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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 Society

Have you ever noticed how much of your time is spent at work doing things that aren't really the technical jobs that you trained and planned for? Like it or not most of us spend more than half of our working hours doing tasks that are more managerial focused than technical. Whether your position has you managing others or you are being managed or both, we need to recognize that success depends on having a balance of skills and knowledge. Recognizing this situation, about two years ago the Broadcast Technology Society along with thirteen other IEEE societies became charter members of the IEEE Technology Management Council. Since the creation of the TMC, I have been on the board of governors and have helped to set its goals and directions.

One of the primary goals of the TMC is to provide information and instruction for technical professionals to help them advance in their careers. I have met a number of engineers who have been promoted to higher level positions only to struggle and sometimes fail because the skills that got them recognized for advancement are not the skills they need to succeed in their new positions. In 1968, Dr. Laurence J. Peter and Raymond Hull published a book entitled "The Peter Principle" which theorized that employees tend to be promoted to the level where they are no longer competent and stay there. I have to say that in my experience, I have seen this happen but I believe that the solution involves both the promoted and the promoter. It is up to those in management to recognize the need for ongoing education of their personnel and it is up to the personnel to actively work on developing themselves. TMC will function as a resource for learning those skills with the advantage that the information

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Inside

From the Editor

William Meintel, BT Newsletter Editor

I continue to receive very positive feedback about our Newsletter and want to again thank all our contributors and the IEEE support staff for the great job everyone is doing to make me look good. There is, however, always room for improvement and in this case I believe what is needed is more content. With that in mind I once again encourage everyone step up, contribute and share your knowledge and stories with your colleagues.

As you all probably know from my previous columns I like to get on my soapbox from time to time, so here I go again. Television and the DTV transition continue to occupy center stage in the United States. As if just getting to the February 2009 shutoff of analog was not enough we have at least four other side shows going on at the same time. There is the continued push by those outside the industry to grab use of what has been referred to as white space in the broadcast spectrum; a proposal to reallocate TV channels 5 and 6 for FM broadcasting; the push

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comes from people who understand the unique disciplines of engineers, not just management and can help bridge the gap. One of the board members equated it to being an impedance matching device between the technical and managerial skills necessary to succeed. I really like that analogy since in my field of broadcasting, the importance of impedance matching is one of the first thing we learn and the results of a bad match are often very loud, costly and sometimes dangerous.

Even though the council's name includes the word management, the goals are not strictly for managers. Another key focus is to provide guidance for engineers who are looking to make the transition to management. The idea here is to provide a resource so that technology professionals who are looking for opportunities to grow can identify areas within themselves that they would need to develop to make the transition smoothly. But more than that, even engineers who are satisfied with where they are still need to learn many of the skills necessary to manage their superiors. I have been an engineering manager in broadcast facilities for my entire career. Initially in radio being an engineering manager was easy since most radio stations had only one true electronics engineer and a bunch of operators. I had to manage myself. In television it became a little more demanding because there was actually a staff of engineers and I needed to find ways to motivate them which was pretty easy. Finding ways to be part of the management team was much more difficult since to most of my peers, engineering was a black art. The importance of this was brought home to me one day at one of my first stations when I noticed the General Manager (who came out of advertising sales) talking with the production manager (who knew how to produce television programs but not how the equipment worked.) I watched several times as the GM made the rounds and talked to everyone but me. I finally asked why that was and he told me that he was comfortable talking with all of the other department managers because he felt that he had a basic idea of what they did and in a pinch he could actually do their jobs. With engineering he was completely unaware of what we did and made the statement that after I would come in and tell him that we needed to do something or purchase something he would say to himself "Please God, don't let him be lying to me." Although initially offended by the statement, I recognized that I was at least partially at fault because I spoke to him like I would to any other engineer without considering that he didn't really understand what I was saying. I decided that I would focus on developing my ability to manage my staff, my peers and my superiors and in doing that, I became a much more knowledgeable and valuable part of the organization. That process was very difficult because I didn't know where to look for a lot of the information I needed and a lot of what I found was written or presented from a point of view that was so far removed from my own, that I felt like my boss did when he was praying that I was being honest with him.

