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IEEE Broadcast Technology Society Newsletter

The technologies to deliver information and entertainment to audiences worldwide, at home and on the go.

From the President

William T. Hayes, President, IEEE Broadcast Technology Society

Greetings BTS members. In this issue, I would like to share with you my views about how rapidly expanding information and communications technologies are benefiting as well as changing, in unexpected ways, our daily lives and social interactions.

In 1989 astronomer Carl Sagan lamented "We live in a society exquisitely dependent on science and technology, in which hardly anyone knows anything about science and technology." At the time he was describing the technical illiteracy that he viewed as a recipe for disaster unless some significant changes were made to improve the general understanding and applications of technology. Thirty years later it doesn't appear that a significant improvement in this situation has occurred and this dependence has increased. As a technologist working in the fields of information and communications technology I find this a disturbing situation since daily dependence on things that are not understood is an invitation to catastrophe. But I am not going to focus on the need for better technical literacy but rather on the need for individual management of personal information and communications technology.

Nowhere is the increased individual dependence more apparent than in personal information technologies. Worldwide cellular and mobile technologies have made it possible for individuals to be globally connected. In my positions, both as BTS President and also as Director of Engineering for Iowa Public Television, I travel quite a bit. Thanks to my PDA and my wireless laptop, I

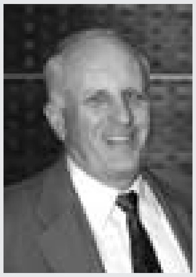
continued on page 2

59th ANNUAL IEEE BROADCAST SYMPOSIUM SEE PAGE 3

Inside

From the Editor

William Meintel, BTS Newsletter Editor



As I write this column IBC2009 in Amsterdam is fast approaching and your Society will play a major role in the technical conference. The BTS is scheduled to provide a half day tutorial on Sunday 13 September entitled Audio Technology: Coding and Concatenation, Loudness and Lip Sync. With television moving to digital in many parts of the world this topic should be of significant interest and we hope it draws a big crowd.

One month after IBC is the 59th annual IEEE Fall Broadcast Symposium in Alexandria VA 14–16 October 2009. I highly encourage you to attend the Symposium since a great 3 day program has been planned. You can check out the program details in this issue or online. The luncheon keynote speakers will be: Jules Cohen, Consulting Engineer, Andrew W. Clegg, U.S. National Science Foundation.

Also as always, the Symposium is a great place to see old friends, make

continued on page 3

Celebrating 125 Years
of Engineering the Future

am "virtually" always in the office. The tremendous benefit of this technology is that I am able to respond to needs quickly. I am able to work dynamically which in my case means when I am at my most creative and that is seldom while I am sitting at my desk. I am able to communicate ideas and instructions to my staff whether I am there or not and whether they are there or not. In essence, I am not tethered. What could possibly be wrong with this?

Well, my experience has been that it is possible to be globally connected and locally disconnected simultaneously. Let's look at the concept of social networking. The word social relates to interaction between people, peoples, and communities. Networking is the practice of building and maintaining informal relationships, especially with people. If you think about it from the standpoint of computer networks, the social portion is the physical layer where the individuals interact with each other directly without the use of technology. Information and communication technologies have added a new layer to the social network that allows the interaction without the direct connection and while this is certainly not new, the rapid growth and deployment of bi-directional wireless technologies has changed the dynamic of interaction and not always in a positive way.

The technologies that are being deployed are neither good nor bad; they are merely tools to be used. Learning how and when to properly use the tools is important because there are often ramifications to their improper use. I am of the opinion that when I am face-to-face with someone, there is great significance to that interaction because it provides the truest view of the relationship. It is theorized that in face-to-face communications, only about 10% of meaning is conveyed by the words. Body language accounts for about 50% and the remainder is carried by the tone of the voice. Body language, facial expression, vocal inflection and tone are all part of the communication that is occurring and we are getting and giving the truest representation possible. All of these factors confirm to and from the other person our level of interest and engagement. In essence we are communicating how important or not we believe the interaction and possibly the person is in our view.

If the theory is accurate, in a conversation over a cell phone, 50% of the meaning may or may not be accurately communicated and if the exchange is text based, that number may rise to 90%. Now notice I don't say that the meaning will be lost but the accuracy will almost certainly suffer. In the case

continued on page 5

Correction

In the 2009 Summer Issue of the BTS Newsletter on page 28 in the article titled ***"Design and Implementation of a Two-way Real-time Communications System for Audio over CATV Networks,"*** the statement below should have been included on the first page of the article. Please add this statement to the article:

For more information

This work was supported by the Korea Research Foundation Grant funded by the Korean Government (MOEHRD) (KRF-2007-314-D00245). For detailed information, contact: Prof. Hong Kook Kim, Department of Information and Communications, Gwangju Institute of Science and Technology (GIST), 1 Oryong-dong, Buk-gu, Gwangju 500-712, Korea. Tel: +82-62-970-2228, Fax: +82-62-970-2204, Email: hongkook@gist.ac.kr

Newsletter Deadlines

The BTS Newsletter welcomes contributions from every member. Please forward materials you would like included to the editor at wmeintel@computer.org. Here are our deadlines for upcoming issues:

Issue	Due Date
Winter, 2009	02 November 2009
Spring, 2010	20 January 2010
Summer, 2010	04 May 2010
Fall, 2010	20 July 2010

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59th Annual IEEE Broadcast Symposium

Wednesday, 14 October through Friday, 16 October 2009
The Westin Alexandria Hotel Alexandria, Virginia USA

The 59th Annual IEEE Broadcast Symposium will again be presented at The Westin Alexandria, a perfect location with ample meeting space, reasonable cost rooms, and an easy shuttle ride from The Ronald Reagan Washington National Airport.

Under the direction of co-chairs Tom Silliman and Eric Wandel, the Broadcast Symposium program emphasizes broadcast transmission, interference and coverage, and digital implementation issues.

In addition to sixteen excellent technical papers dealing with broadcast transmission issues presented by distinguished engineers and technologists from around the world, the program offers a full day of tutorials on FM IBOC transmission, revisiting Longley-Rice, and DTV Emission Standards. Panel discussions include Broadcast Antenna Television Antennas and Digital Implementation Issues. Panelists include experts from the manufacturing and broadcast engineering groups. See program details below.

Keynote speakers for the luncheons include internationally known broadcast engineering consultant Jules Cohen and Andrew Clegg of the National Science Foundation.

As in the past Continuing Education Units (CEUs) will be available with at least 2 units awarded for attendance. Importantly, the Symposium serves as an opportunity to network with top broadcast engineers, meet with old friends, and make new friends. Plan to attend the Wednesday evening Welcome Reception with music by the *Jazz Trio*.

For details and on-line registration, please visit the IEEE Broadcast Symposium website at: www.iee.org/bts/symposium

Preliminary Program

(Subject to Change)

Wednesday – 14 October 2009

Tutorial Day

Session Chairs: David Layer, NAB, USA and Guy Bouchard, CBC Technology, Canada

"Modern FM and IBOC Signal Coverage Measurement Techniques at NPR Labs"

John Kean, NPR Labs – National Public Radio, USA

"Results of the Field Trials for IBOC at Increased Power Levels"

Russ Mundschenk, iBiquity, USA

"Inside a New Implementation of Longley-Rice"

Sid Shumate, Givens & Bell, and BIA Advisory Services – Dataworld, USA

"Harmonic and Spurious Measurement Methodology according to the IEEE P1631 Emission Mask Compliance Recommended Practice"

Greg Best, Greg Best Consulting, USA

EVENING WELCOME RECEPTION

Thursday – 15 October 2009

Coverage and Interference (AM)

Session Chair: Kerry Cozad, Dielectric Communications, USA

"Revisiting the Field Strength Requirements for DTV in the Canadian Context"

Pascal Marcoux, CBC/Radio-Canada

"Radiated Emission Interference from In-House Power Line Telecommunications Devices into the Residential Broadcast Environment"

Charles Einolf, Consultant, USA

"Experimental Results on Wind Turbines Impact to Terrestrial DTV Reception in UHF Band"

David de la Vega, University of the Basque Country, Spain

"IBOC Signal Quality Measurements"

David L. Hershberger, Continental Electronics, USA

"Building a real world HD Radio Application"

Paul Brenner, Broadcast Traffic Consortium, USA

Joint BTS/AFCCE Luncheon
Keynote Speaker – Jules Cohen
"The Transition from Analog to Digital Television"

Broadcast Antenna Technology (PM)

Session Chair: Paul Shulins – Greater Media, MA USA

From the Editor continued from page 1

some new ones and is a great opportunity to do some networking.

If you have not yet read our President's column I think you will enjoy this thought provoking piece on the state of communications in our world today.

As I mentioned in my last column a distinguished lecturer (DL) program has been launched under the direction of Dr. Richard Chernock. Please take a moment to read the article about this tremendous new program and the 10 individuals who will form the initial lecturer group.

While you are "inside" checking out the DL article you should also read about the BTS GOLD program and also an interesting profile article about our first BTS GOLD Committee Chair, Heidi Himmanen. GOLD stands for Graduate of the Last Decade and is an IEEE program developed in 1996 to help young engineers transition from being a student to entering the professional world.

continued on page 9

"AM Modeling using NEC"

Tom Jones, Carl T. Jones Corporation, USA

"Monopoles, and Vertically Polarized Dipoles, Directivity, Effective Height and Antenna Factor"

Valentin Trainotti, University of Buenos Aires, Argentina

"Mathematics of Mechanical Beam Tilt"

S. Merrill Weiss, Merrill Weiss Group LLC, USA

Manufacturers Panel Discussion – TV Antennas

Electronics Research, Inc. (Myron Fanton, P.E.), Dielectric (Kerry Cozad), and Jampro (Dane Jubera)

Moderator – Bill Hayes, BTS President and Iowa Public Television, USA

MANUFACTURERS RECEPTION

Sponsors include: Dielectric, ERI, Jampro, and Shively

Friday – 16 October 2009

Digital Implementation – I (AM)

Session Chair: Bob Surette – Shively Labs, USA

"Feedback Cancellation with a Pilot-Free Reference for the ATSC terrestrial DTV Repeaters"

Ki-Hwan Suh, Pusan National University, Korea

"A Design of a Feedback Canceller for Equalization Digital On-Channel Repeater of the ATSC systems"

Young-Jun Lee, Pusan National University, Korea

"Frequency Synchronization and Field Test Results of Equalization Distributed Translators"

Homin Eum, ETRI, Korea

"Evaluating Equalized Digital On Channel Repeaters: A Simple and Effective Solution for Enhancing ATSC TV Station Coverage"

Nat Ostroff, Acrodyne Industries, USA

"RF Performance of DTV Converter Boxes—An Overview of FCC Measurements"

Stephen Martin, Federal Communications Commission Laboratory, USA

"Mobile/Handheld Digital Television: Testing Update and Potential Use Cases"

Jim Kutzner, Public Broadcasting Service, USA

BTS AWARDS LUNCHEON

Keynote Speaker – Andrew W. Clegg

"The Co-Existence of Broadcasting and Radio Astronomy Services"

Digital Implementation – II (PM)

Session Chair: Doug McCabe, Jampro, USA

"DTV Implementation issues"

Adam Goldberg, AGP, LLC and Matthew Goldman, Tandberg Television

"An Expanded Presentation on AFD"

Michel Proulx, Miranda Technologies, Inc., USA

"Broadcasting 16X9 Standard Definition in North America"

Terry Harvey, Southern Illinois University, USA

Panel Discussion – DTV Implementation Issues

Graham Jones (Moderator), Adam Goldberg, Matthew Goldman, Michel Proulx, Terry Harvey, and Jim Kutzner

IEEE BTS Represented at Broadcast Asia 2009

By Yiyan Wu and Chew Boon Seng, BTS BroadcastAsia Representative

BroadcastAsia 2009 was held 16–19 June 2009 in Singapore. Close to 9,500 visitors from 92 countries and regions across Asia-Pacific, Europe, North America, and the Middle-East attended the event. 617 exhibiting companies from 42 countries showcased innovative solutions in 3D HDTV, Broadcasting-to-Handheld, Digital Media Asset Management, IPTV and Professional Audio Technologies.

IEEE BTS was represented at BroadcastAsia 2009 with a membership booth run by BTS staff, local and international volunteers. Visitors to the booth were able to learn about the IEEE and the BTS as well have the opportunity to join the organization on site.

Yiyan Wu, BTS BroadcastAsia Representative and Chew Boon Seng, local volunteer work the BTS booth at BroadcastAsia

The Singapore Expo center was the home of BroadcastAsia 2009

From the President continued from page 2

of the cellular conversation both parties will continue to receive visual information but it may be completely unrelated to the message. Talking on the cell phone while driving is an easy example where the local external conditions, such as being stuck in traffic, can create an environment of stress that distorts the message being sent or received. The frustration with the external situation will come through in the tone of the voice and may easily imply an unintended message. The issue becomes even more complex and convoluted when the exchange is entirely text based in which possibly ninety percent or more of the intended meaning is missing or uncorrelated. Most people generally read more or less meaning than was intended in the sender's text message due to the receiver filling in the missing meaning as influenced by the receiver's environmental conditions and mood.

To further compound the issue we now are seeing a push to increase the amount of information and content that is available to the consumer regardless of location. Systems to access sophisticated information in real time are being deployed worldwide so that commuters can watch news and entertainment programming to fill the time that would otherwise be "wasted" while sitting in traffic or riding the train from work to home. If that were only the case. In reality what we see are people walking the streets completely oblivious to their local surroundings because they are fully engaged with their mobile devices. It is almost as if the screen on the small hand held device has become their view of the world around them.

