/Applications Engineering Group for Microwave Radio Communications, part of Vislink Communications LLC. Since joining MRC in 1991, he has been Manager of Field Services, System Test Manager, and Systems Engineer.

Mr. Miller attended Northeastern University in 1996, pursuing a degree in electrical engineering. He began his career with Microwave Associates in 1980 as a Field Service Technician, eventually graduating to Engineer. Prior to this, he worked in the communications industry, primarily in broadcast.

Mr. Miller gained practical and field experience in the RF field, eventually leading to management of field projects in the design, installation, and commissioning of microwave systems. With this experience he held positions at several communications companies, Microwave Associates, M/A-COM Inc., California Microwave, and Adaptive Broadband.

Steven E. Mitchel (Chapter 1.2) is Reference Librarian for the National Association of Broadcasters. He has previously held positions as Senior Researcher for ABC News, and Librarian and Legislative History Researcher for the law firm of Winston & Strawn. He has presented papers at conferences of the American Association of Law Libraries, and his articles have appeared in *Law Library Journal* and *Government Publications Review*. He is a recipient of the Donald G. Wing Bibliographic Award.

Tom Mock (Chapter 4.14) heads WYE Consulting and is a consultant to industries specializing in areas involving the application and development of consumer electronic products.

Tom was formerly with the Consumer Electronics Association, a sector of the EIA, from 1981 until 2000, where as Director, Technology and Standards, his duties included staffing of technical committees in the areas of product safety and compliance, vehicular electronics, and liaison with other associations and consortiums. From 1956 until 1981, he served in various engineering capacities in the Government and private sectors related to the military and Department of Defense.

While with the CEA/EIA, Tom was directly involved with the development of stereo broadcasting for TV for which the Association won an Emmy, initiation of the home automation program that became CEBus, and introduction and standardization of the Radio Data System (RDS) in the United States. He was also involved with the standardization of the Closed Captioning and the eXtended Data System (XDS) for TV, the development of the V-Chip parental control system and, coordination of CEA Intelligent Transportation System activities with ITSA and SAE.

Tom has served as U.S. delegate on several IEC committees and is a member of the Institute of Electrical and Electronics Engineers (IEEE), the National Radio Systems Committee (NRSC), and the RDS Forum. He is also a member of Underwriters Laboratories (UL) Standards Technical Panel (STP) for UL 6500 and UL 1678.

Jeff Moore (Chapter 5.10) is President of Ross Video in Iroquois, Canada. Jeff joined Ross Video in 1997, serving as the Director of Marketing and Sales before being promoted to Vice-President Marketing and Sales in 2002. In 2006, Jeff was promoted to President. He holds an MBA from the University of Ottawa.

Jeff was raised in Canada's north, Whitehorse, Yukon, across from an area known as Whiskey Flats. His father had an electrical contracting business and was responsible for sparking Jeff's interest in electronics when he brought home various pieces of equipment that Jeff began experimenting with.

After high school, Jeff spent a few years following a career in geology before realizing that it wasn't his calling. Rekindling his interest in electronics, he attended the Southern Alberta Institute of Technology where he studied broadcast electronics engineering technology, earning an honors diploma.

Jeff got his broadcast start working at CHUM Television in Toronto, at the time CITY TV, Much Music, in the engineering group assisting the Manager of Engineering with the complete redesign and move of the facility. Jeff spent 14 years in Toronto, where he also worked at Azcar Technologies managing broadcast design and installation projects; Sony as a Broadcast Account Manager, Broadcast Television Systems as Regional Sales Manager, Acura Technology Group as Regional Sales Manager, and Tektronix VND as National Business Manager.

When not working, Jeff enjoys cooking, canoeing and kayaking, reading, and spending time with family.

Andrew Morris (Chapter 5.19) is a consulting engineer with over 30 years of experience in the broadcast and cable industries. A four-time Emmy® award winner for his work designing and managing the broadcast communication systems for three of NBC's Olympic broadcasts, Mr. Morris has performed a number of engineering and operational roles in the broadcast industry.

A member of SMPTE, SBE, AES, and IEEE, Andrew resides in Denver, Colorado, and currently works with a variety of systems integrators and broadcasters on the upgrade to and creation of modern broadcast systems.

Richard Morris (Chapter 1.10) studied electronic engineering at Birmingham University in the UK and joined the British Broadcasting Corporation in 1987. Over the next few years, he worked on projects building monitoring and control systems for broadcast networks, including a year reengineering a BBC shortwave transmitter site in Cyprus. Following a

short period working on digital studio to transmitter links, he joined the team that built the world's first fully engineered Eureka 147 DAB transmitter network in 1995. Richard was later the technical authority and team leader for digital radio head end systems with Crown Castle UK, and built DAB coding and multiplexing systems for three commercial Eureka 147 digital radio networks.

In 2003, Richard left the UK to join Commercial Radio Australia, the industry body that is currently working with the commercial radio networks to prepare for rolling out digital radio networks in Australia. He is currently the principal engineer for the DAB trial in Sydney.

Richard has an honors degree in electronics. He is a Chartered Engineer and a member of the Institute of Engineering and Technology (UK). He has presented papers at international digital radio conventions, and is a member of the WorldDAB technical committee.

John Norgard (Chapter 1.1) is a Professor Emeritus at the University of Colorado at Colorado Springs, the President and CEO of ElectroMagnetic Techniques, the Chief Scientist of zeeWAVES, and Senior Research Scientist in the Sensors Directorate at the Rome Research Site of the Air Force Research Laboratory. He was also a Distinguished Visiting Professor at the U.S. Air Force Academy. He has taught graduate and undergraduate courses in electromagnetics for over 35 years and is the Director of the Electromagnetics Laboratory at the University of Colorado. He was a Professor of Electrical Engineering at Georgia Tech and a Post-Doctoral Fellow at the Norwegian Defense Research Establishment in Oslo, Norway. He worked at the Jet Propulsion Laboratory while studying at Caltech (PhD/1969, MS/1967, applied physics) and was a co-op student at Georgia Tech (B.S./1966, ECE) while working at the Charleston Naval Shipyard. He was a Visiting Professor at Tel-Aviv University and a member of the technical staff of the Bell Telephone Laboratories.

He has worked on numerous computational electromagnetic problems, including plasmas (polar ionosphere), field-to-wire coupling (cross-talk, NEMP, lightning), EMI, EMC, EMV/S, HPM, GPR, RF tomography, IR metrology, and holography.

He is a Fellow of IEEE for IR measurements of EM fields, on the Board of Directors of the IEEE/EMC Society serving as the Vice President for Technical Services, on the Board of Physics and Astronomy for the National Academy of Sciences, Past Chairman for Commission A/Metrology of URSI, and an Associate Editor for the *IEEE/EMC Transactions* for antenna metrology.

Robert Orban (Chapter 3.8) received a BSEE degree from Princeton University in 1967 and an MSEE degree from Stanford University in 1968. In 1970, he founded Orban Associates, originally as a manufacturer of studio equipment. In 1975, Orban Associates introduced the original Optimod-FM 8000, the first in a long line of broadcast audio processors for AM, FM, TV, and digital broadcasting from the company.