Learning from the experiences of others who have taken a path similar to the one we are on tends to make the lessons more easily understood and relevant to us, even if the actual lesson is universal. TMC exists to help the technology professionals develop and be more successful and ultimately happier in their careers. It is a simple truth that the need to learn more, never stops but not all lessons need to be learned the hard way. TMC exists to make relevant educational information available and I would encourage the members of the BTS to take advantage of the opportunities that it presents to learn more and to share what you have learned. For more information, visit the TMC website at http://www.ieeetmc.org/.

Bill Hayes
President
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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, 2008	October 20, 2008
Spring, 2009	January 20, 2009
Summer, 2009	April 20, 2009
Fall, 2009	July 20, 2009

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to develop a standard and implement it for mobile and handheld devices and now, a lifting of the freeze on requests from Class A television stations to maximize facilities or change channels. For those not familiar with Class A stations, they are low power TV (LPTV) stations that have been granted primary status and as such must be protected by full service TV stations as opposed to other LPTV stations that operate on a secondary basis which do not receive protection from full service stations and can be displaced by them.

Each of these side shows, regardless of whether they are good or bad ideas, is a distraction to the main goal of meeting the February 2009 deadline. As I have discussed in some of my previous columns, the broadcast industry in the U.S. is short on talent to deal with the many of these issues. I believe this situation highlights the case. I know this from personal experience since I have been involved in one way or another with each of these issues and have found it very difficult to handle all of them at once. I also know that many others in our industry are also facing the same problems. The issue is not that specific individuals are taking on too much work but not having enough qualified people to handle the load. The result of this is likely to impact the DTV transition to some extent and a failure to adequately address all the other issues.

There are two different things that come out of this situation. The first that I have already touched on is the need for more broadcast engineers and the fact that broadcast engineering is not a dying profession but a dynamic one. The second is that the timing of all of this could have been better managed. I realize that the mobile/handheld initiative may be very important to the survival of the industry and that there also may only be a short window of opportunity to make it viable. On the other hand, the other three issues in my opinion should have been put on hold until after the DTV transition deadline has passed and then deal with them individually in the following order with one additional item that has been on hold for quite a while:

1. Class A maximizations and channel changes,
2. A Rule Making from the FCC on Distributed Transmission,
3. Reallocation of TV channels 5 and 6 and
4. Use of broadcast spectrum white space.

That's my opinion and I would like to hear yours.

On a much lighter note I would like to congratulate our BTS President Bill Hayes on being selected by the Society of Broadcast Engineers (SBE) as 2007 Educator of the Year. Way to go Bill!

As always I welcome your input so let me hear from you.

Bill Meintel
Editor
wmeintel@computer.org

IEEE 58th Annual Broadcast Symposium

Wednesday 15 October through Friday 17 October 2008
The Westin Hotel
Alexandria, Virginia USA

The 58th Annual IEEE Broadcast Symposium offers an exciting program, with cutting edge presentations by leading professionals in the broadcast engineering field. Wednesday offers a full day of tutorials, ollowed by our evening Welcome Reception, featuring music by the Jazz Trio. The Thursday session offers a two track option. Track 1 will feature papers on "Managing the Transition-Digital TV and Digital Radio". Track 2 will feature papers on "Managing the Transition" –Refining the process. These papers deal with new and alternative areas of broadcasting. The Friday morning session is devoted to Digital Radio, while our afternoon focuses on the Audio issues with Digital Television. The afternoon is highlighted by a Panel discussion on Television Audio Loudness. Panelists to include representatives from television networks and equipment manufacturers.