There are many times and many individuals who use the technology as a way to actually avoid face-to-face interaction. Sometimes it is easier to deliver the message remotely and be removed from the consequences. Sometimes the person or persons don't interact well and the technology is used as a buffer or shield. Sometimes it is just too much trouble or someone's too busy. I think everyone at some time has used the technology as a tool to either avoid or minimize the effect of a communications situation. These situations remind me of a statement a friend of mine made about serving as sailor. "At some point in its life on a ship at sea, every tool becomes a hammer." He was of course referring to the amount of corrosion that an ocean going vessel accumulates and the need to constantly maintain and clean the ship. The sailor often finds himself trying to free or remove a corroded item using a wrench or a screwdriver as an impact tool because he didn't have a hammer.

Likewise in communications there are times when remote communications must be used when in reality face-to-face would be better. As I noted in this column earlier, the science and technologies we are exploring are neither good nor evil, they are tools and it is up to the user to select the right tool for the job. In the beginning I quoted Carl Sagan and his concern regarding technical literacy and to that I would add that we should also be learning to manage our use of technology. It will be very sad if we find ourselves in electronic conversations with people across the globe and yet unable to communicate with people across a table.

So, what impact has information and communications technology had on the world? The answers are endless and more are coming. On a large scale, the technologies have given access to knowledge to everyone everywhere which is a tremendous benefit. It allows people the opportunity to study and understand their neighbors next door and their global neighbors as well. Through that study and understanding, common goals and interests can be identified and the social network becomes more global and perhaps the needs and good of all will take precedence over the wants and desires of the few. While this is certainly a noble ideal, it remains to be seen if the individuals utilizing the technologies will ever look up from their screens and recognize that they must live, work and impact the physical world as well as the cyberspace layer.

I welcome your thoughts on this subject. If you are interested in personally discussing your views with me, I would be glad to meet with you at a BTS AdCom meeting, Symposium or in my office at Iowa Public Television, Johnston, IA, USA. Feel free to contact me by phone at 1 + 515-242-3116 or email at <hayes@iptv.org>.

Bill Hayes,
President
hayes@ipt.org

ATSC Mobile DTV Work Moves Ahead

By Jerry Whitaker, VP of Standards Development, ATSC

The ATSC Mobile DTV standardization effort has reached a significant milestone—approval from the Technology and Standards Group (TSG) as a Proposed Standard. Prior to advancing to this point, the document set describing ATSC Mobile DTV (known as "A/153") had been a Candidate Standard (CS). Advancement of a document to CS status is an explicit call to those outside of the related specialist group for implementation and technical feedback. This is the phase at which the specialist group is responsible for formally acquiring that experience or at least defining the expectations of implementation.

During the CS phase, considerable input was provided by member organizations. Implementations ranged from complete mobile DTV systems to individual elements of the system. During the seven month CS period, four updates to the A/153 specification were issued. During this time, comprehensive demonstrations of ATSC Mobile DTV were held at the Consumer Electronics Show and the National Association of Broadcasters Convention, both held in Las Vegas.

During the TSG ballot, a number of comments were received from member companies. Those comments were being addressed as this article went to press. Following completion of the comment resolution process, any sustentative changes will be sent to TSG for approval.

The final approval step for the A/153 document set is a ballot of the full ATSC membership. If all goes as expected, the ATSC Mobile DTV standard could be finalized and approved in Q3 or Q4 of this year.

About the Project

ATSC Mobile DTV is being developed to support a variety of services including free (advertiser-supported) television and interactive services delivered in real-time, subscription-based TV, and file-based content download for playback at a later time. The standard can also be used for transmission of new data broadcasting services.

ATSC Mobile DTV is built around a highly robust transmission system based on vestigial sideband (VSB) modulation, with enhanced error correction and other techniques to improve robustness and reduce power consumption in portable receivers, coupled with a flexible and extensible Internet Protocol (IP) based transport system, efficient MPEG AVC (ISO/IEC 14496-10 or ITU H.264) video, and HE AAC v2 audio (ISO/IEC 14496-3) coding. ATSC Mobile DTV services are carried in existing digital broadcast channels along with current DTV services without any adverse impact on legacy receiving equipment.

In addition to live television, the ATSC Mobile DTV system provides a flexible *application framework* to enable new receiver capabilities. Receivers that make use of an optional Internet connection will enable new interactive television services, ranging from simple audience voting to the integration of Internet-based applications and transactions with television content.

Development of the ATSC Mobile DTV system began in May 2007 with the issuance of a request for Proposals (RFP). Since that time, enormous progress has been made.

Documentation

In a tip of the hat to the core ATSC DTV Standard—document A/53—the final ATSC Mobile DTV standard will be known as A/153. Like A/53, A/153 is modular in concept, with the specifications for each of the modules contained in separate Parts. The major Parts are as follows:

- **Part 1** – "Mobile/Handheld Digital Television System"
- **Part 2** – "RF/Transmission System Characteristics"
- **Part 3** – "Service Multiplex and Transport Subsystem Characteristics"
- **Part 4** – "Announcement"
- **Part 5** – "Application Framework"
- **Part 6** – "Service Protection"
- **Part 7** – "Video System Characteristics"
- **Part 8** – "Audio System Characteristics"

Part 1 describes the overall ATSC Mobile DTV system and explains the organization of the standard.

These documents remain available on the ATSC Web site during the ballot process. See: http://www.atsc.org/standards/candidate_standards.php.

New Work on a Scalable Full-Channel Option

Work has begun work on an extension of the ATSC Mobile DTV system described in A/153 that enables use of the full channel bandwidth for mobile services. The New Work Item, "Enabling Scalable Full-Channel Use for Mobile DTV Services," was approved by the ATSC Board of Directors in June and assigned to TSG.

This work is intended to add increased capacity in a scalable manner up to complete channel bandwidth usage. The Scalable Full-Channel Mobile Mode (SFCMM) technology will provide additional operational options for use of A/153. The existing A/153 (Core Mobile Mode, or CMM) requires a minimum of 4.7 Mbps to be transmitted as conventional 8-VSB. SFCMM, on the other hand, could scale capacity up to the total available from the channel.

Requirements and compatibility with existing devices and systems include the following:

- The emitted SFCMM signal must be compatible with the A/153 (CMM) emitted signal so as to allow receivers designed for SFCMM reception to be able to also receive A/153 (CMM) signals.
- A CMM-compatible portion of the emitted signal from a SFCMM system must be capable of being received and decoded on a CMM receiver.
- Like the current A/153 (CMM), emission of the SFCMM must not have any adverse impact on existing and future receivers deployed to receive ATSC A/53 DTV.

Work on the scalable full-channel system is underway on a new subgroup of TSG/S4, known as S4-5. This group is led by Jordan Cookman of Auvitek.

Get Involved

Work within ATSC is open to all organizations with a direct and material interest. If you would like to be involved in this ongoing work, please contact the author at jwhitaker@atsc.org

The ATSC Mobile DTV Candidate Standard document set can be downloaded from the Candidate Standard page on the ATSC Web site: http://www.atsc.org.

BTS Distinguished Lecturer Program

By Rich Chernock, Chair
(rchernock@TriveniDigital.com)

The IEEE Broadcast Technology Society has started a new Distinguished Lecturer (DL) program. The intent of this program is to provide a resource for the BTS chapters—serving the needs of the members of the BT Society to enhance their professional knowledge and vitality by keeping them informed of the latest research results and their practical applications. This program is not intended to provide speakers for BTS conferences, regional conventions, university seminars, or trade shows. BTS will maintain a list of 10 available DLs (with 3 year terms). All of the DLs in this program are well-respected in the field and have considerable experience in presenting technical information. By the time of publication, further information about the DL program will be available through the BTS web site.

In short, BTS Chapter Chairs are invited to visit http://www.ieee.org/organizations/society/bt/lecturers.html to see a list of available DLs, the lecture topics that each can provide and the geographical area that each will cover. Currently, worldwide chapter support can be provided. After selecting a potential DL and topic, the chair will discuss availability and details directly with the DL. Once agreement has been reached, the visit needs to be approved by the DL chair (Rich Chernock—the author). There are requirements for announcement of the events and follow-up, with further details on the web site. Limited funding is available through BTS to support these visits (with some limitations). There is also limitation to the number of DLP talks each DL may give in a year, so please plan early.

The current list of DLs (and their lecture topics) is as follows:

- Dave Bancroft: Reference monitoring for broadcast production in the flat panel era, Comparing image characteristics of television cameras with different optical formats and sensor architectures
- Lap-Pui Chau: Source and Channel Rate Allocation Techniques for Digital Video Transmission Applications, Multip-Program Video Coding for Digital Video Broadcasting Applications
- Rich Chernock: DTV Technology Tutorials, DTV Monitoring, ATSC Mobile Television
- Matt Goldman: Broadcast Television Analog Turn-off, Advances in Video Compression Technology for Contribution and Distribution, MPEG-2 Technology, MPEG-4 AVC Technology
- David Layer: Digital Radio, Digital TV, Broadcast Regulatory and Legislative Issues
- Gary Sgrignoli: Transmission and Reception of 8-VSB DTV transmissions
- Valentino Trainotti: AM Low and Medium Frequency Transmitting Antennas, Transmitting Antennas for FM and TV Broadcasting in VHF and UHF Bands
- Xianbin Wang: Robust System Design for Multimedia Broadcasting Services under Distributed Transmission Networks, Emerging Technology and New Applications for ATSC DTV Systems
- Hsiao-Chun Wu: Digital Transmission and Signal Processing in Broadband Multimedia Communications, Transmitter Identification for Digital Video Broadcasting
- Yiyan Wu: Broadband Multimedia Transmission and Processing, Digital Television Engineering

All BTS chapter chairs are encouraged to take advantage of this new resource.

Dr. Heidi Himmanen

Chair BTS Gold Member Program

A BTS Member Profile

By Jennifer Barbato, BTS Publications/Newsletter Coordinator

The BTS is excited to introduce to you Heidi Himmanen, the first BTS GOLD Member Program Chair. If you are not already familiar with the GOLD (Graduates of the Last Decade) program, the focus is to help young engineers transition from being a student to entering the professional world. Heidi became the Chair of the BTS GOLD committee in January 2009. She has already held her first successful meeting in May at BSMB 09' in Bilbao Spain with more than 40 persons in attendance.

In this article, the BTS would like you to learn a little more about Heidi and her activities in the broadcast engineering profession.

Heidi Himmanen

An Early Interest in Engineering

Heidi was born in Vaasa, Finland, where she grew up in a bilingual household. She speaks Swedish to her mother and Finnish to her Father. Her mother works in the ICT field and her father owns his own company in the Electrical Technology field. Heidi became interested in many different topics while attending High School including mathematics, physics, law and psychology. She says "my parents influence helped to make my final decision to study engineering".

In 1999, Heidi performed voluntary military service. In Finland military service is compulsory for men and voluntary for women. She served in the Finnish Marine forces and Reserve Officer School. She was trained to be a Signaling officer and received the rank of Second Lieutenant in reserve.

In 1998 Heidi moved from Vaasa, Finland to Helsinki, Finland to study. In 2005, she received her Master of Science Degree from the Helsinki University of Technology, with major studies in Networking Technology and minor studies in Economic and Property Law. Before graduating she moved to Turku, Finland in 2004 where she has lived ever since. She worked for the University of Turku since November 2004 on industry projects. After Heidi received her Master's degree she immediately began working towards her Doctoral Degree at the University of Turku mainly in DVB terrestrial and handheld broadcasting technologies. In 2006, Heidi married Mikko Himmanen and in 2008 their son Esko was born. During all of this personal change in Heidi's life, she submitted her doctoral thesis for review in September 2008. Despite caring for a newborn, Heidi managed to publish her thesis and have a public doctoral defense in February 2009. The title of her thesis is "On Transmission System Design for Wireless Broadcasting." Prof. Ulrich Reimers, chairman of the Technical Module of the DVB Project was her esteemed opponent. You can read her dissertation online at https://oa.doria.fi/handle/10024/43604.

Heidi has had her work published in many Scientific Journals, Books, International conference proceedings, International Standards and Technical reports. She has also acted as a reviewer for numerous articles for the IEEE Transactions on Broadcasting, Wireless Communications and Mobile Computing and papers submitted to International IEEE conferences.

Other Activities

In her spare time, Heidi enjoys fitness training, hiking, organizational actives, gardening and music. She is a member of the committee for government employees at the Tekniikan Akateemisten Liitto, which is a Finnish professional and labor market organization for graduate engineers. She is also a member of the local board of Swedish speaking engineers in Turku, and the secretary and founding member of the work place association for teachers and researchers in technology. She also taught at the University of Turku.

Getting to know the IEEE and the BTS

Heidi learned of the IEEE while reading publications posted on IEEE Xplore during her Master's degree studies. She attended her first IEEE conference in 2005 during her doctoral studies and at that point she decided to become an IEEE student member.

In 2007 Heidi attended her first BMSB conference in Orlando, FL and happily realized that all of the papers presented were related to her field. She has been attending the BMSB conferences ever since. It wasn't until 2008 that Heidi decided to join the BT Society. She says "I decided to join the BTS when I got the chance to create the added value for young professionals within this society". She has been working on the BTS GOLD program for the society since the AdCom appointed her January 2009.