Mr. Orban has been involved in professional recording for many years, and has mixed several records released on the Warner Bros. label, as well as on small independent labels. As a composer, his music has been heard on classical radio stations in New York and San Francisco, and his score for a short film, *Dead Pan*, was heard on PBS television in Chicago. He has designed studio reverberation systems, stereo synthesizers, compressors, parametric equalizers, enhancers, and de-essers under both the Orban and dbx brand names.

Mr. Orban was actively involved in NRSC committee AM improvement work. He is widely published in both the trade and refereed press (including *J. Audio Engineering Soc.*, *Proc. Soc. Automotive Engineers*, and *J. SMPTE*). He is the author of the chapter on "Transmission Audio Processing" in the *NAB Engineering Handbook*, 9th edition. He currently holds over 20 U.S. patents.

Mr. Orban was elected a Fellow of the Audio Engineering Society in 1973. In 1993, he shared with Dolby Laboratories a Scientific and Engineering Award from the Academy of Motion Picture Arts and Sciences. In 1995, he received the NAB Radio Engineering Achievement Award.

Thomas G. Osenkowsky (Chapter 2.7) began his career in broadcasting in 1973 while a senior in high school. He has held positions as announcer, Chief Engineer, Operations Manager, and General Manager at broadcast stations in Connecticut.

Tom has written software for antenna system design and analysis, RFR, mapping, and other broadcast engineering related tasks. He has served as a consultant to AM and FM stations in the United States and Caribbean islands. He is a Senior Member of the Society of Broadcast Engineers (SBE), Institute of Electrical and Electronics Engineers (IEEE), and National Association of Radio and Telecommunications Engineers (NARTE).

Tom earned the Professional Broadcast Engineer Life Certification from the SBE, the Certified Master Engineer with Master RF Radiating Endorsement from NARTE, and holds a First Class Radiotelephone license from the FCC. He has presented papers at NAB Broadcast Engineering Conferences, SBE Annual Conventions, and state broadcasters annual conventions.

Tom is a regular contributor to *Radio World* magazine, a private pilot, and an amateur radio operator.

David Philip Otey (Chapter 1.6), AZCAR Technologies, began his broadcasting career in 1974, at age 15, as an announcer for radio station KEYE in Perryton, Texas. After college, he focused on television. In 1983, he was part of the engineering team that launched Channel 42 in Austin, Texas, then known as KBVO but now—by remarkable coincidence—carrying the call sign KEYE. He joined the engineering department of public TV station KLRU in 1985, serving as Chief Engineer, 1990–1996.

From 1996 to 2001, David worked for HSE Communications, a Colorado-based integrator of microwave

systems, as Chief Engineer and later Operations Manager. During this time, he became involved in frequency coordination of Broadcast Auxiliary Services. From 2002 to 2005, he served on the staff of the Society of Broadcast Engineers as Frequency Coordination Director. His work on 2 GHz relocation led to his joining SignaSys in 2005 to lead the industrywide training effort in Digital Electronic News Gathering, and in 2007 to AZCAR Technologies.

David is an SBE-certified Professional Broadcast Engineer. His articles have appeared in *TV Technology*, *Radio World*, and *Radio Guide* magazines, and he has presented technical papers and training seminars at SBE national and regional conferences as well as the annual conventions of several state broadcasting associations. A 1981 graduate of Trinity University in San Antonio, David holds two master's degrees from the University of Texas at Austin. He lives with his family in the Denver area, where he also pursues a hobby in community theater.

Karl Paulsen (Chapter 5.9) is currently the Chief Technology Officer for AZCAR Technologies with offices in Markham, Ontario, Canada, and AZCAR USA, Inc., in Canonsburg, Pennsylvania. He has over 30 years of industry experience as a broadcast operator, engineering director, and consultant in the fields of broadcast, IPTV, mobile television, 3D graphics-and-animation, and systems integration.

Mr. Paulsen is a monthly columnist for *TV Technology* magazine, having contributed over 120 articles related to video servers, storage, and media management. He is the author of *Video and Media Servers: Technology and Applications*, 2nd edition, published by Focal Press.

Mr. Paulsen is an SBE Life Certified Professional Broadcast Engineer, an IEEE member, and a Fellow in the SMPTE.

Howard K. Pelton, P.E., (Chapter 3.2) began his career in noise control engineering and acoustical consulting in 1963. He has held positions with an industrial silencer manufacturer and several acoustical consulting firms, the latest of which is Pelton Marsh Kinsella, LLC. Mr. Pelton is a registered engineer in Texas and Louisiana. He is the author of Noise Control Management and many noise control articles. He also belongs to a number of professional organizations including ASA, ASHRAE, and ASME.

Mr. Pelton has extensive experience in the development of noise control management systems and programs for a wide variety of public and private sector clients. His experience includes plant surveys, feasibility studies, hearing conservation programs, training programs, seminars, noise control design, and construction management of detailed noise control programs. His architectural acoustics background includes design and development of noise and vibration control systems for high-rise office buildings, hotels, convention centers, hospitals, and schools, as well as remedial noise and vibration control evaluation, development of

recommendations for corrective action, construction management, and partition testing.

Mr. Pelton has designed quality acoustical environments for spaces such as schools, churches, auditoriums, and meeting and lecture rooms. He has also performed assessments of environmental noise impacts from industrial plants, airports, freeways, and railroads for city, state, and federal regulations.

Skip Pizzi (Chapter 3.11) is Technical Policy Manager for Microsoft's Entertainment & Devices Division, a position in which he helps define the company's media-related public and business policies. In addition, he has represented Microsoft in digital broadcast standards organizations worldwide, and serves as a corporate liaison to the broadcast technology industry.

Skip is a contributing editor at *Radio World* magazine, where he writes "The Big Picture" column that appears in every issue. Previously, he served as Editor-in-Chief of *BE Radio* (now *Radio*) magazine, and earlier spent 13 years at National Public Radio where he served as technical director for numerous award-winning programs, and founded the company's technical training program. His book, *Digital Radio Basics*, the world's first on the subject of DAB, was published in 1992. He has contributed to several other technical texts, including McGraw Hill's *Digital Consumer Electronics Handbook* and the CRC/IEEE Press *Electronics Handbook*.

Skip is a frequent speaker at international conferences on broadcasting and audio, and currently cochairs the Surround Sound Audio Task Group of the National Radio Systems Committee. He also serves as a judge for the National Television Academy's "Technical Emmy" Awards. He is a graduate of Georgetown University in Washington, D.C.

Schuyler Quackenbush (Chapter 3.7) is an expert in digital audio technology. He is active in the area of standardization of audio coding algorithms and is currently the chair of the International Standards Organization Motion Picture Experts Group (ISO/MPEG) Audio subgroup. He was one of the authors of the ISO/IEC MPEG Advanced Audio Coding standard. He has worked on audio and speech coding algorithms, audio and speech quality assessment, audio error mitigation algorithms, and real-time signal processing algorithms and hardware. He holds 12 patents and is the author of more than 30 publications in these areas, including one book, *Objective Measures of Speech Quality*.