New for 2008! CEUs will be available for those interested. Up to 2.1 CEUs can be awarded for attendance. In addition, the Symposium serves as an opportunity for you to network, meet with old friends and make new friends. Plan to attend the Welcome Reception on Wednesday evening.

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

Preliminary Technical Program

Subject to change

Wednesday - 15 October 2008

Tutorial Day

Session Chair: James Fang - Consultant

Understanding Computer Networking

John Yazinsky, Cisco Systems, Inc, USA

Box Lunch

"Mobile TV: The Opportunity and the Challenge"

Keynote Speaker: Jerry Power, Alcatel-Lucent

Afternoon Session

DTV Transport Basics: AKA - What You Really Need to Understand about Digital Television

Rich Chernock, Triveni Digital, USA

Status of IEEE DTV Emission Measurement Draft Standard P-1631

Greg Best, Greg Best Consulting, Inc., USA

Evening Welcome Reception

Thursday - 16 October 2008

Track 1 - Morning

Managing the Transition - Digital TV

Session Chair: Lanny Nass – CBS

IEEE P802.22 Wireless WRANs: Background, System Description, and Status Update
Winston Caldwell, Fox Technology Group, USA

Brazilian DTTB Coverage Performance Evaluation
Gunnar Bedicks, Mackenzie Presbyterian University, Brazil

Broadcast Video Quality Assurance
Rich Chernock, Triveni Digital, USA

Reinventing Digital Television - Mobile/Handheld Standardization Activity
Mark Aitken, Sinclair Broadcast Group, USA
Brett Jenkins, ION Media Networks, USA

The U.S. DTV Transition - Will February 18, 2009 be a Catastrophe? What are the Problems and How to Fix Them
Bill Mientel, Meintel, Sgrignoli & Wallace, USA

Mobile and Handheld Field Measurements
Dennis Wallace, Meintel, Sgrignoli & Wallace, USA

Track 2 - Morning
Managing the Transition - Refining the Process: Part 1
Session Chair: Jinyun Zhang - Mitsubishi Electric

Implementation of the Interactivity Channel of Terrestrial Brazilian DTV System Using Concepts of Software Defined Radio Reconfigurability
Rodrigo Admir Vaz, Samsung Brazil R&D Center, Brazil

Statistical Analysis of Digital Television Planning for the ISDTV System
Késia C. Santos, Federal University of Campina Grande, Brazil

DVB-H coverage estimation in highly populated urban area
Jyrki T.J. Penttinen, Nokia and Nokia Siemens Networks, Spain

Cooperative Local Area Contents Transmission within Single Frequency Broadcast Networks
Sungho Jeon, Broadcast Technical Research Institute (BTRI) in Korean Broadcasting System (KBS), Korea

New Method to Determine the SFN Gain of a DVB-H Network
David Plets, Ghent University, Belgium

Performance of an Echo Canceller based on Pseudo-Noise Training Sequences
Matteo Mazzotti, University of Bologna, Italy

Joint AFCCE/IEEE BTS Luncheon
Keynote Speaker: Richard Wiley, Weily Rein, LLP

Track 1 – Afternoon
Managing the Transition - Digital Radio
Session Chair: Jon Edwards - de Treil, Lundin & Rackley, Inc.

Coverage Extension Transmission Technologies for Digital Radio
Dave Hershberger, Continental Electronics Corporation, USA

FM-IBOC Digital Radio Laboratory Tests at the Communications Research Centre Canada (CRC)
André Carr, Communications Research Centre Canada (CRC), Canada

Study of a 10dB Power Increase in Digital Carrier Level for HD Radio™ in the FM Broadcast Band
Steve Densmore, iBiquity, USA

IBOC DAB implementation
John Kean, NPR Labs - National Public Radio, USA

Test Results of AM IBOC into Antenna Simulator
Tom King, Kintronics, USA

Track 2 - Afternoon
Managing the Transition - Refining the Process: Part 2
Session Chair: Charles Einolf, Jr., Consultant