Heidi believes that the most important part of the GOLD program is "global networking with people in the same working field. Networking for young engineers just beginning in this field is extremely important so that they can find their place in the worldwide engineering community." Heidi is planning activities in the future to assist the members of the GOLD program with the understanding and type of skills that are needed in developing themselves in the engineering field. "Social and networking skills are not taught at the Universities but are an intricate part of an engineers professional life" she explains. When asked how she came to decide to assume the Chair of the BTS Gold program Heidi stated "The more you give, the more you get. By being an active participant in BTS you will get the most out of your membership with great hopes that the young BTS members become social, motivated and proud engineers."

Looking to the Future

Heidi is especially interested in wireless broadcasting and plans to study the future role of broadcasting within the field of telecommunications and especially the role of wireless broadcasting within the field of wireless telecommunications. Before her maternity leave she was working on the DVB-T2 Standardization process and writing of the DVB-T2 Standard.

We asked Heidi to tell us what she enjoys most about her engineering work and career she responded with, "The problem solving and teamwork. I also enjoy that engineers all over the world can work together to solve technical problems, despite their backgrounds or beliefs."

Heidi gave this advice to young people considering a career in engineering, "Engineering is cross-disciplinary. In addition to a broad knowledge in technology, it is good to understand marketing, usability and law. Take part in student activities and personal associations. You will learn many important skills for your professional career and know people who may influence your future."

The BTS GOLD Program Moves Ahead

The BTS is proud that Heidi Himmanen is Chair of the BTS GOLD Program. Her leadership of the GOLD program will benefit young engineers to learn how to succeed in their early engineering careers and build valuable professional relationships.

Please see Heidi's first report of her GOLD members meeting which is presented on page 10.

The BTS encourages you to participate in GOLD program by contacting Kathy Colabaugh at k.colabaugh@ieee.org and joining the GOLD e-mail list.

From the Editor continued from page 3

In addition to the above we have updates on the ATSC Mobile DTV Work by Jerry Whitaker as well as reports from our chapters. But there is still more with feature articles on

- TV.s Longest Remote
- AM Antenna Performance Verification
- Urban Propagation Measurements for Digital TV
- and another installment from Sid Shumate relating to his work on improving the Longley-Rice propagation model.

All in all we have another great issue thanks to our many contributors.

Now for more on the topic of the U.S. DTV transition that you have probably come to expect from me. The DTV transition in the United States occurred on June 12th as scheduled and approximately 1,800 full power analog stations have ceased operation. We are now working to understand and correct some of the problems that have surfaced now that analog is no longer a fallback position when a viewer is unable to receive a station's digital transmission. Keep in mind that for the past several years most of these 1,800 stations have operated both digital and analog facilities. Therefore, we were not sure how many viewers may have experienced DTV reception problems and just switched back to the analog. With the analog gone that is no longer an option.

From what we know at this point most of the problems appear to be with indoor reception of VHF channels. Based on several weeks of field work that is to continue for the foreseeable future some things have become apparent. The first problem is that many of the antennas available for indoor use perform very poorly at VHF. We have found antennas that not only do not have any gain with respect to a dipole but actually have a significant loss. In some cases the impedance matching between the antenna and the tuner has been found to be the culprit. Still another problem in some areas has been overload from a nearby FM broadcast station likely due to a lack of filtering in the DTV receiver since adding an FM trap has proved to eliminate the problem. There have been some issues related to receiver scanning when a station switched to its analog channel on the transition date and a rescan failed to recognize the change until the receiver memory had been manually cleared.

Many of the problems have been diagnosed to be one of those discussed above or some other obvious deficiency; however, there are still others that we have yet to resolve. As I noted above, this work is ongoing and maybe by the next issue I will be able to report some progress in explaining the cause of those that currently lack an explanation. With this in mind we welcome articles on how the transition went for your station and any unusual problems that you may have encountered and hopefully solved.

Bill Meintel
Editor
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BTS GOLD Introduces Activities for Young Professionals

By Heidi Himmanen, BTS GOLD representative
(heidi.himmanen@ieee.org)

Greetings, this is Heidi Himmanen from Finland, the new and first ever IEEE BTS GOLD representative. I have the pleasure of starting some new activities in the society. The GOLD activities in BTS are primarily intended for young professionals and student members, but anyone interested in the activities are welcome to join.

GOLD stands for Graduate of the Last Decade and is an IEEE program developed in 1996 to help young engineers' transition from being a student to entering the professional world. If you are an IEEE Member who has received your first professional degree within the last ten years, you are automatically part of IEEE GOLD (http://www.ieee.org/gold). Now, the IEEE GOLD program is organizing its society activities, so a lot of new things and information will follow. BTS will both inform you about interesting IEEE GOLD activities and create our own activities for young society members.

The first BTS GOLD event was arranged at the BMSB'09 in Bilbao, Spain, in May with more than 40 persons attending. A short presentation about the GOLD program and planned BTS GOLD activities were given, followed by cocktails and mingling. There definitely seems to be a

Call for Presentations

The BTS GOLD committee requests all society members to send in a short presentation of your research group or developing team. We hope to connect professionals within the fields of broadcasting and broadband multimedia and support young engineers in finding research co-operation and exchange. Especially, we want to provide means to find a destination for young engineers, who want to spend some time working abroad.

Please provide at least the following information: research group's name and location, research topics, size, contact person and website. Pictures are appreciated. Send your presentations by October 2009 to heidi.himmanen@utu.fi. The presentations will be placed on the public website of BTS GOLD and possibly also collected for an electronic newsletter.

Networking at the GOLD event

GOLD attendees film a video for "GOLD around the world" (www.goldaroundthe world.com)

Heidi Himmanen welcomes attendees to the first BTS GOLD event

BTS GOLD members are invited to become active participants in the new program

demand for BTS activities for young engineers! The idea is to connect people, both personally and virtually, and to provide services and information to help members in the beginning of their careers. Also, a BTS GOLD committee will be formed. We are four at the moment but are still looking for volunteers, especially members working in the industry. Please send me an e-mail if you are interested.

Planned BTS GOLD activities so far are a website, presentations of different research groups with BTS GOLD or student members (see separate announcement), and a BTS GOLD e-mail list. Also, GOLD events at the annual BMSB conferences are planned. To ensure you will get the information about our activities, please join the e-mailing list! If you are a BTS member but not a GOLD member (student members are not GOLD members) and want to join the e-mailing list, please send an e-mail to Kathy (k.colabaugh@ieee.org).

Looking forward to meeting you (either virtually or in person)!

BTS Argentina Chapter Report

By Valentino Trainotti, Chair

Student Field Trip

On Wednesday 20 May 2009, the IEEE Argentina Chapter organized, through its Chair Valentino Trainotti a visit to the Channel 11 TV Telefe transmitting station with several students of the Technological National University IEEE Student Branch.

Eng, Ruben Correa, the station chief engineer, and Mr. Gonzalez, his assistant, gave the students and their professor details of the TV transmission signal through the switchboard and the transmitter. An explanation was provided of the RF signal path through the coaxial lines, combiner and filters to the antenna on the Alas Building roof located in downtown Buenos Aires.

Seminar on Convergence of Broadcasting and IT

The Argentina Chapter of the IEEE BTS Broadcast Technology Society held a Seminar of the Convergence of Broadcasting and IT. The speakers were Stachuk, Luis Gerardo, Javier Staffa and Javier Bonini at the IEEE Argentina Section headquarters in Buenos Aires, as described below.

Objective

Just as has happened with other telecommunications services, the technology associated with rapidly converging broadcasting Information Technology (IT for short), and specifically with technology based on IP or Internet.

The seminar's objective was to interpret why this convergence is happening and what are the reasons. At the same time, both technologies are highly complex to know them in their entirety. However, the objective of this presentation was to provide participants with introductory concepts that intersect both worlds and expected to deepen in the future.

Agenda

- Changes in technology that support the media industry.
- Convergence of IT and broadcasting.
- Other cases of convergence.
- Introduction to networking, shared media and the OSI Model as a way to understand the convergence.
- IP networks: Quality of Service, Multiple-IP networks, Best practices.
- Audio and video compression: Video formats, Codecs.
- IPTV: WebTV, examples of video over IP networks.

Duration: There were two presentations of 2 hours and 30minutes each, on successive days

Date and time: Wednesday 17 and Thursday June 18, beginning at 6:15 PM

Place: Auditorium IEEE/CICOMRA Av Córdoba 744 Piso 1 B, Buenos Aires

Registration: This seminar was free with open access to all interested persons.

Satellite Communications Conference

The BTS Argentina Chapter along with the A&P, ECM and ComSoc Chapters has planned a two hour Satellite Conference which is free and open to all interested attendees.

With the sponsorship of the Distinguished Lecturer Program of the AESS IEEE (Aerospace and Electronic

Chief Eng. Ruben Correa explaining the operation of The Buenos Aires TV Channel 11 Transmitting Planet to members of IEEE UTN Branch

IEEE UTN Student Branch receiving an explanation of the transmitting station operation

Chief Eng. Ruben Correa, Prof. Valentino Trainotti and members of IEEE UTN Student Branch visiting Buenos Aires TV Channel 11 Transmitting Plant

Systems Society), on Thursday 03 September 2009, Dr. Sajjad H. Durrani, IEEE Fellow, will present a lecture on "Satellite Communications" at the IEEE Argentina Section Headquarters in Buenos Aires as detailed below.

Abstract

Several global, regional and domestic systems are currently providing satellite communications services throughout the world.

Dr. Durrani's talk will present an overview of the subject, briefly tracing the development of satellite systems since the 1960s.

He will describe some of the existing and proposed systems to serve fixed and mobile users, and the basic technologies involved. He will conclude with a discussion of market and regulatory issues, and major trends and potential capabilities in the near future.

Biographical Sketch, Dr. Sajjad H. Durrani

Sajjad Durrani received his undergraduate education in Pakistan, a Master's degree from Manchester, England in 1953, and a doctorate from the University of New Mexico in 1962, all in Electrical Engineering. He taught for more than 10 years in several universities, and had industrial experience of another 10 years with GE, RCA Space Center, Comsat Labs, etc. He then joined NASA in 1974 and held research and management positions in the area of space communications at Goddard Space Flight Center and at NASA Headquarters. After retiring from NASA in 1992, he worked for Computer Sciences Corporation, and retired from CSC in October 1998.

Dr. Durrani was a Guest Lecturer on space communications at the International Space University in Strasbourg, France in 1998, and served in Pakistan in 1999 as a Consultant to SUPARCO under the UN Development Program. During 2000–2001 he served an IEEE-USA Executive Fellow with the Office of Engineering and Technology of the Federal Communications Commission in Washington, DC.

He also served with the US Department of State under a similar IEEE program in 2004–05, first as a Technical Advisor to the Communications and Information Policy Office in the Bureau of Economic Affairs (EB/CIP), and then as Senior Advisor in the Science and Technology Cooperation Office of the Bureau of Oceans and Environmental and Scientific Affairs (OES/STC). In the latter capacity, he coordinated R&D activities of US agencies with their counterparts in several countries in the Western Hemisphere.

Dr. Durrani is a Fellow of the Institute of Electrical and Electronics Engineers (IEEE) and has been active in the IEEE for more than 40 years. He was President of the Aerospace and Electronic Systems Society (AESS) in 1982 and 1983, and a member of the IEEE Board of Directors in 1984 and 1985. He has also served as an ABET Program Evaluator for Electrical Engineering programs at several universities.

Dr. Durrani has given courses on Satellite Communications in the US and more than 25 other countries, and received the IEEE Educational Activities Board's Meritorious Achievement Award in Continuing Education in 1994. For his professional services, he received the CSC President's Excellence Award in 1996, as an "Ambassador" to the profession.

He was President of the DC Council of Engineering and Architectural Societies during 2006-07, and is a member of the Advisory Board for Electrical Engineering at the University of DC. He is also a Fellow of the Washington Academy of Sciences, where he was Vice President for Administration from 2001 to 2004, and VP for Membership 2008–09.*

Agenda

Date and Time: Wednesday 03 September 2009, starting at 3:00 PM

3:00 PM – Registration of participants

3:30 PM – Presentation of the IEEE AES Society: Invitation to form a Chapter Argentina.

4:00 PM – Conference – Part One

5:00 PM – Break – Coffee

5:15 PM – Conference – Part II

6:15 PM – Questions and Answers

7:00 PM – End

The Conference will be held in the English language

Place: Auditorium IEEE/CICOMRA Av Córdoba 744 Piso 1 B, Buenos Aires

Registration: This conference is free and open access. We would appreciate pre-registration through the web, completing the form available (in short) in http://www.ieee.org.ar/sistemainscripciones/InscripcionSolicitud.asp?idevento=59 Alternatively, e-mail to sec.argentina@ieee.org citing 'Conference Durrani' or by phone at IEEE/CICOMRA (011) 4325 8839.

BTS Japan Chapter Activity Report

By Shuji HIRAKAWA, Chair

BTS Japan Chapter had two joint meeting below with the Institute of Image Information and Television Engineers (ITE) during May 2009 to July 2009.

A technical meeting was held on 18 June 2009 at Kikai Shinko Kaikan, Tokyo, Japan.

There were 3 technical presentations on general topics below:

- "Development of a Fully Solid State Wide band Short-wave Transmitter using PSM" by Masahiko YAMAZOE, Kazuhisa HAEIWA, Shoji HIROSE, Masayoshi FUKUMOTO, and Hideo SATO.
- "A study on the SFN-GF system design technology" by Hiroki OHTA, Makoto ITAMI, Hiroshi SUGAWARA, and Kazuki KUMAGAI.
- "The Novel Signal Processing Method for Super Resolotion" by Seiichi GOHSHI, Masatsugu TERAGAWA, Hiroshi MIKAMI, and Shigeki IMAI.