Dr. Quackenbush received a BS degree from Princeton University in 1975, an MS degree in electrical engineering in 1980, and a PhD degree in electrical engineering in 1985 from Georgia Institute of Technology. He was Member of Technical Staff at AT&T Bell Laboratories from 1986 until 1996, when he joined AT&T Laboratories as Principal Technical Staff Member. In 2002, he founded Audio Research Labs, an audio technology consulting company. He is a Fellow of the Audio Engineering Society (AES) and a senior

member of the Institute of Electrical and Electronics Engineers (IEEE).

Ronald D. Rackley, P.E., (Chapter 4.3) is a Consulting Radio Engineer with the firm of du Treil, Lundin & Rackley, Inc. of Sarasota, Florida. He has been a specialist in the design, adjustment, and testing of the antenna systems that are employed by medium-wave (known as AM in North America) radio stations for more than 30 years and practices internationally as well as domestically.

Mr. Rackley developed several antenna design, analysis, and measurement techniques that are in common use today. He is a frequent author and lecturer on the subject of medium-wave antenna systems and participant in advisory committees for regulatory agencies. His work has included medium-wave directional antennas ranging in power to 2,000,000W and in complexity to 12 towers.

Mr. Rackley is a member and has served as President of the Association of Federal Communication Consulting Engineers. He is a member and has served as Vice President of the Institute of Electrical and Electronic Engineers Broadcast Technology Society, and is a member of the Institute of Electrical and Electronic Engineers Antennas and Propagation Society.

Mr. Rackley holds a BSEE degree from Clemson University in his native South Carolina and is a Registered Professional Engineer.

Phillip Rayson (Chapter 7.1) is currently Radian Communications Services Corporate Safety Officer. He is a Certified Hoisting Engineer-Mobile 1 with over 25 years of experience in the construction industry. For 16 years, he was involved with workplace safety, tower assembly, tower erection, and station and switch yard construction for a major utility company in Canada. Over the past six years he has been responsible for managing safety in both the United States and Canada for Radian Communication Services.

Mr. Rayson works with the Radian safety team conducting safety inspections, audits, safety training, and provides safety support to Aerial and Technical staff involved with broadcast, telecommunications, and wind turbine projects. He has been involved with developing and maintaining OSHA partnership agreements in regions 5 and 7.

Mr. Rayson holds the following certifications: OSHA 510, OSHA 500, OSHA Construction Outreach Trainer, Instructional Techniques Workshop, Propane CCR, Workplace Health and Safety Agency Core Certification Training Cert. ID: WHSC05395, TapRoot Incident Investigation & Root Cause Analysis, and Hoisting Engineer-Mobile 1 339A-171158.

Jeffrey Riedmiller (Chapter 5.18) is Senior Broadcast Product Manager at Dolby Laboratories in San Francisco, where he is responsible for the specification and development of Dolby's broadcast products and technologies including Dolby Digital, Dolby Digital Plus, Dolby E, and Metadata, with a strong focus on loudness estimation and control processes. He is also

responsible for managing the specification and integration of Dolby technologies and systems into major cable networks and cable distribution facilities. He was responsible for creating and leading the development of the Dolby LM100 Broadcast Loudness Meter with Dialogue Intelligence, for which he received an Emmy® in 2004 for Outstanding Achievement in Engineering Development. He is coinventor of two patents in the area of speech-based loudness estimation and control, as well as methods to analyze, process, and correct audio metadata in the compressed domain.

Mr. Riedmiller has 20 years of experience in audio engineering and electronics as a Chief Engineer of a major upstate New York recording studio, a member of Time Warner Communications Studio Engineering Group, and an independent consultant on various facility, system, and custom electronic designs for recording studios, broadcast, and postproduction facilities throughout the United States.

Mr. Riedmiller is a member of the Mathematical Association of America, an active member of the Society of Cable Telecommunications Engineers and its Standards Committees, and serves as Associate Editor for *Transactions on Broadcasting* for the IEEE Broadcast Technology Society. Previously, he also served as cochairman for the National Cable & Telecommunications Association Engineering Committee Audio Quality Subcommittee.

Roy W. Rising (Chapter 3.1) is retired after 38+ years with ABC-TV, Hollywood. His career began in 1965 following graduation from U.C.L.A. with a Bachelor of Science degree in engineering. He has held supervisory positions in TV Engineering Facilities and TV Engineering Operations. His activities included design, construction, installation, maintenance, modification, and operation of broadcast audio facilities. His show mixing credits range from Music-Comedy-Variety with live orchestras, Sitcoms, Game Shows, News and Sports to the Oscar®, Emmy®, and Grammy® award shows.

Mr. Rising's writing credits include 15 years of the "Sound Ideas" monthly column in *Video Systems Magazine* and feature articles for *Broadcast Engineering* and *Recording Engineer-Producer* magazines. He also has contributed sections to *The Electronics Handbook* (CRC Press/IEEE Press) and the *NAB Handbook*, 9th edition.

Richard A. Rudman (Chapter 2.7) retired from KFWB Radio in Los Angeles (Infinity/CBS) as Director of Engineering on June 15, 2002, after 27 years in that position. He now owns and operates his own firm, Remote Possibilities, that consults on emergency public information, emergency preparedness for communications facilities, construction of 802.11 (b) (g) wireless nodes, and specialized broadcast spectrum issues. He holds Certification from the Society of Broadcast Engineers as Professional Broadcast Engineer (CPBE).

Richard has authored many papers on EAS, AMBER, emergency public information, emergency

preparedness for communications facilities, and broadcast auxiliary spectrum. His paper, *Disaster Recovery for Broadcast Facilities*, was presented at the 1996 Spring NAB Convention and published in the Convention Proceedings. He is also the author of book chapters on broadcast auxiliary frequency coordination and disaster preparedness for communications facilities in the *NAB Engineering Handbook* and in two electronics textbooks published by CRC Press.

Richard was one of the 17 founding Trustees for the Partnership for Public Warning (founded in November, 2001) and contributed to several reports submitted to FEMA and the FCC on the subject of public warnings and the EAS.

Richard was elected National President of the SBE in 1985 and elected as a Fellow of the SBE in 1987. He still serves as a member of several national SBE committees. In November 2002, he received a lifetime achievement award from the SBE for his contributions to emergency public information, EBS and EAS, and for his contributions to broadcast auxiliary spectrum coordination.

Stanley Salek, P.E., (Chapters 1.9, 8.1) is a Senior Engineer in the consulting engineering firm of Hammitt & Edison, Inc., San Francisco, California. Since joining the firm in 1991, he managed numerous projects related to broadcast radio and television technology, including analog and digital radio and television transmission analysis, signal coverage evaluation, and RF safety compliance. He is presently cochair of the AM Broadcasting Subcommittee of the National Radio Systems Committee, working toward the development and enhancement of industrywide technical standards.