Network Planning for Delivering Digital Television to Mobile and Portable Devices: A Hybrid Broadcast and Cellular Approach
Jose Antonio Arenas, Telefónica Móviles España, Spain

The Influence of Network Evolution, Cryptography Advances, and the Need for Flexible Entitlement Models in DCAS Design
Graham Turner, Nagravision, Switzerland

Efficient FEC Protection of Scalable Media Streams in DVB-H
Imed Baouazizi, Nokia Corporation, Finland

Cognitive Equalization: Methods for Estimation of Instantaneous Channel Multipath Properties in Highly Dynamic Propagation Conditions
Jan Garmany, Coherent Logix, Inc., USA

Physical Layer Error Protection for Mobile Broadcasting in Ku-band with Reduced Gain Antennas
Albert Heuberger, Fraunhofer-Institut für Integrierte Schaltungen IIS, Germany

Friday - 17 October 2008

Morning
Digital Radio
Session Chair: Bob Surette - Shively Labs

Review and Analysis of Medium Wave Directional Antenna Sample Systems
Stephen S. Lockwood, Hatfield & Dawson Consulting Engineers, USA

DAB/DMB Broadcast Signal Delivery in Underground Public Transportation Systems: Concept Investigation
A. Mouaki Benani, Communications Research Centre Canada (CRC), Canada

Effects of Degraded Digital Audio on Memory
Ellyn Sheffield, Towson University, USA

Overhead Quasi-Coaxial Transmission Lines
Valentino Trainotti, University of Buenos Aires, Argentina

Overview of The Sirius Satellite Radio System
Stefano DiPierro, Sirius Satellite Radio, USA

Annual BTS Awards Luncheon
Keynote Speaker: Peter Fannon, Panosonic Corporation of North

America

Afternoon

Digital Television - Audio
Session Chair: Eric Wandel - Wavepoint Research, Inc.

Audio Loudness
Robert P. Seidel, CBS Television Network, USA

Loudness Control for DTV Broadcasters
Steve Lyman, Dolby, USA

Loudness Models, Testing and Use
James D. Johnston, Neural Audio Corporation, USA

Panel discussion on Television Audio Loudness
Moderator, Jim Kutzner, PBS

Confirmed Panelists include:
Jim Starzynski, NBC Universal, New York, NY
Robert P. Seidel, CBS Television Network, USA
Steve Lyman, Dolby, USA
James D. Johnston, Neural Audio Corporation, USA

BroadcastAsia Report

Yiyan Wu

BroadcastAsia 2008 was held 17 – 20, June 2008 in Singapore. Close to 12,000 visitors from 71 countries and regions across Asia-Pacific, Europe, North America, and the Middle-East attended the event. 717 exhibiting companies from 46 countries showcased innovative solutions in Broadcasting-to-Handheld, Digital Media Asset Management, HD (High Definition), IPTV and Professional Audio Technologies.

IEEE BTS had a membership booth at the BroadcastAsia 2008 run by BTS Shanghai chapter and local volunteers. Over 20 people joined BTS during the show.

IEEE BTS volunteer Benseng Chou (a graduate student at Nanyang Technological University, Singapore) talking to visitor from Malaysia.

Singapore Expo where BroadcastAsia2008 was held

BTS volunteers, from left to right, Benseng Chou, Yiyan Wu (CRC Canada) and Prof. Lin Gui (BTS Shanghai Chapter, Shanghai Jiaotong University.

BTS volunteers and family members having dinner at Marina Square, Singapore.