And there was one invited presentation for

- "Acceleration of Digitization – Recent Development about DTT, HDTV, IPTV, Mobile TV-" by Kenichi YAMADA.

Another technical meeting was held on 30–31 July 2009 at Hokkaido University, Sapporo, Japan.

There were 15 technical presentations on general topics below:

- "Development of Color MTX Corrector Unit for Camera System" by Kenji TATSUGUCHI, Masaya MAKINO, Makoto SETO, Kaneyoshi SUGAWA, and Iwao HASHIMOTO.
- "Development of Optical Interface for Full-Resolution Super Hi-Vision Production Systems" by Madoka NAKAMURA, Tsuyoshi NAKATOGAWA, and Kimiyuki OYAMADA.
- "Development of remote receiving system for microwave band FPU using Radio on Fiber technology" by Satoshi HOSAKA, Shunichiro TOYAMA, Takao YAMASHITA, Yukio KATAYANAGI, and Katsushi MIURA.
- "A Study on Complexity Reduction of Zero-Forcing ICI Canceller in Mobile Reception of OFDM" by Akira NAKAMURA, Kento ISHII, Kohei OHNO, and Makoto ITAMI.
- "A theoretical study on an iterative detection of pre-coded OFDM" by Yoko Masuda, Kohei Ohno, and Makoto ITAMI.
- "A Study on Schemes of Reducing Influence of Impulse Noise in OFDM under Multi-path Channel" by Teruhiko UMATANI, Kohei OHNO, and Makoto ITAMI.
- "Improving Productivity in Embedded Software Development with Code Generator and Functional Widgets" by Masao ISHIGURO, Akira YONEKAWA, Teppei YAMAGUCHI, Takashi TASHIRO, and Toshimitsu HONKAWA.
- "Improving Performance of Cooperative Reception of One Segment ISDB-T" by Naoki KOBAYASHI, Takashi OKUBO, Kohei OHNO, and Makoto ITAMI.
- "A Study of Transmission System Using AC of One-Seg for Earthquake Early Warning (I)" by Kenichi MURAYAMA, Makoto TAGUCHI, Hiroyuki FURUTA, Hiroyuki HAMAZUMI, Kazuhiko SHIBUYA, and Masayuki TAKADA.
- "A Study of Transmission System Using AC of One-Seg for Earthquake Early Warning (II)" by Makoto TAGUCHI, Kenichi MURAYAMA, Hiroyuki FURUTA, Masayuki TAKADA, Hiroyuki HAMAZUMI, and Kazuhiko SHIBUYA.
- "Development of one-segment broadcasting re-transmission system for community antenna television" by Satoshi KIMURA, Mikio MAEDA, Osami TAMARU, Hitoshi SANEI, Mitsuo KOSUGI, Akira TAKAHASHI, Toshimi KAGEYAMA, and Tsutomu SUGAWARA.
- "A study of the SFN-GF system design technology" by Hiroki OHTA, Makoto ITAMI, Hiroshi SUGAWARA, and Kazuki KUMAGAI.
- "A study of the SFN-GF system design" by Takamasa KUGE, Kohei OHNO, Makoto ITAMI, Hiroshi OHTA, Hiroshi SUGAWARA, and Kazuki KUMAGAI.
- "Numerical Analysis of Mobile Propagation Loss Characteristics on an Urban Road" by Tomohito SHOJI, Tomotsugu HASEGAWA, Manabu OMIYA, and Mitsuru MURAMOTO.
- "Computer Simulations for Location Estimation of Sensor Nodes in Wireless Sensor Networks" by Tomotsugu HASEGAWA, Tomohito SHOJI, and Manabu OMIYA.

And there was one special topic for

- "Trends on Storage Media for Broadcasting Use" by Toshihiro UEHARA.

The BTS Japan Chapter is planning a joint meeting with the Institute of Image Information and Television Engineers (ITE) on 23 October 2009 at NHK Nagoya Broadcasting Station, Nagoya, Japan.

TV's Longest Remote

By James O'Neal, Technology Editor, TV Technology

Severna Park, MD.

On the evening of July 20, 1969, when Neil Armstrong set foot on the moon and proclaimed that his action amounted to "one small step for man and one giant leap for mankind," it signaled the beginning of a new era in space exploration and was viewed live by perhaps the largest television audience ever—more than half a billion people.

For those of us who witnessed this event live, the images coming back from the moon are etched in memory forever. The successful landing and return of the spacecraft climaxed more than a decade of the so-called "space race" with the Soviet Union, and even though the Soviets played the first hand with the launch of Sputnik in 1957, America trumped it mightily with Apollo 11.

Would Armstrong's lunar excursion have been believable without live video?

It's conceivable that an audio broadcast might have convinced some individuals, but radio, by its very nature, plays to the theatre of the mind. Hadn't Orson Welles one evening in 1938 convinced a large share of the CBS radio audience that Martian forces had landed in Grover's Mill, N.J., just by putting together the right mix of dialog and sound effects?

No, television had to be part of the lunar mission, or it wouldn't have been that credible.

But how to get live video of the event back to earth and a global television audience?

Remember, this was the decade of the 60s when broadcast gear was big—switchers and microwave links were stuffed full of vacuum tubes, video recording was done on 2-inch tape and cameras had heads weighing hundreds of pounds and were backed by CCUs and support electronics that ate heavily into rack space.

Westinghouse Gets the Nod

In the 1960s, the two recognized suppliers to the broadcast industry were General Electric and RCA. However, neither had, nor was planning to, make any sort of really small, lightweight camera.

This is where Westinghouse Electric and one Stanley Lebar entered the picture.

At the time, Westinghouse had a reputation for manufacturing mainly consumer devices—electric ranges, hot dog cookers, and TV sets. To a lesser degree the company was identified as a supplier of a limited range of broadcast products such as transmitters and power tubes. But there was another side to the Pittsburgh giant—military electronics. Westinghouse supplied a lot of battle-hardened electronic gear to the Pentagon, including some small black and white television cameras for use on ships and helicopters. Westinghouse also had something that many companies didn't at the time—a facility for fabricating custom integrated circuits solely for use by the company.

And to make the hand even more attractive, Westinghouse had created a very special television camera pickup tube; one that could run circles around conventional image orthicons and vidicons in terms of size, sensitivity, S/N and lag. This was the secondary electron conduction, or SEC, tube. It had an outstanding dynamic range and was so sensitive that, without stretching the truth too much, it could make pictures of the proverbial black cat in a coal bin at midnight.

These facts weren't wasted on the small group of NASA officials who were promoting video from space on the Apollo missions, and in particular the planned manned lunar landing. If a compact, reliable and high performance camera were to be constructed, it would need a tube such as the SEC, along with a customized chip set to drive it.

"We had all of the building blocks that they were looking for at the time," said Lebar, who would be tapped to head up the Westinghouse camera program for the Apollo missions. "NASA concluded that we were the only company that could do it."

Lebar, whose career track had been in airborne radar, not video, reflected that even though the camera would be a sole source procurement, Westinghouse still had to deliver a written proposal to the government.

"We were already working on tracking sites," he said. "And I had a trip to South America scheduled in 10 days. But we pulled a team together and put together the proposal in a week. I'd already left for Ecuador when they called me and told me to get to Houston to negotiate a contract for the camera with NASA. That was in July of 1964."

The Apollo camera was tested in one of numerous pre-launch simulations

Lebar, who now lives in the Baltimore suburb of Severna Park, Md., said that under the contract that was hammered out, Westinghouse had to deliver a number of cameras for the space program.

And those space cameras couldn't be just reverse engineered from existing circuitry either. Other NASA specs spelled out the impossibility of using 525-line, 60-field video.

"They told us that we had only 500 kilohertz of bandwidth for video," Lebar said. "This limited us to 320-lines and 10 frames per second with no interlace.

"Also, the camera had to have an environmental range of from plus 300 degrees to minus 250 degrees Fahrenheit. The specs covered every environmental aspect that the LEM (lunar excursion module) and moon surface would see."

Stanley Lebar (today)

Lebar and his team soon set to work on designing the unusual camera, but found the NASA specs, especially those defining video performance to be extremely confining.

"Several managers commented up front that 'this was a dog,'" Lebar said. "Ten frames per second and 500 kHz of bandwidth don't make good images. We were fighting for at least an additional 250 kHz. And you have to remember that standards conversion technology was very primitive then; we had to convert this 320-line, 10 fps video to something that the networks could broadcast. RCA made an image converter to work with a camera they had—it was basically a 525 camera shooting a CRT displaying slow-scan video images. Not the best quality."

With such a contrivance being the state-of-the-art for standards conversion, Lebar and his team knew that every fraction of a dB in camera S/N performance was precious.

"When we built the camera, we went to extreme lengths to keep the noise down to an absolute minimum," he said. "We knew that a lot of noise would be added in the optical conversion and in relaying the video around the world from the tracking stations."

The Westinghouse team did deliver a workable camera in time to be used on some of the Apollo missions leading up to the one now planned for July 1969; the one that would actually put a man on the surface of the moon.

However, early that year, it seemed that the camera might not be a part of that trip after all.

Not Mission Critical

"George Lowe, who was head of the Apollo program, called a meeting to decide if we really should fly a camera to the moon or not," Lebar said. "It was a big meeting—all the sub-system people were there, and all of the astronauts.

"It was being argued that it [the camera] served no scientific purpose, so it shouldn't be carried to the moon. The NASA attitude then was that it was a 'fifth wheel.' They termed it 'non-mission critical.'" (This meant that the Apollo mission objectives would be met even if the camera failed or had to be jettisoned for some reason.)

Westinghouse's $1 million lunar camera

"However, the old timers made it known that this was not the case—that NASA shouldn't miss the opportunity to televise the mission."

Lebar remembered that it was really mission commander, Neil Armstrong, who cinched the deal. Armstrong ruled the roost and stated that he wanted the camera aboard. That was that. There would be live video.

The Camera

In addition to operating over a wide range of temperatures, the Apollo camera had to be special in other ways too. Lebar recalled that NASA insisted on an automatic light control system—something unheard of then in live broadcast cameras. Also there was a lot of concern about the 8 kV that the SEC tube needed. Arcing was feared to be a major concern in the high vacuum conditions encountered on the moon. Special alloys had to be developed for use in connectors exposed to vacuum conditions too.

A special group of Westinghouse employees—all women—were hand selected to assemble the cameras going aboard the spacecraft.

"We even brought in a psychologist to guide in selection of the people used to build the cameras," Lebar said. "We chose six top people for the job—one camera per person. This was so that one person made every decision involving construction of the camera. The women treated the cameras like they were their own children."

The finished cameras were inspected by both Westinghouse and government QC people.

"When it was finally time to get ready for Apollo 11, we all got very nervous," Lebar said. "There was not going to be any backup camera inside the lander. We had some very high level NASA people visit the plant a few weeks prior to the launch who met with the president of the Westinghouse Baltimore divisions and myself, and they asked if we believed that the camera would really work."

Lebar admitted that his answer was a bit evasive.

"I stated that my program manager had done everything possible to make it a success," he said. "We believed that the camera would be successful, but we did worry about the transmission back on earth from the tracking stations."

In truth, the situation might have been painted as a bit more dire. Lebar recalled that the president of his division of Westinghouse had an independent contractor conduct a study of the potential for failure or success of Apollo's video component. That study indicated only a 50 percent probability of success.

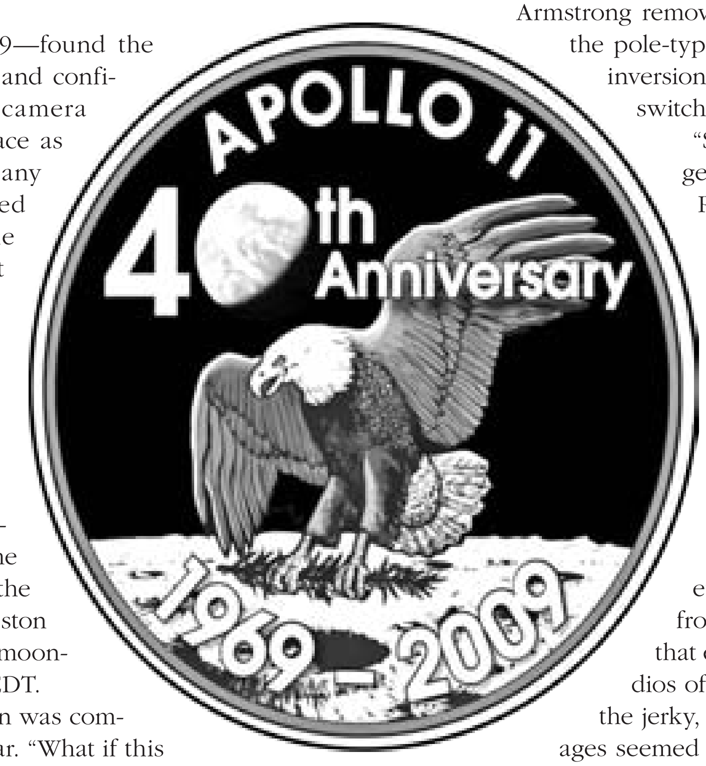
"The company was concerned about the corporate image being on the line," Lebar said. "Its slogan was 'You Can Be Sure If It's Westinghouse.' We really had to be sure."

On a strictly personal basis, there was a lot more at stake for Lebar. He'd been informed by corporate management that if the camera failed for any reason, he would be the Westinghouse employee that would have to stand in front of the cameras and reporters and explain to the world why there was no video.

"And that was a reality that I preferred never having to actually cope with," Lebar said.