Prior to his present position, Stan was Director of Radio Engineering at the National Association of Broadcasters, a design engineer with RF and audio broadcast equipment manufacturers, and has managed technical projects at several broadcast stations. He is a graduate of Florida Institute of Technology, earning a BS in electrical engineering, and is a Registered Professional Engineer in the state of California. He holds a U.S. patent for an RF modulator design. He also holds FCC commercial and amateur radio licenses, and is a member of IEEE, AES, SMPTE, and AFCCE. He has authored articles and book chapters on various topics related to broadcast engineering.

Gary Sgrignoli (Chapter 8.4) received Bachelor and Master of Science degrees in electrical engineering from the University of Illinois, Champaign-Urbana in 1975 and 1977, respectively. He joined Zenith Electronics Corporation in January 1977, where he worked as an engineer in the Research and Development department for 27 years. In March 2004, he set up Sgrignoli Consulting, a DTV-transmission consulting firm, and in April 2005, he merged his practice with those of Bill Meintel (Techware, Inc.) and Dennis Wallace (Wallace and Associates) to create Meintel, Sgrignoli, and Wallace (MSW). Further information can be found at www.MSWdtv.com.

Mr. Sgrignoli has worked in the R&D design area on television "ghost" canceling, cable TV scrambling, and cable TV two-way data systems before turning to digital television transmission systems. Since 1991, he has been extensively involved in the VSB transmission system design, its prototype implementation, the ATTC lab tests in Alexandria, Virginia, and both ACATS field tests in Charlotte, North Carolina. He holds 35 U.S. patents.

Mr. Sgrignoli was involved with the DTV Station Project in Washington, D.C., helping to develop DTV RF test plans. He has also been involved with numerous television broadcast stations around the country, training them for DTV field testing and data analysis, and participated in numerous DTV over-the-air demonstrations with the Grand Alliance and the ATSC, both in the United States and abroad.

In addition to publishing technical papers and giving presentations at various conferences, he has held numerous VSB transmission system seminars around the country.

Thomas B. Silliman, P.E., (Chapter 6.8) is President as well as the Chairman of the Board of Directors of Electronic Research Inc. (ERI). He attended Cornell University in 1964, where he received a Bachelor of Electrical Engineering degree in 1969 and a Master of Electrical Engineering degree in 1970.

After graduating from Cornell University, Mr. Silliman went to work for ERI, where he designed the ERI Rototiller antenna in 1975 for which he was granted a patent (assigned to ERI) on August 22, 1975. While working for ERI, he was also a partner in the broadcast consulting firm of Silliman and Silliman with Robert Silliman, his father.

Mr. Silliman is a Registered Professional Engineer in Indiana, Minnesota, and Maryland, and a Senior Member of the IEEE. He is currently serving as Secretary of the IEEE Broadcast Technology Society Administrative Committee. He is a full member of the Association of Federal Communications Consulting Engineers (AFCCE), and a past two-term President of that organization. He also serves as a Board Member of WNIN, an Evansville, Indiana, local public radio and television provider.

Wes Simpson (Chapter 6.13) is president and founder of Telecom Product Consulting, an independent consulting firm that focuses on helping companies develop and market video and telecommunications products. He holds a BSEE from Clarkson University and an MBA from the University of Rochester.

Wes has over 20 years of experience in the design, development, and marketing of products for telecommunication applications. Before founding Telecom Product Consulting, he was COO of VBrick Systems, Inc., a manufacturer of MPEG video equipment. Earlier, at ADC Telecommunications, he was the Director of Product Management for the DV6000, a market leading video transport system. He previously held a variety of marketing and engineering positions in the telecommunications industry. Wes was a founding

member of the Video Services Forum, and was a member of its Board of Directors from 1997 to 2001.

Wes is a frequent speaker and analyst for the video transport marketplace, and is author of the book *Understanding Video Transport over IP Networks, A Practical User's Guide to Technologies and Applications*, published by Focal Press in 2005.

Sidney M. Skjei, P.E., (Chapter 6.11) is President of Skjei Telecom, a technical consulting company providing engineering and operational support for satellite and broadcasting applications. Since its founding in 1994, Skjei Telecom has provided consulting and support services to over 100 different companies or organizations in a broad spectrum of sectors involved in satellite communications and broadcasting.

Prior to co-founding Skjei Telecom, he held senior-level engineering management positions with GTE, Southern Pacific Satellite Company (SPRINT), and COMSAT World Systems. He has over 25 years of experience in engineering and developing a wide range of hardware and software telecommunications and broadcasting products, systems and services, and in providing engineering support to the procurement, operation, and marketing numerous geosynchronous communications satellites. His experience and expertise includes domestic U.S., international, and military communications satellites.

Mr. Skjei has taught numerous satellite and digital video courses for both private industry and government students. He is the author of numerous articles and a textbook on satellite telecommunications and has testified as Litigative Consultant and Expert Witness. He holds a BS degree from the U.S. Naval Academy and an MSEE degree With Distinction from the Naval Postgraduate School. He is a Registered Professional Engineer in the Commonwealth of Virginia and a member of the IEEE, Eta Kappa nu, SMPTE, and AFCCE.

Derek Small (Chapter 6.7) is Director of Filter Products for MYAT, Inc. After receiving his BS in electrical engineering from the University of Maine in Orono in 1986, he was immediately immersed in the design of passive microwave components and filter subsystems for military programs with M/A-Com and Continental Microwave.

From 1993 to 1999, Mr. Small was the primary developer of high power filter products and other passive components for Passive Power Products of Grey, Maine. Key among his activities at Passive Power Products was his work in passive components and the development of very stable, high power UHF cavities. In January 2000, he established Lowpass Prototype Inc. to develop and manufacture filter based products for the broadcast and wireless industries, and served as its President until its acquisition by MYAT, Inc. in October 2001.

Mr. Small has published numerous papers and articles, and is the holder of one patent, with others pending. His research interests are focused on filters and other products for high power applications.

Eric Small (Chapters 4.8, 6.3) is founder and Chief Technology Officer of Modulation Sciences, Inc., in Somerset, New Jersey. Modulation Sciences manufactures products including the CP-803 Composite Processor, the Sidekick™ SCA Generator, the StereoMaxx™ Spatial Image Enlarger, and the FM ModMinder™ Modulation Monitor.

Mr. Small's career began at classical music station WNCN, New York, in 1964. In 1969, he joined A&R Recording under Phil Ramone. Later, as a consultant, he worked for most of the major broadcasters in North America. He was an aerospace hardware and software designer for the visual portion of the F/A-18 combat flight simulator in the 1980s. In 1974, he participated in the design and subsequent widespread use of the original Optimod™ 8000 FM processor. In 1975, he authored the technical chapter in the *CPB Handbook* for setting up SCA-based Radio Reading Services for the blind. He has remained active in radio reading services since.

When Multichannel Television Sound emerged, Mr. Small was a voting member of the BTSC, the group that wrote the standard for stereo TV sound. Modulation Sciences went on to design and manufacture a TV Stereo Generator and a TV Stereo Reference Decoder. It also designed and a manufactured NTSC vide/audio demodulator, and digital TV 8VSB analyzer.