Live from the Moon

The big night—July 20, 1969—found the Westinghouse team as ready and confident as possible that the camera would deliver video from space as planned. However, as with any complicated and multifaceted project, there is always the nagging uncertainty that something might not quite work out.



Lebar waited out the evening in a lab at the Houston Manned Spacecraft Center or MSC (later renamed the Johnson Space Center). Video gear had been set up for monitoring the moon "remote" and he recalled his experiences after the LEM set down safely and Houston gave approval for the first moonwalk, shortly before 11 p.m. EDT.

"Suddenly this railroad train was coming at you very fast," said Lebar. "What if this thing doesn't work? What am I going to say? Both Westinghouse and NASA had asked me to be the point person if a failure occurred. The corporate image was on the line. It was difficult beyond all belief."

The order was given to power up the camera, and Lebar crossed his fingers and rubbed his rabbit's foot once more.

"The camera was stowed in the LEM's MESA (Modular Equipment Stowage Assembly) door and was positioned to capture Armstrong as he descended the ladder. So it was in total darkness when it was first turned on," Lebar said. "About two seconds after the turn-on command was given, I saw a sync pulse on the monitor and thought 'it looks like it's going to work.'

"All the tension and agony drained out of me when the door was opened and I saw video and realized that we were successful. Then I was in seventh heaven."

However, the video that was making its way across 239,000 miles of space and several thousand more of terrestrial linkage was far from perfect.

"The image was bad, very dark," said Lebar. "The technician at the [Goldstone, Calif.] tracking station was randomly adjusting the scan converter, and at one point the image actually went negative for a while."

Lebar found out later that the Goldstone video tech was new to the job and had never operated the optical converter before that evening.

"He just turned every knob he could and then froze up," said Lebar.

(Actually the first images reaching terrestrial television viewers were inverted top-to-bottom, as the camera was initially resting upside down. Its top plate was the only flat surface and this was the way the camera rested until Armstrong removed it and began to carry it by the pole-type handle on its underside. The inversion was correctible by flipping a switch on the converter.)

"Someone said that they were getting a better picture from the Parkes tracking station in Australia [actually a radio telescope installation]," Lebar said. "NASA switched over to Parkes and never went back to Goldstone."

Due to the primitive image conversion technology, contrast was blocked up and a lot of noise was added to the picture; so much so that the images took on a ghostly, ethereal look—quite different from the video being pumped out that evening from the New York studios of ABC, CBS and NBC. However, the jerky, noisy, and black and white images seemed to fit correctly into the scheme of things.

"The comment was made then that if the video had looked like the live television everyone was used to, no one would have believed that it was coming from the moon," said Lebar.

Now that he, Westinghouse, NASA, and the world at large was assured that the $1 million camera was actually working as planned, Lebar took time out to ponder what had been going through his mind that evening.

"I had very mixed emotions," he said. "Worry, then success when the sync pulse came up, then distress when the image wasn't that good, then happiness when the switch to Parkes was made."

Even after 40 years, Lebar says that he still hasn't been able to completely sort out his emotions from that very special evening.

"I just know that I never want to go through this again, but it was a moment in history that I will never forget having been a part of, and watching, as the camera performed flawlessly."

Asked if he had made any special comments or proclamations about the event at the time, Lebar revealed that he had summed up the moment very simply.

"I just said that I thought it was great."

What else does Lebar remember from that evening of evenings?

"There was an all-night party at the King's Inn motel near the MSC," he said. "Westinghouse took over the cocktail lounge at the motel for the celebration, with champagne being served all night long. At seven in the morning they fed breakfast to anyone still standing."

Acknowledgement

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James E. O'Neal is technology editor at TV Technology Magazine. He is a member of the IEEE, SMPTE and SBE. James is a graduate of the University of Arkansas.

Am Directional Antenna Performance Verification Using a Method of Moments Analysis

... is an Impedance Matrix Really Necessary?

By J.L. Smith, PE
(jlsmithpe@ieee.org)

Introduction

Section 73.151(c) of the FCC rules significantly relaxes the requirement for field measurements on a directional AM antenna when the array is adjusted such that an approved antenna monitor system reads according to settings determined by a method of moments (MOM) analysis. In an effort to prove the integrity of the model used in the MOM analysis, the rules further require a matrix of impedance listings showing a favorable comparison of the calculated self impedances and a corresponding set of measured self impedances.

There are several reasons why the calculated and measured self impedances do not initially agree. First off, although MOM programs are wonderful tools and do many things quite well, calculating impedance is not their strong suit. MOM calculated impedance is an approximation at best and while the results are adequate for most applications, there are several limitations inherent in the calculating code. The way the code handles the source voltage, the effect of unequal segment lengths, the effects of unequal wire radii and other factors all adversely affect the accuracy of the calculated impedance. Outside the code itself is the disagreement between calculated and measured self impedance that may occur because the measured self impedance includes the effects of all contributors whereas the calculated self impedance includes only the effect of the contributors that the practitioner has elected to include in his model.

To address the latter, the rules permit the MOM model to depart from the parameters of the physical array, even to the extent of using an arbitrary height for the towers. Such a drastic relaxation, however, amounts to little more than creating an error to offset another error and raises a question as to the advisability of even having a rule that requires a matrix showing a favorable comparison of the calculated and measured self impedances.

This article presents data showing that a matched impedance model is not necessary to determine the appropriate antenna monitor settings and that the rule requiring the model's calculated self impedances to match measured self impedances adds considerable effort but yields no particular advantage.

The Model

The comparison data used in this article is taken from an actual application for license as filed with the FCC. This particular array was chosen because it is sufficiently complicated to give a meaningful demonstration yet it is not overly complicated. In the model, there are four top loaded towers on the premises but only three of these towers are used in the array. The unused tower is detuned using a base inductance.

The self impedance measurements given in the FCC application were made at the final J-plug within the ATU with the companion towers open circuited at corresponding locations. Antenna monitor samples were taken from current transformers located at the output of the ATU. The analysis model used in this article duplicates those characteristics.

The MOM analysis included in the FCC application was carried out using a MININEC based analysis program. The analysis created for use in this article was carried out using BNEC.EXE which is the NEC2 based analysis program furnished with the author's book titled *Basic NEC with Broadcast Applications*. The results are almost identical using either program.

This article demonstrates several advantages that NEC2 has over MININEC. These advantages include:

1) The ability to incorporate networks directly into the model thus eliminating the extra work involved in using post processing programs such as WCAP.
2) The ability to directly model the reference point at the final J-plug in the ATU.
3) The ability to copy a complete tower structure and duplicate it at a new location thus simplifying the geometry definitions.

Comparing Self Impedance Values

In the FCC application that was used as a data source for this article, favorable comparison of measured and calculated self impedances was achieved by artificially adjusting the tower height and modeling the ATU/Tower interface using an LC network. The calculated drive point impedance as it appears at the final J-plug in the ATU was then determined as a separate calculation by simulating the LC network / tower combination using the WCAP computer program.

The data generated for this article was generated using BNEC.EXE to model towers having calculated self impedances that match measured self impedances without artificially modifying tower heights. The first tower was defined, then copied and reproduced at the other three locations. Networks were included within the model itself to directly consider the interface between the ATU and tower proper thus eliminating the need for any WCAP type post processing. Thus the BNEC.EXE output file directly displays the drive point impedance as it appears at the final J-plug in the ATU and it also shows the impedance as seen looking into the tower at the drive point.

The model thus generated is a practical and accurate representation of the array as built and requires no scaling of parameters or assumptions.

The tower configuration used is shown as Figure 3-1(c) and described in Section 3.3.3 of *Basic NEC with Broadcast Applications*. The radius of the wire containing the source voltage was varied to adjust the resistive component of the drive point impedance to the measured value. (See Section 8.2.5 of *Basic NEC with Broadcast Applications*). The series inductance of the LC network was then varied to adjust the reactive component of the drive point impedance. Since the adjustment is an iterative process, the example in this article used only enough effort to get the results within the range of the FCC rule requirement and made no effort to get exact agreement of calculated and measured self impedances.

Selected excerpts from the BNEC.EXE analysis output data file showing impedance agreement have been collected, regrouped and shown below.

$Z_{Modeled}$ is the impedance seen by the network as it looks into the tower. It is underlined in the output file segment shown below.

```
                              - - - STRUCTURE EXCITATION DATA AT NETWORK CONNECTION POINTS - - -
TAG   SEG.   VOLTAGE (VOLTS)              CURRENT (AMPS)             IMPEDANCE (OHMS)            ADMITTANCE (MHOS)          POWER
NO.   NO.    REAL         IMAG.           REAL         IMAG.         REAL         IMAG.          REAL         IMAG.         (WATTS)
101     5    1.06480E+00  -1.24741E-01    2.96524E-02  1.53050E-02   2.66408E+01  -1.79573E+01   2.58098E-02  1.73972E-02   1.48324E-02
201    38    1.01162E+00  -1.60938E-02    2.58737E-02  1.86374E-02   2.54468E+01  -1.89519E+01   2.52771E-02  1.88255E-02   1.29372E-02
301    71    1.06799E+00  -1.23783E-01    2.94248E-02  1.60631E-02   2.61933E+01  -1.85057E+01   2.54662E-02  1.79921E-02   1.47185E-02
401   104    1.10378E+00  -2.52802E-01    3.31241E-02  1.34974E-02   2.59104E+01  -1.81900E+01   2.58529E-02  1.81496E-02   1.65747E-02
```

Z_{ATU} is the impedance seen by the ATU as it looks toward the tower from the final J-plug. The impedance from this reference point is calculated as part of the analysis without further effort. It is underlined in the output file segment shown below.

```
                                         - - - ANTENNA INPUT PARAMETERS - - -
TAG   SEG.   VOLTAGE (VOLTS)            CURRENT (AMPS)             IMPEDANCE (OHMS)             ADMITTANCE (MHOS)          POWER
NO.   NO.    REAL         IMAG.         REAL         IMAG.         REAL         IMAG.           REAL         IMAG.         (WATTS)
100   1      1.00000E+00  0.00000E+00   2.96648E-02  1.54113E-02   2.65455E+01  -1.37908E+01    2.96648E-02  1.54113E-02   1.48324E-02
200   2      1.00000E+00  0.00000E+00   2.58743E-02  1.86757E-02   2.54103E+01  -1.83408E+01    2.58743E-02  1.86757E-02   1.29372E-02
300   3      1.00000E+00  0.00000E+00   2.94370E-02  1.61697E-02   2.60967E+01  -1.43349E+01    2.94370E-02  1.61697E-02   1.47185E-02
400   4      1.00000E+00  0.00000E+00   3.31494E-02  1.36089E-02   2.58156E+01  -1.05981E+01    3.31494E-02  1.36089E-02   1.65747E-02
```

Table I summarizes the results of the BNEC.EXE comparison of measured and computed self impedances. XL is the reactance of the series inductance of the lead from the ATU to the tower and XC is the assumed reactance of the base insulator capacity as taken from the FCC application.

Calculating Predicted Monitor Readings

Using the model generated above, a complete BNEC.EXE MOM analysis was run to determine the predicted monitor readings. In the output thus generated, the current at the current sampling transformer adjacent to the final J-plug

Table I – Comparison of Calculated and Measured Self Impedances using BNEC.EXE

Tower	X_L	X_C	$Z_{Modeled}$	Z_{ATU} Modeled	Z_{ATU} Measured
1	j4.205	–j10,000	26.64 – j17.96	26.55 – j13.79	27.8 – j13.8
2	j0.622	–j10,000	25.44 – j18.95	25.41 – j18.34	25.4 – j18.9
3	j4.205	–j10,000	26.19 – j18.50	26.10 – j14.33	27.4 – j14.3
4	j1.226	–j10,000	25.91 – j18.19	25.82 – j10.60	26.5 – j10.6

in the ATU, is underlined in the output file segment shown below.

```
                                  - - - ANTENNA INPUT PARAMETERS - - -
TAG  SEG.  VOLTAGE (VOLTS)                CURRENT (AMPS)                 IMPEDANCE (OHMS)               ADMITTANCE (MHOS)              POWER
NO.  NO.   REAL            IMAG.          REAL            IMAG.          REAL           IMAG.           REAL           IMAG.           (WATTS)
100  1     -1.14428E+02  -2.26477E+02     1.07122E+01  -2.11437E-01    -1.02607E+01  -2.13445E+01   -1.82944E-02  3.80561E-02    -5.88945E+02
200  2     -2.91853E+02  -5.48374E+02    -1.66291E-01  -6.95601E+00     7.97920E+01  -4.00495E+01    1.00106E-02  5.02457E-03     1.93152E+03
400  4     -3.96925E+02  -7.56194E+02    -3.96465E+00  -2.08163E+01     3.85599E+01  -1.17239E+01    2.37391E-02  7.21774E-03     8.65742E+03
```

The currents are summarized and the predicted monitor readings are calculated as shown in Table II.

Table II – Predicted Monitor Readings Using "Matched" BNEC.EXE Model

Tag	Segment	Current at Toroid (peak)		Monitor Reading
100	1	10.712 – j0.211	10.714 @ – 1.13°	0.506 @ 99.65°
200	2	–0.166 – j6.956	6.958 @ 268.63°	0.328 @ 9.41°
400	4	–3.965 – j20.816	21.190 @ 259.22°	1.000 @ 0.0°

These predicted monitor readings compare favorably with those presented in the FCC application with the variance being no more than might be expected from the differences in calculating methods used in NEC2 and MININEC.

The Question …

While on the subject of difference, however, the question arises as to whether or not adjusting the model such that the calculated self impedances match measured self impedances actually proves the validity of the model. The question arises "Is such a model necessary to yield a usable prediction of the antenna monitor readings that would occur when the array is properly adjusted?"

Some insight into the answer is conveniently obtained by running other analysis using less complicated models that do not match calculated and measured self impedances then comparing the monitor readings shown in the table above to the predicted monitor readings obtained using the simple models. To that end, a "normal" model that represents a most probable configuration was analyzed then a "simple" model consisting only of the bare essentials was analyzed and the predicted monitor readings for each was compared. No attempt to match measured self impedances was made for these simplified models.

The Normal Model –

The model considered "normal" is essentially the same model used previously except that no attempt is made to match the calculated self impedance to the measured self impedance. The tower uses height AGL and is made up of 3 wires in series. The first wire has a length equal to twice the insulator height and is divided into 3 segments. The excitation source is placed on segment #2 of this wire and thus appears at the height of the insulator. This is done to satisfy the FCC rule that requires the source voltage to be at the bottom of the tower. The second wire is included simply to add a couple of segments whose lengths equal the length of the source segment and thus satisfy some of the accuracy requirements of the NEC2 code. The third wire is the tower proper. Six additional wires make up the top loading and the bottom ring. The input file uses the GM commands to copy tower #1 and then duplicate it at each of the locations of the other three towers to make up the complete 4-tower installation. Thus the tower model is simple with no networks or other considerations being included in an attempt to match a measured self impedance.

In this model, the current through the current transformer corresponds to the source current and that current is underlined in the output file segment shown below.

```
                                  - - - ANTENNA INPUT PARAMETERS - - -
TAG   SEG.  VOLTAGE (VOLTS)                CURRENT (AMPS)                 IMPEDANCE (OHMS)               ADMITTANCE (MHOS)              POWER
NO.   NO.   REAL            IMAG.          REAL            IMAG.          REAL           IMAG.           REAL           IMAG.           (WATTS)
101     2   -1.20001E+02  -2.82671E+02     1.02415E+01  -1.83749E-01    -1.12183E+01  -2.78018E+01   -1.24816E-02  3.09325E-02    -5.88529E+02
201    37   -3.08369E+02  -5.71087E+02    -2.10477E-01  -6.65374E+00     8.72083E+01  -4.35866E+01    9.17492E-03  4.58561E-03     1.93238E+03
401   107   -5.78492E+02  -7.56092E+02    -3.92483E+00  -1.98941E+01     4.21038E+01  -2.07720E+01    1.91016E-02  9.42382E-03     8.65614E+03
```

These currents are collected and normalized to the reference in Table III to yield the predicted antenna monitor readings for the "normal" analysis.

Table III – Predicted Monitor Readings Using "Normal" BNEC.EXE Model

Tag	Segment	Current at Toroid (peak)		Monitor Reading
101	2	10.2415 – j0.1837	10.2431 @ -1.03°	0.505 @ 100.3°
201	37	–0.2105 – j6.6537	6.657 @ 268.19°	0.328 @ 9.35°
401	107	–3.9248 – j19.8941	20.2776 @ 258.84°	1.000 @ 0.0°

The Simple Model –

The predicted monitor readings obtained when using the Normal Model above compare so favorably with those obtained when using the model that matches calculated and measured self impedances, that one is encouraged to simplify the model even further and see what the predicted antenna monitor readings will be. To that end, a model was created in which the three wires modeling the radiator are reduced to a single wire with 20 segments and the source voltage is placed on the first segment. This is the ultimate in modeling simplicity.

Again, the current through the current transformer corresponds to the source current and that current is underlined in the output file segment below:

```
                                          - - - ANTENNA INPUT PARAMETERS - - -
TAG  SEG.  VOLTAGE (VOLTS)            CURRENT (AMPS)             IMPEDANCE (OHMS)           ADMITTANCE (MHOS)          POWER
NO.  NO.   REAL          IMAG.        REAL          IMAG.        REAL          IMAG.        REAL          IMAG.        (WATTS)
101   1    -1.19970E+02  -3.07720E+02  1.02597E+01  -1.57754E-01  -1.12295E+01  -3.01657E+01  -1.08385E-02  2.91155E-02  -5.91158E+02
201  33    -3.24440E+02  -5.67790E+02 -2.74913E-01  -6.68403E+00   8.67969E+01  -4.49697E+01   9.08300E-03  4.70592E-03   1.94216E+03
401  97    -6.26760E+02  -7.41590E+02 -4.02756E+00  -1.99215E+01   4.18747E+01  -2.29956E+01   1.83477E-02  1.00757E-02   8.64895E+03
```

These currents are collected and normalized to the reference in Table IV to yield the predicted antenna monitor readings.

Table IV – Predicted Monitor Readings Using "Simple" BNEC.EXE Model

Tag	Segment	Current at Toroid (peak)		Monitor Reading
101	1	10.2597 – j0.1578	10.261 @ –0.881°	0.505 @ 100.55°
201	33	–0.2749 – j6.6840	6.690 @ 267.645°	0.329 @9.08°
401	97	–4.0276 – j19.9215	20.325 @ 258.570°	1.000 @ 0.0°

Table V – Summary of Predicted Monitor Readings

Twr	FCC Application	Matched BNEC	Normal BNEC	Simple BNEC
1	0.501 @ 99.7°	0.506 @ 99.7°	0.505 @ 100.1°	0.505 @ 100.5°
2	0.336 @ 9.5°	0.328 @ 9.4°	0.328 @ 9.4°	0.329 @ 9.1°
4	1.000 @ 0.0	1.000 @ 0.0°	1.000 @ 0.0°	1.000 @ 0.0°

Summary

The predicted monitor readings generated by the very simple model agree quit favorably with both the results given in the FCC application and the results obtained by the BNEC.EXE matched impedance model. For convenience, the predicted monitor readings of all four models are given in Table V:

Because it is not known how much difference is contributed by the differences in calculating methods between NEC2 and MININEC, the more informative comparison is that between the three BNEC models. The difference in results obtained when matching self impedances and when not matching them is less than 1/3 of 1% in amplitude and less than 7/8 of 1° in phase. This is certainly not a significant difference.

It is clear then, that the results obtained with the simple unmatched models are just as practical as that obtained with the complex matched model and there is no validation or advantage gained by complicating the model to make the calculated self impedance match the measured self impedance.

Conclusions

The data above leads to the conclusion that the rules requiring an impedance matrix is unnecessary and can be eliminated without subtracting from the quality or trustworthiness of the MOM analysis. The FCC rules as presently written contain safeguards elsewhere that are sufficient to guarantee the integrity of the model. Section 73.151(c)(2)(i) requires that the field ratios calculated by the MOM analysis compare favorably with the target field ratios. A favorable comparison of field ratios is both a necessary and sufficient condition to confirm the validity of the MOM model and no further validation of the model is necessary or desirable.

Postscript

The author encourages readers to examine these results carefully and solicits comments from the readers. In particular, the author is interested in learning of any flaws that may be detected in the logic and any related suggestions. Input and output files generating the data used in this article and usable with either BNEC.EXE or NEC4 will be sent by email to readers who request them. The author can be contacted at jlsmithpe@ieee.org.

About the Author

J.L. Smith is author of *Basic NEC with Broadcast Applications* published by the Focal Press imprint of Elsevier. The book is published in cooperation with The Society of Broadcast Engineers and is currently available through the SBE bookstore and other major book sellers.

J.L. Smith began his career in broadcasting at KTRH in Houston, Texas in 1946. In 1956 he joined Collins Radio Company where he held the usual positions in research and development culminating in Department Head, Research and Development. He served as Manager, Broadcast Systems Engineering at Collins Radio Company in the 1960's. Smith is now retired and devotes his time to analytical research involving AM directional antennas.

Urban Radio Propagation Measurement for Digital TV Broadcast in Jakarta, Indonesia

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Abstract—Radio propagation measurement is carried out in Jakarta, Indonesia, in anticipation of digital TV implementation in the country. Measurements are made using a fixed, portable receiver outdoors and indoors. Spatial variations of the received power, both large-scale and small-scale, are measured in these locations. Results show that the large-scale path loss variation characteristics, as described by a power-law dependence on distance with shadowing-induced variation, are typical of those found in urban areas. Small-scale spatial variations are also examined by comparing the measurements with exponential and lognormal distribution for all outdoor and indoor locations.

Keywords—digital television, measurement, radio propagation.

I. Introduction

Recent years have witnessed rapid growth in terrestrial digital TV implementation. This phenomenon does not only belong to the developed countries, but the developing ones as well [1]. In planning the digital TV broadcasting system, knowledge of radio propagation characteristics is imperative. Inexistence of such information would lead to non-optimal network planning that might result in costly operation of transmitters by the broadcast operator and low service quality on the consumer side ([2], [3]). A large number of radio propagation measurement efforts for digital TV broadcast network planning have been reported in the literature. For instance, radio channel and/or network performance measurements have been made in Germany [4], Spain [5]–[6], Ireland [7], and other countries involving the implementation of DVB-T system. Results from various countries, although obtained through possibly the same procedure, might vary to a significantly large extent. This might have something to do with the local characteristics of radio propagation environment and the specific situations in which the test transmitter and the receiver operate. For example, the type and density of buildings in large cities in different countries can considerably differ, which in turn implies different random characteristics of radio propagation pertinent with such mechanisms as reflection, transmission, scattering, and diffraction.

This article reports a measurement campaign that was carried out in downtown Jakarta, Indonesia during the 2007–2008 period. The city is the largest in population in the country, but the tall buildings are not as spatially dense as those in large cities in Europe or North America. A DVB-T test transmitter is used to transmit multiple programs, digitized versions of local TV programs originally broadcast using analog TV systems. The transmit power is approximately 400 W radiated through an omni-directional antenna at an elevation of about 120 meters. Measurements were made outdoors and indoors, targeting at reception using fixed, portable antennas. For outdoor measurement, results for LOS (line-of-sight) and NLOS (non-line-of-sight) conditions are distinguished. The analysis of measurement results reported herein focuses on distance-dependent variation of local mean of the received power, shadow fading variation, and spatial variation of received power in small areas. The article starts with the description of the measurement system, followed by the results of the measurement and analyses of the channel characteristics. The analyses are divided into two sections, namely, those on large-scale variation and small-scale variation.

II. Measurement System and Locations

A DVB-T test transmitter is used to transmit simultaneously five programs, MPEG-2 encoded versions of local TV programs originally broadcast in analog PAL system. The modulation settings used are 8K mode, 16-QAM, 3/4 code rate, and 1/16 guard interval. The test transmitter is installed on a 120 m tall tower property of the state-owned TV operator, TVRI, and is transmitting at 575.25 MHz (channel 34). The output power of the transmitter is about 400 W, but the ERP is 44.47 dBW. The DVB-T signal is radiated through a directional horizontally-polarized antenna having a half-power beamwidth of approximately 230°.

The measuring equipment consists of two sets of instruments. The first is a Promax Prodig-5 used in measurement of received power and carrier-to-noise power ratio (C/N). The second set consists of Pixelmetrix instruments that include DVStation Remote, DVStation POD-TSP, DVStation POD-DVB-T and DVStation POD-COFDM, designed to measure the performance of a digital TV network. A rectangular patch antenna commonly used for vehicular reception of TV signal is employed and invariably positioned at a height of 1.5 m above the ground. Prior to measurement in each site, the patch antenna azimuth orientation is always adjusted to obtain the best reception.

Received power measurements for outdoor large-scale path loss characterization are made in 18 sites covering a range of transmit-receive distance of up to 5 km. The map of measurement area showing the transmitter location and the measurement sites is given in Fig. 1. Fig. 2 shows photographs of the neighbourhoods of two representative sites of the outdoor measurement. Fig. 2(a) shows a site having a large building obstructing the direct path from the transmit antenna, whereas the site depicted in Fig. 2(b) is surrounded by open areas with tall buildings far in the background. Indoor measurements were made in the multi-storey BPPT building, particularly on the ground and the 21st floors. The transmit antenna is visible from the window of one side of the 21st floor, but not from the ground floor. The building is located around 4 km from the transmitter.

Fig. 1 – Area of path loss measurement

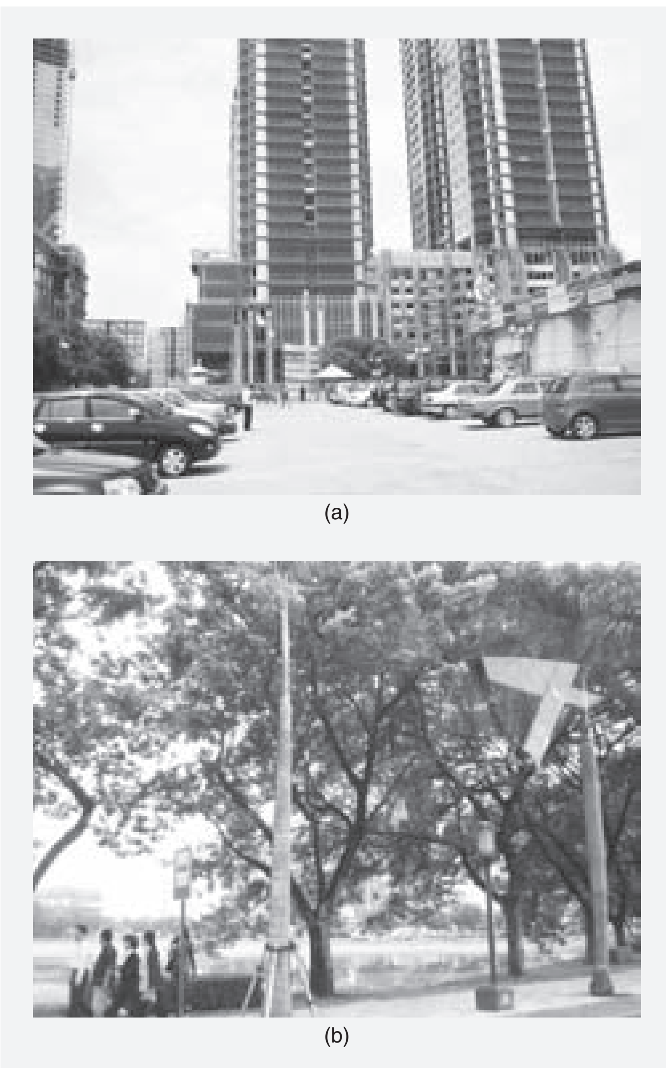

Fig. 2 – Photographs of two areas of measurement site: (a) with a tall building blocking the direct path from transmit antenna and (b) with an open area surrounded by buildings in the far background

III. Large-Scale Spatial Variation of Received Power

Out of the 18 measurement sites, three located less than 500 m away from the transmitter are disqualified since the measurements in these locations are found to be influenced by null-approaching slope of the transmit antenna vertical pattern. In addition, after data processing it is discovered that, due to insufficiency of available data from five other sites required for spatial averaging, only ten remaining sites can be included in the large-scale variation analysis.