Mr. Small continues to participate in international standards committees and represented and spoke on behalf of the United States as a member of several U.S. delegations to ITU-R, SG10B meetings in Europe.

Martin Stabbert (Chapter 3.5) is Director of Corporate Engineering for Citadel Broadcasting, a position he's held since 2003. When asked why he chose to enter broadcasting, he contends that the fit was so natural, it's almost as if radio chose him. He recalls working in his father's appliance business as early as the age of 6, repairing toasters and coffee makers. The inclination toward technology, all things mechanical, and a general interest in audio led him to KVIP/KVIP-FM in Redding, California, where he began his radio career as a board operator. He quickly realized that the engineering aspect of radio was for him.

Graduating with degrees in electronic technology and electronic engineering from Shasta College in Redding, California, Martin spent several years as a contract engineer with clients in Nevada as well as Northern and Central California before accepting a position with Citadel Broadcasting in 1992 as Market Engineer for their Reno, Nevada facility.

When not tuned in to radio, Martin enjoys snowmobiling, pistol marksmanship, and is occasionally found on the ham radio bands with call sign KC7FTK. Martin and his wife Monica currently reside in Reno with their three dogs.

Leon Stanger (Chapter 6.15) is an independent consulting engineer serving the television industry. He has served the television industry in a broad range of engineering design, development, and management

capacities at KWCS, KOET, Harris Corp., The Grass Valley Group, Utah Scientific, and DIRECTV.

Mr. Stanger received a Bachelor's degree in electronic engineering in 1968 from Weber State University and a Master's degree in business administration from the University of Phoenix in 1995.

Mr. Stanger is an active member of the Institute of Electrical and Electronic Engineers (IEEE) and The Society of Motion Picture and Television Engineers (SMPTE). He has served on a number of engineering committees to develop standards and practices for the broadcast industry as well as private companies. He holds 10 patents relating to television production, distribution, and transmission. He can be reached via e-mail at stanger62@msn.com.

Mike Starling (Chapter 3.4) joined NPR in 1989 as Senior Engineer, was named Director of Engineering in 1991, Vice President for Engineering in 1998, and Vice President, Chief Technology Officer in 2005. He is also Executive Director of NPR Labs, NPR's broadcast technology research and development unit.

Mr. Starling's undergraduate degree is in broadcast journalism and radio-TV from the University of Maryland. He also earned a BSL and Doctor of Jurisprudence degree from National University School of Law in San Diego.

In the 1970s Mr. Starling founded, built, and managed commercial and noncommercial stations in Virginia (WKYY-AM, WUDZ-FM, and WWLC-FM) and was Chief Engineer for NPR Member Station KPBS-FM in San Diego in the 1980s. He is a Board Member of the Richardson Maritime Museum in Cambridge, Maryland, and a past Board Member of the International Association of Audio Information Services, and the North American Broadcasters Association. He consults for radio stations in the United States and Southern Africa, and has been a U.S. delegate to the ITU.

Mr. Starling received the IAAIS 2004 C. Stanley Potter Award for work on digital radio reading services, and was named one of *Radio Ink's* 35 "Most Admired Engineers for 2005," and *Radio World's* "Excellence in Engineering—Engineer of the Year 2005" for his work on digital radio multicasting.

Mr. Starling is Chair of the Radio Subcommittee for the North American Broadcasters Association, a founding member of the Association of Public Radio Engineers, a member of the IEEE and the Radio Club of America. He is also a lawyer and a member of the California and D.C. bars.

Robert A. Surette (Chapter 4.10) is Manager of RF Engineering with Shively Labs, a Division of Howell Laboratories. He has been directly involved with design and development of broadcast antennas, filter systems, and RF transmission components since 1974, and as an RF Engineer for six years with the original Shively Labs in Raymond, Maine, and for a short time with Dielectric Communications.

Mr. Surette graduated from Lowell Technological Institute, Lowell, Massachusetts, in 1973 with the degree of Bachelor of Science in electrical engineering.

Mr. Surette is currently an Associate Member of the Association of Federal Communications Consulting Engineers and a Senior Member of IEEE. He has participated in writing several articles for trade publications. He was a lecturer for the National Public Radio seminars, has spoken at many local SBE meetings, and presented papers at NAB national conventions and national SBE meetings. He has authored a chapter on filters and combining systems for the latest edition of *The Electronics Handbook* from CRC Press and for the *NAB Engineering Handbook*, 9th edition.

Dr. Norman M. (Sam) Swan (Chapter 2.1) began his broadcasting career in 1967 as a radio announcer at KFVS-AM in Cape Girardeau, Missouri, in radio news and programming. In 1969, he joined sister station KFVS-TV, where he served as host of the Breakfast Show and as a news anchor and reporter.

Mr. Swan graduated from Southeast Missouri State University and worked in Sri Lanka in 1970–71 developing radio quiz shows for Young Farmers clubs. Later, he was a radio and television reporter for the University of Missouri Extension Service in Columbia, producing radio and TV reports used by Missouri broadcast stations.

Mr. Swan completed a PhD at the University of Missouri in 1978 and became Electronic Media Leader at the University of Minnesota. There he led a group of writers and producers in the production of programs used by radio and TV stations throughout Minnesota.

In 1981, Mr. Swan became Head of the Department of Radio-Television at Southern Illinois University in Carbondale. He produced several programs for WSIU-FM and WSIU-TV. He later became Head of the Department of Broadcasting at the University of Tennessee in Knoxville. He also served as General Manager of WUTK-FM and WUTK-AM. He produces a weekly news magazine program for WBIR-TV in Knoxville.

Mr. Swan currently serves as a trainer and consultant to radio and television stations around the world. He has conducted over 100 workshops on broadcast management and broadcast journalism for the Voice of America, Radio Free Europe/Radio Liberty, IREX, U.S. State Department, and other agencies. He conducts annual management workshops for broadcast engineers as part of the USTTI program in Washington, D.C. He writes a monthly newsletter for radio and TV affiliates of Voice of America in Central and Eastern Europe and published a book on broadcast management for the International Broadcasting Bureau in Prague.

Peter Symes (Chapter 5.7) is Manager, Advanced Technology, for Grass Valley division of Thomson Broadcast, with responsibilities that include strategic planning, intellectual property, and technological liaison. In the latter role, he represents Grass Valley in many organizations, including the Society of Motion Picture and Television Engineers (SMPTE). He served two terms as Engineering Vice President of SMPTE, and is currently the SMPTE Financial Vice President.

Mr. Symes gained his Bachelor of Science degree with honors in 1967 and began his career in television in the engineering department of the British Broadcasting Corporation. He worked in product management for Philips and Central Dynamics before joining Grass Valley in 1983.

Mr. Symes holds patents and is the joint recipient of Emmy® awards for the architecture of the digital picture processor. He is a Senior Member of the Institution of Electrical Engineers (IEE), and a Fellow of the SMPTE.

Mr. Symes has written and presented numerous papers at industry conferences, and is the author of *Video Compression* (1998), *Video Compression Demystified* (2001), and *Digital Video Compression* (2003), all published by McGraw-Hill. He has also contributed to other books, including the *NAB Engineering Handbook* and *Understanding Digital Cinema* (Focal Press, 2004).