In the study, the power-law relation between the median received power and transmit-receive distance is adopted, on top of which the occurrence of spatially varying lognormally distributed shadow fading is also assumed. The expression for received power S in Watts is thus:

$$S = kr^{-\alpha}10^{L/10} \qquad (1)$$

where k represents the modified transmit power in Watts that incorporates the effects of effective radiated power, antennas used (which can be estimated using Lee's expression, as suggested by Rebhan and Zander [8]) and distance normalizing factor $1000^{-\alpha}$, r denotes the distance in km between the transmitter and the receiver, α denotes the distance exponent and $10^{L/10}$ represents lognormally distributed shadowing (i.e., given in decibels, $L \sim N(0, \sigma)$).

Two parameters are especially of interest, namely, the distance exponent α characterizing the power-law decrease of the median received power (or equivalently, the power-law increase of median path loss) with distance from the transmitter and the standard deviation σ of the variation in dB around the median, i.e., the shadowing variation. Scatter plot of the measurements together with the power-law fit is given in Fig. 3. The fitting process results in a distance exponent α of 3.28 with a shadowing standard deviation σ of 8.12 dB. These results are typical of urban UHF radio propagation channels commonly seen in both broadcasting systems and cellular phone networks [3], [9].

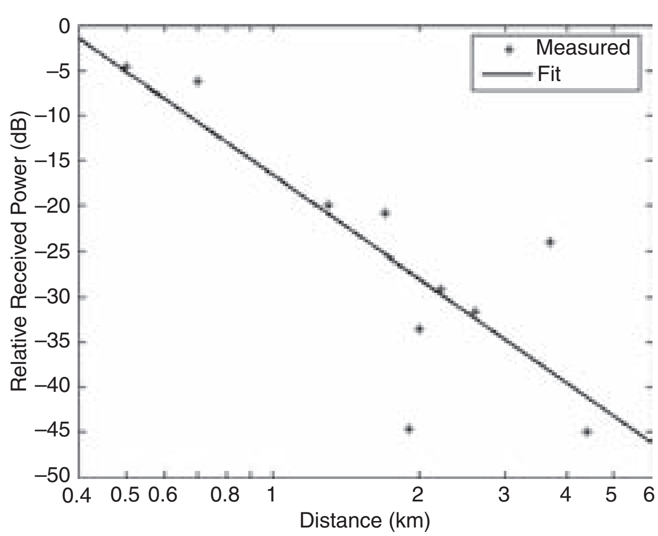

Fig. 3 – Power-law fit to the relative received power

IV. Small-scale Spatial Variation

For the outdoor measurement, categorization into LOS and NLOS is simply based on the visibility of the transmit antenna tower from the receiver position, which is confirmed visually all the times by means of a binocular. The analysis involves measurements from several LOS and NLOS sites, with different distances from the transmitter. Following [4], in each measurement location a 100 m × 100 m area is determined, within which twenty measurements are made at different, randomly selected points. The distribution of received power for different sites are given in Figs. 4–6, while Table I recapitulates the measurement data from all sites. The mean power is computed in linear scale but given in dBm in Table I.

Representative results for outdoor LOS measurement are presented in Fig. 4. The cumulative distribution of received power for each site approaches both exponential and lognormal, the former suggesting Rayleigh distribution of received signal envelope. However, the farther the distance of the site from the transmitter, the two theoretical distributions become more distinct. In the parking lot of BPPT building complex, the distinction is quite clear. Received power levels in the probability range below 0.5 appears to be lognormal, whereas those above 0.8 probability are closer to exponential. Those with probabilities in the 0.5–0.8 range are lower than both exponential and lognormal. For NLOS sites, as depicted in Fig. 5, the received power distribution from the site at 3 km distance is well approximated by both exponential and lognormal. However, for the site at the park of the National Monument, about 4.5 km from the transmitter, the distribution is closer to lognormal, although more measurements should probably be made for this location.

For indoor locations inside BPPT building, it can be observed from Fig. 6 that the higher the floor on which the

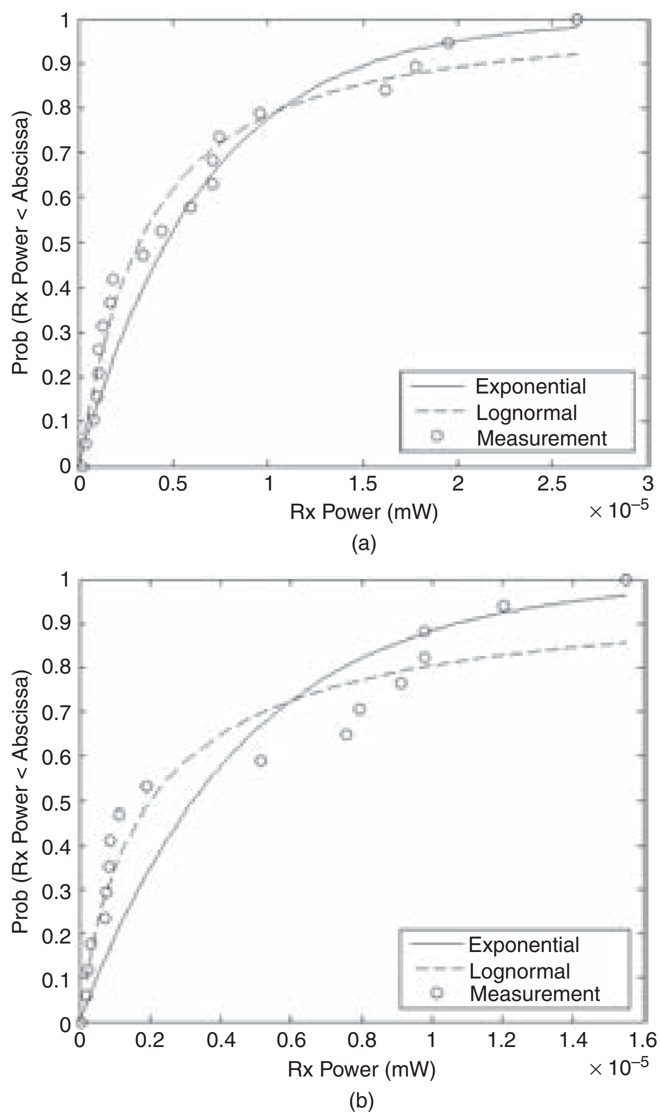

Fig. 4 – Cumulative distribution of outdoor received power at two LOS sites: (a) Kuburan Karet around 2.5 km and (b) the parking lot of BPPT complex about 4 km from the transmitter

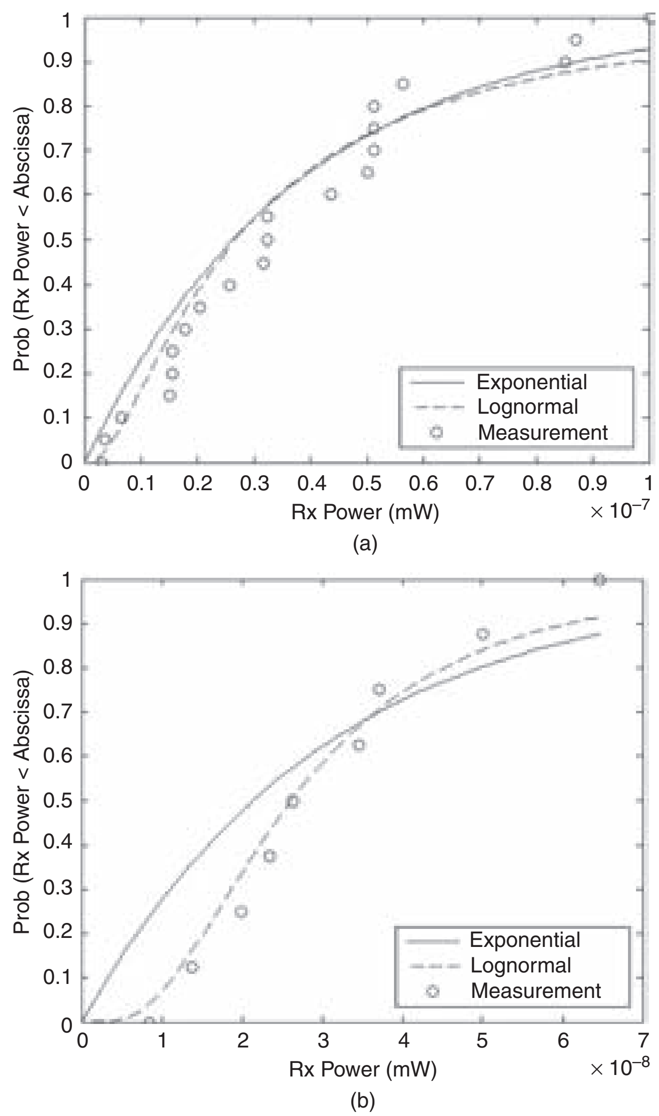

Fig. 5 – Cumulative distribution of outdoor received power at two NLOS sites: (a) Taman Lawang located around 3 km and (b) the National Monument park about 4.5 km from the transmitter

receiver is, the greater the mean received power, as expected. The ground floor measurement reveals better fit to lognormal. However, measurements on the higher floors show that the distribution in the lower probability range is closer to lognormal, but in the higher probability range it approaches exponential better. As such, the theoretical distribution model that best describes the received power on higher floors is inconclusive at this point. The same thing also happens for LOS measurements in the parking lot of the same building, as explained earlier. By comparing the mean received powers obtained on different floors with the outdoor results from the parking lot, it can be seen that the outdoor-to-indoor floor-average penetration loss might range from 5–22 dB, dependent on the floor height.

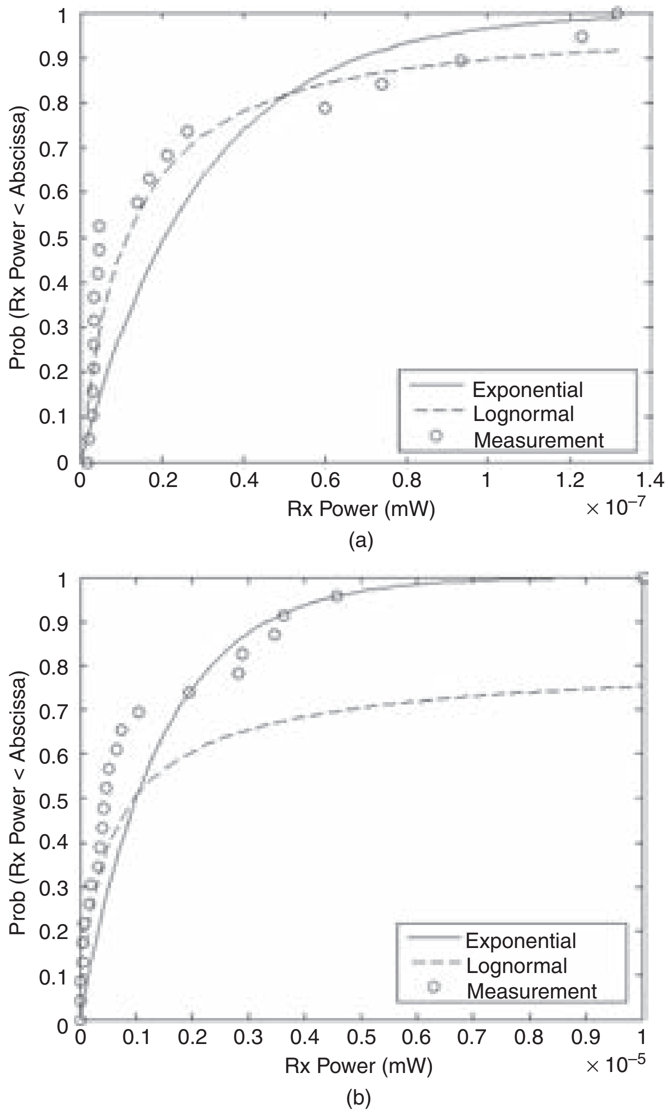

Fig. 6 – Cumulative distribution of received power on different floors in the BPPT building, namely, (a) the ground floor and (b) 21st floor

From the small-scale measurements, the coverage level in percentage at each site can be estimated of all twenty locations in which the detected C/N is greater than a specified threshold. In this case we set the threshold to 16.7 dB, the minimum required C/N for QEF reception. The outdoor locations are categorized into three classes with respect to their respective distance from the transmitter, namely, near (500 m–1 km), medium (1–4 km), and far (>4 km). The indoor measurement is made in the BPPT building as previously explained. The results are tabulated in Table II. In general, LOS sites produce satisfactory coverage regardless of the distance in the range of 500 m–5 km for our current transmission setting. All of sites show probability of "outage" (defined herein as probability of finding a point within the local area of interest that experiences less than QEF quality) of less than 10%. However, when NLOS conditions are concerned, only the near site indicates probability of outage of less than 10%, whereas the sites in the medium and long distance categories experience outage of more than 90%. The latter suggests coverage quality of less than 10%, far below the acceptable level of 70% [10]. Despite these findings, the SFN transmitter power and spacing that should be used in practice is still inconclusive since all the measurements are done with transmit power fixed at 400 W.

As for indoor reception in a multi-story building, the result shows that although the building itself is located in the 'far' category, the reception might still be acceptable on a

Table I Summary of small-scale measurement results

Site	Approx. Distance from Tx (km)	Condition	Mean Power (dBm)	Distribution
Senayan	0.5	Outdoor, LOS	–46.39	LN, Exp
Kuburan Karet	2.5	Outdoor, LOS	–51.74	LN, Exp
BPPT parking lot	4	Outdoor, LOS	–53.32	–
Taman Lawang	3	Outdoor, NLOS	–74.21	LN, Exp
Monas	4.5	Outdoor, NLOS	–75.09	LN
BPPT 21st floor	4	Indoor, LOS through one side of the building	–58.38	–
BPPT 3rd floor	4	Indoor, NLOS	–70.28	–
BPPT ground floor	4	Indoor, NLOS	–75.24	LN

Table II Percentage of locations not achieving QEF quality

Condition	Location	Percentage of Locations with C/N < 16.7 dB
Outdoor, LOS	Near	9.4%
	Medium	6.4%
	Far	9.5%
Outdoor, NLOS	Near	9.7%
	Medium	90.1%
	Far	94.5%
Indoor	Ground floor	79.2%
	21st floor	34.3%

sufficiently high floor, such as the 21st floor (QEF-quality coverage of approximately 66%). This achievement might result from the presence of LOS path between the transmitter and that floor of the building. On the other hand, reception on the ground floor indicates unacceptable coverage with only about 20% of the local area undergoing C/N of QEF quality or better.

V. Conclusions

The results of UHF propagation measurement in downtown Jakarta have been reported. In particular, it is found that the large-scale variation of path loss, which includes the impact of distance and environment-dependent lognormal shadowing, is typical of those found in urban areas in other parts of the world for broadcasting and cellular network applications. Study on the small-scale spatial variation of received power in locations relatively close to the transmitter, i.e., 3.5 km or less, the variation approaches both exponential and lognormal. The variation in NLOS sites located 4 km or more away from the transmitter, either outdoors or indoors, tends to follow lognormal distribution. However, LOS sites in the same range of distance follow neither exponential nor lognormal. It is also found that the average building penetration loss ranges from 5–22 dB depending on the existence of LOS path from the transmitter to the floor.

Results of small-scale spatial variation also shows that the presence of LOS path from the transmitter determines the acceptability of reception, especially for medium and far distance reception sites. In addition, use of repeaters appears to be necessary for reception in buildings far from the transmitter site, especially on the lower floors that tend to experience NLOS condition.

VI. Acknowledgement

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Longley-Rice's Faulty Subroutines, Part 2: dlthx:

By Sid Shumate, Givens & Bell

In the last article of my Longley-Rice series, in the Spring '09 issue, I ended with: There is another fix required to get good results with a one arc second database; I will discuss it in the next article. I took a "summer break', so this is the next article. The problem I will discuss today is not a problem for databases of 3-arc-second or longer; but it starts to be a problem if an attempt is made to use Longley-Rice software that uses the NTIA Irregular Terrain Model (ITM) subroutine core, with a 1-arc-second database. The problem occurs in subroutine dlthx, delta-h-experimental. The last problem, in subroutine zlsq1, affects the computation of delta-h; this problem is in the delta-h subroutine itself. For those familiar with the c++ language version of the ITM, it is necessary to correct the range limit for argument ka, and therefore argument n, to allow use of highly detailed terrain databases.

The Problem Starts Here:

Fair Warning! This section is primarily of interest to radio propagation engineers who are also programmers in c and/or c++. The subroutine sets argument ka to be equal to 1/10 of (xb-xa+8). The argument xb is the end point of the middle section of the terrain path used in calculating the terrain irregularity factor, delta-h; xa is the start point. So ka represents 1/10 of (8+length of the section of the total path to be considered, measured in increments. The computer code then sets the range of ka to be between 4 and 25 increments.

Since *ka* is declared as an integer (int), the data used to calculate its value must be int; but the declared local xb and xa are of type double. The function, by stating (int) after the equal sign and before the calculation, forces (creates) an output that is (int). The source code so far is:

```
ka=(int)(0.1*(xb-xa+8.0));
ka=mymin(mymax(4,ka),25);
```

Then the subroutine sets the value of *n* equal to (10 times ka) – 5; since ka is limited in range to between 4 and 25, n is limited in range to between 35 and 245 increments.

This is an archaic, problem-causing range limit for *n*, far too small for today's 90-meter (3 arc-second) 30-meter (1 arc-second) and 10-meter (1/3 arc-second) paths, which have thousands of intervals. It limits n to 245 times 90 m, or 22 km, for 3 arc-second database interval sizes, which should leave it marginally functional, but less than optimum. For a 1 arc-second terrain database for which all terrain points are being processed, it limits the maximum consideration of line-of-sight to only 7.35 km and 2.45 km for 1/3 arc second database all-points intervals. However, this range limit must be able to handle long horizons, such as those from a tall tower or mountaintop transmitter site that can transmit over relatively flat land; an example being paths from transmitter sites atop Cheyenne Mountain, in Colorado Springs, transmitting toward Denver.

The FCC regulations for their version of [delta] h specifies a minimum 10 km, and up to a 50 km maximum, limit for n; the n limit of 7.35 km for 1 arc-second database all-points intervals, and 2.45 km for 1/3 arc second database intervals, are both below the minimum FCC limit for consideration.

In continuing the comparison to the FCC's terrain consideration rules, we find that FCC 47CFR73.7313 indicates that the consideration of terrain roughness extends from n = 10 to 50 km; i.e. the maximum length of the path to be considered was 50 km from the transmitter to the receiver, and the calculation was to be made using terrain information on the signal path starting at 10 km and extending to the receive point, up to a maximum of 50 km. No consideration was to be made for terrain roughness if the path was less than 10 km. The length of n, being 10 times ka less 5, can only compare well with the 10 to 50 meter maximum range of the FCC's delta h determination method, unless ka = 1, where n would = 5; since ka is range-limited to be not less than 4, this is not possible. So let us look at another part of the FCC regulations; where at least 50 increments over the 40 km consideration path section are required. Converting from paper maps to a digital database, this is 1.2 increments per km, equivalent to an 830-meter database, or roughly equivalent to, and therefore compatible with, the 900 meter GLOBE 30 arc-sec database utilized by the NTIA Windows version of the ITM (itm.exe).

The maximum and minimum limits for ka, therefore, need to be set based upon the path lengths, not the number of intervals. We only need to reset the maximum limit, as ka is calculated to be far less than xb. The maximum length of n, to be limited to 50 km, or 50,000 meters, is dependent on ka, so we want to set ka to be a maximum of 5,050 meters. Distance in meters can be converted to intervals by dividing by pfl[1], the increment width, so: (Line numbers are for reference only, your copy may vary)

On Line 1245; add kmx, between k, and j on the int declaration line.

Assuming the units of pfl[1] is meters/increment, in *dlthx2*, line 1258 should be replaced by:

```
(replacement) Line 1258:   kmx=(int)(5000.5/pfl[1])
(replacement) Line 1259:   ka=mymin(mymax(4,ka),kmx);
```

The new Line 1258 sets the kmx, or ka maximum, to be the integer value of 5500.5 divided by the increment width, leaving kmx measured in increments. The new Line 1259 replaces 25 with kmx. In actual testing, we find that this should only be implemented if the database used is always 3 arc-sec or better; additional code switching between the new and old versions needs to be added to continue to occasionally use a database with intervals wider than 3-arc-sec.

Tutorial at the Symposium:

After 34 years of attendance, I will finally be speaking (as more than an awards presenter) at the IEEE-BTS Broadcast Symposium. I am moving up to a tutorial! If you are interested in FM analog and IBOC radio propagation and the current controversy over increasing the IBOC sideband power in the USA, I wish to invite you to attend one of the best tutorial lineups ever: Wednesday, Oct 14. First it's John Kean, on the signal measurements for FM and IBOC used by NPR Labs. The FCC has just concluded a request for comment period, and one of the comments subjects requested concerned whether the FCC should wait until NPR Labs finishes its report, due in September, before making a decision on the proposed IBOC power increase. The next tutor is Russ Mundschenk, from iBiquity, and his subject is the results of high power IBOC field trials. After lunch, I will get to the point of this series of articles, and more, with a familiarization tutorial on the inner working of a new generation of propagation software. The last tutor of the day will be Greg Best; his subject will be how to measure Harmonic and Spurious Emissions in order to meet the IEEE P1631 Mask Compliance.

My tutorial will be about combining the best of Longley-Rice's Tech Note 101, the corrected ITM, ITU P-series Recommendations, and the Quinteq Generic Model of Propagation through Clutter, into a new, world-class propagation prediction implementation that uses the 3-arc-sec worldwide-SRTM terrain databases. I will then walk attendees through the methodology for utilizing this new Longley-Rice-and-more implementation in a Comprehensive Market Analysis report, to provide new insight into FM radio reception determination, and provide proofs of concept and accuracy. Copies of the final Washington, DC demo report will be made available to attendees.

59th Annual
IEEE Broadcast Symposium

SAVE THE DATE!

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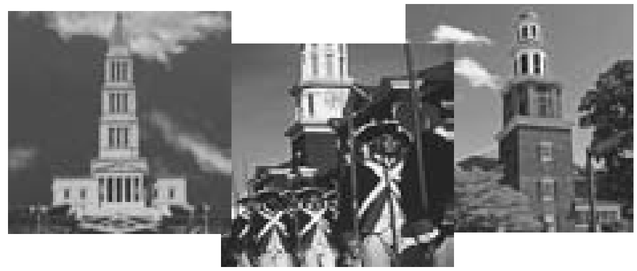

Please mark your calendar to attend the 59th Annual IEEE Broadcast Symposium to be held at the Westin Hotel in Alexandria, Virginia on 14-16 October 2009.

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Topic Areas:

Presentations are being scheduled who will present on topics such as the post transition performance of digital terrestrial TV, AM and FM digital radio performance, the results of increasing the level of FM IBOC carrier levels relative to the FM analog carrier power level, predictions of FM IBOC interference to adjacent channels and observed interference to adjacent channels, point to multi point TV transmission to mobile hand held devices, distributed transmission for TV and FM, advances on the use of Longley Rice modeling to determine predicted coverage contours for radio and TV, and other topics that are relevant to the modern broadcast engineer.

This event will now offer Continuing Educations Units (CEUs) for attending the technical sessions. Most consultants and PE's know that those are often required to maintain professional engineer licenses. Please feel free to request the CEU accreditation when you register for the conference.

Potential presenters are still invited to submit abstracts for proposed papers on advances in broadcast technology, including presentations in the following topic areas: 1) Technical issues associated with the termination of analog television broadcasting, 2) Repurposing of analog television broadcast transmitters, 3) Digital radio and television systems: terrestrial, cable, satellite, Internet, wireless, 4) Streaming, IPTV, VoIP, VoD, Mobile TV, Wireless Multimedia, 5) Wireless Broadband Networks; e.g., IEEE 802.22 Wireless Regional Area Networks ("WRANs"), 6) Transmission, propagation, reception, re-distribution of broadcast signals.

Prospective authors are invited to submit extended abstracts of 500-1000 words by e-mail to bts@ieee.org. Please indicate that the abstract is submitted to the 2009 Annual IEEE Broadcast Symposium, and include the corresponding author's full name and contact information including: Affiliation, address, e-mail, and phone number. Abstracts must be submitted by May 31, 2009 for consideration to be included in the 2009 Symposium technical program.

For details visit the Broadcast Symposium web site: www.ieee.org/bts/symposium

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2. ***Multimedia devices***
   - 2.1. Display technology
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   - 3.1 Performance evaluation
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4. ***Multimedia processing***
   - 4.1. Audio technology
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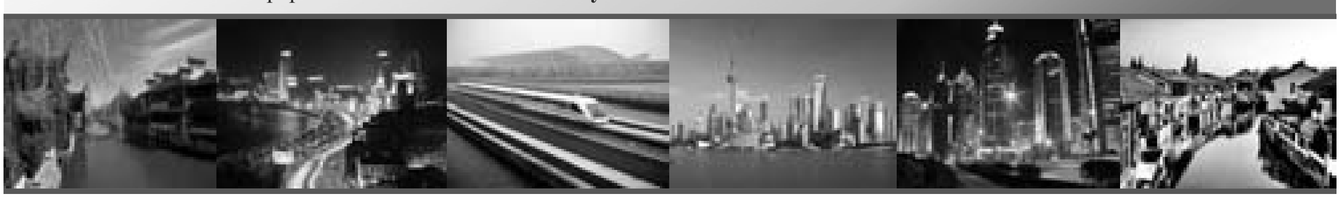

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