Rolf Taylor (Chapter 3.10) is currently Product Manager for telephony product lines at Telos Systems and works with the Research and Development Department as well as the Support Engineering Department. Telos Systems, with headquarters in Cleveland, Ohio, and offices in several states and Europe, makes digital network and telephone interface products for talk-show programming, call-in segments, teleconferencing, audio production, remote broadcasts, and inter-com applications.

After joining Telos Systems in 1995, Rolf was involved with telephony in the form of ISDN and T1. As Senior Customer Support Engineer, he helped customers solve telephone system interface problems.

Rolf uses his knowledge of “working with the phone company” originally gained during his analog program loop days and often takes support calls to keep in practice. In Research and Development, he is involved in user-interface design, as well as being an expert on matters pertaining to telephony.

Rolf learned telephone technology at age 10 by dismantling a telephone. Later, as Technical Director at WRUW-FM, he learned the “art” of dealing with the phone company, and understanding analog program loops and 1A2 key systems. At WRUW-FM, he managed a complete refit of the air studio and replacement of old program loops with a 950 MHz STL.

Rolf writes white papers and product manuals at Telos. He has presented a paper at the 2002 NAB Engineering Conference, and contributed several definitions for *Newton's Telecom Dictionary*.

Rolf's hobbies include collecting and restoring vintage telephones and reading books about telephone technology or science fiction.

Phil Tudor (Chapter 5.6) is a Senior Engineer at the BBC's Research Department at Kingswood Warren, Surrey, UK and is a Chartered Engineer. He studied electrical and information sciences at Cambridge University, graduating in 1990.

Over the last six years, Phil has been active in industry efforts to develop standard file formats for use in program making, in particular MXF and AAF.

He represents the BBC on the board of the Advanced Authoring Format Association, and leads their engineering work. He is also a member of SMPTE W25 technology committee.

Phil's technical background includes MPEG-2 video standardization, video coding optimization, and MPEG bitstream manipulation. His current work areas include file format standardization, metadata interoperability, and technical architectures for program making.

David T. Turner (Chapter 3.6) is currently Executive Vice President of ENCO Systems, Inc., in Southfield, Michigan, where he directs development of software-based solutions for the broadcast industry.

Mr. Turner started in broadcasting in 1972 while a freshman in high school. He has an extensive background in radio and television broadcasting, including 20 years of top ten market experience. He has performed a variety of responsibilities including disc jockey, board operator, Transmitter Supervisor, Chief Engineer, Technical Director, Operations Supervisor, Facility Design Engineer, and has operated and serviced nearly every type of broadcast equipment.

Mr. Turner holds a Bachelor of Science degree in electrical engineering from the University of Michigan, is an FCC-licensed First Class Radio Telephone Operator, and holds an Extra Class Amateur Radio Operator License.

Mr. Turner is a contributing author to the *NAB Engineering Handbook* and has been a guest speaker and NAB, SBE, and SMPTE conferences.

Jay Tyler (Chapter 3.5) currently manages the U.S. distribution of Audioarts Engineering and works directly with the major industry groups on the Wheatstone product line. He has been a Sales Engineer for Wheatstone Corporation in New Bern, North Carolina since 1996.

Mr. Tyler was working his way through community college in his hometown of Syracuse, New York at an audio-video store when he remembers attending to a particular client well-versed in audio. That client turned out to be Wheatstone founder Gary Snow. After getting to know each other and touring the Wheatstone factory with Gary, Jay couldn't resist the opportunity to work in a technology field, where he was hooked.

Although Wheatstone is his first career position in the broadcast industry, Mr. Tyler started working with consumer audio at the age of 14 with basic 12-volt automotive audio. By the age of 18 he was designing, selling, and installing premier home AV systems throughout the Syracuse area.

When he's not traveling for Wheatstone, Jay enjoys boating, skiing, golfing, and of course, “Listening to the Radio.”

Doug Vernier (Chapter 1.8) is President and Head Engineer at V-Soft Communications, a broadcast engineering and software development firm with television and radio clients across the United States. His

propagation prediction software is used by a majority of the country's broadcast engineering consultants and station engineers. He is principal technical advisor for the Corporation for Public Broadcasting's digital conversion program.

Mr. Vernier retired in 2002 from a 30-year appointment as Director of Broadcasting Services at the University of Northern Iowa in Cedar Falls. He has served two terms on the National Public Radio Board of Directors. His bachelor and masters degrees are from the University of Michigan, where he studied engineering and telecommunications. Mr. Vernier is certified as an SBE Professional Broadcast Engineer. He has an FCC First Class Radiotelephone License and an amateur radio operator Extra Class (K0DV). He is a motorcycle rider and a collector of antique radios.

John Wahba, PhD., PEng., P.E., (Chapter 7.1) is President and Principal Engineer of Turris Corp. Dr. Wahba has over 16 years of experience with structural engineering and design of broadcast and telecommunication towers. He has research experience in that field in addition to his design activities. He has designed literally hundreds of towers including some 600m guyed towers with candelabras for multiple broadcast antennas and a 395m self-supporting structure. He has coauthored several publications in the field of dynamic and static analyses and design of towers.

Dr. Wahba has held several senior engineering positions with Radian Communication Services and also headed the safety group at Radian. He holds engineering licenses in over 40 jurisdictions across the United States and Canada. He has been active on several technical committees (CSA, TIA, and ASCE dynamics of latticed structures).

Dr. Wahba is a member of the Canadian Standards Association Technical Committee on Communication Towers and the workgroup on Wind Turbines.

John Warner (Chapter 4.6) is Vice President of AM Engineering for Clear Channel and is responsible for the maintenance of nearly 400 AM stations.

John attended the University of Maryland, and after over a decade in defense electronics and communications took a position at WBAL in Baltimore. During his almost 20 years there, he was involved in numerous upgrades, and he spent many weekends working on directional antennas in the area. He came to Jacor in 1999 and moved into Clear Channel shortly thereafter. At Clear Channel, he has been responsible for the construction and commissioning of numerous directional arrays, including several high power diplexes.

John is a member of the Antennas and Propagation and Broadcast Technology Societies of the IEEE and has been a presenter at several NAB conferences.

John holds an Amateur Radio Advanced License, is a licensed pilot, and enjoys fishing and cross-country skiing.

S. Merrill Weiss (Chapter 6.5) heads the Merrill Weiss Group LLC in Metuchen, New Jersey, and is a

consultant in electronic media technology and technology management. He is a graduate of the Wharton School of the University of Pennsylvania.

Mr. Weiss' career is dedicated to designing and building systems for broadcast and related-industry entities. He also has worked on developing many of the technologies that underlie the digital television systems currently being implemented. He has led several development efforts and tests and chaired committees that have prepared standards for the Society of Motion Picture and Television Engineers (SMPTE), the FCC Advisory Committee on Advanced Television Service (ACATS), and the Advanced Television Systems Committee (ATSC).

Mr. Weiss has pursued, for over 15 years, use of multiple transmitters by television broadcasters to cover their service areas. Such service can be provided by distributed transmitters, distributed translators, and digital on-channel repeaters, or combinations of them. Use of multiple transmitters requires synchronized with one another. To make such uses practicable, he invented technology that allows synchronization of 8-VSB modulation and recently received a patent on the method. The current ATSC standard for transmitter synchronization (A/110) embodies his technology.

Mr. Weiss is a Fellow of SMPTE and received its 1995 Sarnoff Gold Medal Award and its 2005 Progress Medal. He was the 2006 recipient of the NAB Television Engineering Achievement Award.

Robert D. Weller, P.E., (Chapter 2.4) is a Senior Engineer at Hammett & Edison, Inc., Consulting Engineers, and has been involved with RF safety issues for over 20 years. He is a member of the International Committee on Electromagnetic Safety (Subcommittee IV, Radio Frequencies), the IEEE Committee on Man and Radiation (COMAR), an Associate Member of the Bioelectromagnetics Society, a Full Member of the Association of Federal Communications Consulting Engineers, and a Senior Member of the IEEE.

Mr. Weller is a graduate in electrical engineering and computer science of the University of California at Berkeley, and a Registered Professional Engineer in California and Colorado. He spent nine years at the U.S. Federal Communications Commission.

Mr. Weller's philosophical interests include the interaction of electromagnetic (EM) waves with matter, EM wave propagation, EM modeling, and measurement. He has published a number of papers in these areas, and serves as a peer reviewer for two IEEE publications.

Jerry Westberg (Chapter 4.4) has been at Broadcast Electronics for the past 16 years in the research and development department as a Principal Engineer. He earned Bachelor's and Master's degrees from Western Illinois University and an engineering degree from Southern Illinois University at Edwardsville, Illinois.

Jerry left the world of teaching high school math and physics in 1979. He is best known for his work in the AM phasing and matching design work, where he spent eight years at Harris Broadcast as a design

engineer. He holds the patent on 4M Modulation. He also sells software for AM Phasor and Diplex designs.

Jerry Whitaker (Chapters 1.11, 1.16, 5.2, 9.2) is Vice President for standards development for the Advanced Television Systems Committee.

Mr. Whitaker supports the work of the various ATSC technology and planning committees and assists in the development of ATSC Standards and related documents. He currently serves as Secretary of the Technology and Standards Group and Secretary of the Planning Committee, and is closely involved in work relating to educational programs.

Mr. Whitaker is a Fellow the Society of Broadcast Engineers and a Fellow of the Society of Motion Picture and Television Engineers.

Mr. Whitaker is the author and editor of more than 30 books on technical topics, including *The Standard Handbook of Video and Television Engineering*, 4th edition, *NAB Engineering Handbook*, 9th edition, *DTV Handbook*, 3rd edition, and *The Electronics Handbook*, 2nd edition. Prior to joining the ATSC, Mr. Whitaker headed the publishing company Technical Press, based in Morgan Hill, California. He has served as a Board Member and Vice President of the Society of Broadcast Engineers.

Danny Wilson (Chapter 8.2) is the founder, CEO, and President of Pixelmetrix Corporation, a Singapore-based company that specializes in the design and production of management and telemetry systems for digital broadcasters. The company's award-winning products are deployed globally at numerous terrestrial, satellite, cable, and IPTV operators.

Mr. Wilson began his management career at Hewlett-Packard. Initially based in Canada as the Business Manager of HP's Communication Measurement Division, he was responsible for the introduction of the MPEGScope Transport Stream Analyzer as well as the world's first ATM/B-ISDN Test System, which accelerated the development and deployment of ATM technology worldwide. He later went on with HP to Kobe, Japan, where he established and managed HP's Asia Business Centre, leading the development of the world's first multi-port network monitoring system, which was accepted and implemented throughout Japan by telecom giant NTT.

Mr. Wilson is a frequent speaker at IPTV and television conferences in Europe, Asia, and North America. He currently chairs the IPTV Quality of Service working group within ITU-T/IPTV-FG. Born in Edmonton, Canada, he holds a computer engineering degree from the University of Alberta.

David Wilson (Chapter 1.18) is Director, Engineering and Standards at the Consumer Electronics Association in Arlington, Virginia, where he oversees CEA's work on various technical activities affecting consumer electronics products. He joined CEA in 2000 after six years at the National Association of Broadcasters, where he was Manager of Technical Regulatory Affairs.

Prior to NAB, Mr. Wilson spent four and a half years in the Office of Engineering and Technology at the Federal Communications Commission, providing engineering support on equipment authorization and spectrum allocation issues. Before that, he spent six years at WUVA-FM in Charlottesville, Virginia, serving for several years as the station's Chief Engineer before becoming its General Manager and President.

Mr. Wilson holds a BS degree in electrical engineering and an MS degree in accounting, both from the University of Virginia. He is also an SBE-certified Broadcast Engineer.

David Wood (Chapter 1.14) is Head of New Media for the European Broadcasting Union (EBU), Geneva, Switzerland.

The EBU is the collective organization for Europe's 65 national broadcasters, and has a further 60 associate members from the rest of the world. It acts in matters of common interest to its members in television, radio, and multimedia, in sports coverage, news coverage, music, drama, and documentary, and in legal and technical matters.

David has chaired new media coordination activities for the EU IST program for many years, and chaired several Working Groups in the ITU. He is particularly interested in the future success of radio as a media form in the new media environment, and in the evolution of audio components of television.

David was educated at Southampton University in the UK, the UNIIRT in Odessa, and the Harvard Business School in the United States. He worked for the BBC and the IBA in the UK before joining the EBU.

Authors whose material was used from the 9th Edition and not listed above are:

Edward J. Anthony (Chapter 4.2)

Lynn Claudy (Chapter 3.2)

James H. Cook, Jr. (Chapter 6.11)

Eric Dye (Chapter 4.9)

Clifford D. Ferris (Chapter 2.6)

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Greg Silsby (Chapter 3.3)

Edmund A. Williams (Chapter 6.3)

Scott A. Wright (Chapter 4.14)

Fred Wylie (Chapter 3.7)

NAB Engineering Achievement Award Recipients

Since 1959 the National Association of Broadcasters annually recognizes broadcast industry engineers for outstanding achievements during their distinguished professional careers and for significant contributions that have advanced the state of the art of broadcast engineering.

In 1991 a second award was developed in order to separately recognize achievements in Radio and Television engineering and, on occasion, a third award is given to recognize individuals for their Service to Broadcast Engineering.

The awards are presented during the Technology Luncheon at the annual NAB Convention.

For more information on the award and how nominations may be made see: www.nab.org

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| 1959 | John T. Wilner, Vice President of Engineering, Hearst Corporation, Baltimore, Maryland | 1967 | Robert M. Morris, Staff Consultant, Engineering Department, American Broadcasting Company, New York, New York |
| 1960 | Commissioner T. A. M. Craven, Federal Communications Commission, Washington, District of Columbia | 1968 | Howard A. Chinn, Director, General Engineering, CBS Television Network, New York, New York |
| 1961 | Raymond F. Guy, Consultant | 1969 | Jarrett L. Hathaway, Senior Project Engineer, NBC Television Network, New York, New York |
| 1962 | Ralph N. Harmon, Vice President for Engineering, Westinghouse Broadcasting Co., New York, New York | 1970 | Philip Whitney, General Manager, WINC, Winchester, Virginia, and Supervisory Engineer for Richard F. Lewis radio stations |
| 1963 | Dr. George R. Town, Dean of Engineering, Iowa State University, Ames, Iowa | 1971 | Benjamin Wolfe, Vice President Engineering, Post-Newsweek Stations, Washington, District of Columbia |
| 1964 | John H. DeWitt, Jr., President, WSM, Inc., Nashville, Tennessee | 1972 | John M. Sherman, Director of Engineering, WCCO, Minneapolis, Minnesota |
| 1965 | Edward W. Allen, Jr., Chief Engineer, Federal Communications Commission, Washington, District of Columbia | 1973 | A. James Ebel, President and General Manager, KOLN-TV, Lincoln, Nebraska |
| 1966 | Carl J. Meyers, Senior Vice President and Director of Engineering, WGN Continental Broadcasting Co., Chicago, Illinois | 1974 | Joseph B. Epperson, Vice President Engineering, Scripps Howard Broadcasting Co., Cleveland, Ohio |
| | | 1975 | John D. Silva, Director, Research and Development, Golden West Broadcasters, Los Angeles, California |
| | | 1976 | Dr. Frank G. Kear, Consulting Engineer, Washington, District of Columbia |
| | | 1977 | Daniel H. Smith, Senior Vice President for Engineering, Capital Cities Communications, Inc., Philadelphia, Pennsylvania |
| | | 1978 | John A. Moseley, President, Moseley Associates, Inc., Goleta, California |

- 1979 Robert W. Flanders, Vice President and Director of Engineering, McGraw-Hill Broadcasting Co., Inc., Indianapolis, Indiana
- 1980 James D. Parker, Staff Consultant, Telecommunications, CBS Television Network, New York, New York
- 1981 Wallace E. Johnson, Executive Director, Association for Broadcast Engineering Standards, Washington, District of Columbia
- 1982 Julius Barnathan, President, Broadcast Operations and Engineering, American Broadcasting Companies (ABC), Inc., New York, New York
- 1983 Joseph Flaherty, Vice President, Technology, CBS Inc., New York, New York
- 1984 Otis S. Freeman, Vice President and Director of Engineering, WPIX, Inc., Tribune Broadcasting, New York, New York
- 1985 Carl E. Smith, President, Smith Electronics, Cleveland, Ohio
- 1986 Dr. George Brown, RCA Laboratories, Princeton, New Jersey
- 1987 Renville H. McMann, CBS Technology Center, Stamford, Connecticut
- 1988 Jules Cohen, Jules Cohen and Associates, Washington, District of Columbia
- 1989 William Connolly, President, Sony Advanced Systems, Montvale, New Jersey
- 1990 Hilmer Swanson, Senior Staff Scientist, Harris Corporation, Broadcast Division, Quincy, Illinois
- 1991 George Marti, President and CEO, Marti Electronics, Cleburne, Texas (Radio)
- Kerns Powers, David Sarnoff and NBC Consultant, Princeton, New Jersey (Television)
- 1992 Edward Edison and Robert L. Hammett, Hammett & Edison, San Francisco, California (Radio)
- James C. McKinney, Chairman, Advanced Television Systems Committee, Washington, District of Columbia (Television)
- 1993 Robert M. Silliman, Silliman and Silliman, Silver Spring, Maryland (Radio)
- Stanley N. Baron, Managing Director, Technical Development, NBC, New York, New York (Television)
- Herb H. Schubarth, Vice President of Engineering, Gannett Broadcasting, Denver, Colorado (Service to Broadcasting Engineering)
- 1994 Charles T. Morgan, Vice President and Director of Engineering, Susquehanna Radio Corporation, York, Pennsylvania (Radio)
- Thomas J. Vaughan, President, PESA Micro Communications, Inc., Manchester, New Hampshire (Television)
- 1995 Robert Orban, Chief Engineer, AKG Acoustics, Inc. San Leandro, California (Radio)
- Carl G. Eilers, Manager of Electronic Systems R&D, Zenith Electronics, Glenview, Illinois (TV)
- 1996 Ogden Prestholdt, A.D. Ring & Associates, Nakomis, Florida (Radio)
- Charles Rhodes, Advanced Television Test Center, Alexandria, Virginia (Television)
- Gerald Robinson, Hearst Broadcasting, Milwaukee, Wisconsin (Service to Broadcast Engineering)
- 1997 George Jacobs, George Jacobs & Associates, Silver Spring, Maryland (Radio)
- Michael Sherlock, NBC, New York, New York (Television)
- 1998 John Battison, P.E., John Battison, Consultant, Loudonville, Ohio (Radio)
- Robert Hopkins, Sony Pictures High Definition Center, Culver City, California (Television)
- 1999 Geoffrey Mendenhall, P.E. Harris Corporation, Quincy, Illinois (Radio)
- John Turner, Turner Engineering, Mountain Lakes, New Jersey (Television)
- 2000 Michael Dorrough, Dorrough Electronics, Woodland Hills, California (Radio)
- Max Berry, Capital Cities/ABC Elkins Park, Pennsylvania (Television)
- 2001 Arno Meyer, Belar Electronics Laboratory, Devon, Pennsylvania (Radio)
- Larry Thorpe, Sony Electronics, Inc., Park Ridge, New Jersey (Television)
- 2002 Paul Schafer, Schafer International, Bonita, California (Radio)
- Bernard Lechner, Consultant, Princeton, New Jersey (Television)
- 2003 John W. Reiser, FCC, Mt. Vernon, Virginia (Radio)
- Robert P. Eckert, FCC, Washington, District of Columbia (Television)
- 2004 Ira Goldstone, Tribune Broadcasting, Los Angeles, California (Television)
- E. Glynn Walden, Infinity Broadcasting, New York, New York (Radio)

NAB ENGINEERING ACHIEVEMENT AWARD RECIPIENTS

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| 2005 | Dr. Oded Bendov, TV Transmission Antenna Group, Inc. Cherry Hill, New Jersey (Television) | 2007 | Victor Tawil, Senior Vice President of the Association for Maximum Service Television (MSTV), Washington, D.C. (Television) |
| | Milford K. Smith, Greater Media Inc. Braintree, Massachusetts (Radio) | | Louis A. King, Founder and Chairman, Kintronic Labs, Inc. Bristol, Tennessee (Radio) |
| 2006 | Benjamin F. Dawson, III, P.E., Hatfield & Dawson Consulting Engineers, Seattle, Washington (Radio) | | |
| | Ronald D. Rackley, P.E., du Treil, Lundin & Rackley, Sarasota, Florida (Radio) | | |
| | S. Merrill Weiss, Merrill Weiss Group, LLC, Metuchen, New Jersey (Television) | | |