Congratulations to the IEEE BTS Members recently elevated to Senior Member Grade

The IEEE Broadcast Technology Society sends its heartiest congratulations to the following BTS members elevated to Senior Member status from 2007 through June 2008:

2007

Weihua Bing – Boston Section, U.S.A
Robert Good – Susquehanna Section, U.S.A
Dong Han – Taegu Section, South Korea
William Hayes – Central Iowa Section, U.S.A
Thorsten Herfet – Germany Section
Chak-Joo Lee – Singapore Section
Stephen Marshall – Dallas Section, U.S.A
Justin Mitchell – U.K. & Rep of Ireland Section
George Paunovic – Spain Section
George Waters – Melbourne Section, Australia
Leif Wilhelmssor – Sweden Section
Liang Zhang – Ottawa Section, Canada

2008

Balagopalan Ambady – Denver Section, U.S.A
Shiqiu Jeff Cheng – Boston Section, U.S.A
John Convington – Charlotte Section, U.S.A
Benjamin Dawson – Seattle Section, U.S.A
John Footen – Northern Virginia Section, U.S.A
Anastasia Kastania – Greece Section
Manijeh Khataie – Montreal Section, Canada
Jianhua Lu – Beijing Section, China
Nathan Maxemous – New York Section, U.S.A
William Sanders – Seattle Section, U.S.A
Alexander Smith – Northern Virginia Section, U.S.A
Hirokazu Tanaka – Tokyo Section, Japan
Demin Wang – Ottawa Section, Canada

There are many benefits to becoming an IEEE Senior Member:

- The Professional recognition of your peers for technical and professional excellence
- An attractive fine wood and bronze engraved Senior Member Plaque to proudly display
- Up to $25 gift certificate toward one new Society membership
- A Letter of commendation to your employer on the achievement of Senior member grade (upon the request of the newly elected Senior Member)
- Announcement of elevation in Section/Society and/or local newsletters,newspapers, and notices
- Eligibility to hold executive IEEE volunteer positions
- Can serve as Reference for Senior Member applicants
- Invited to be on the panel to review Senior Member applications

"The requirements to qualify for Senior Member elevation are, a candidate shall be an engineer, scientist, educator, technical executive or originator in IEEE-designated fields. The candidate shall have been in professional practice for at least ten years and shall have shown significant performance over a period of at least five of those years."

To apply, the Senior Member application is available in 3 formats: Online, downloadable, and electronic version. For more information or to apply for Senior Membership, please see the IEEE Senior Member Program website: http://www.ieee.org/web/membership/senior-members/index.html. If you need additional assistance, please contact your IEEE Section Chair or the BTS Senior Administrator Kathy Colabaugh at k.colabaugh@ieee.org.

BTS Beijing Chapter Report

by Prof. Jianwei Zhang, Chair

The IEEE BTS Beijing chapter organized a workshop "Digital Television and Mobile Multimedia Broadcasting" under this year's IEEE International Conference on Communications (ICC'2008). The ICC'2008 was successfully held in Beijing, China, 19-23 May, 2008. The conference received more than 3,000 paper submissions from 58 countries. After vigorous peer-evaluation, 1105 papers from 49 countries were accepted. There were more than 1,500 people registered for the conference. The numbers of paper submissions and acceptances, as well as registered attendance were all a record high.

The BTS Beijing Chapter members spent much time and effort organizing the workshop. The workshop, held on 23 May, was divided into two parts. The first part started with the invited talk of "Recent and Future Developments in Digital Television and Mobile" by Dr. Yiyan Wu, CRC Canada and a BTS representative,, followed by three presentations which were: "Supporting scalable multimedia streaming over converged DVB-H and DTMB networks" by Dr. Hongfei Du from Create-Net, Italy; "Channel Estimation for the Chinese DTTB System Based on a Novel Iterative PN Sequence Reconstruction" by Mr. Fang Yong from Tsinghua University, China; and "H.264 Frame Layer Rate Control Based on Block Histogram Difference", by Mr. Tian Lan, from Harbin Institute of Technology, China.

Workshop Co-Chair Dr. Jian Song, Tsnghua University

After the coffee-break, Prof. Jianwei Zhang, from University of Hamburg, Germany, gave another invited talk of "Review of FP6 Project "Multi-standard integrated network convergence for global mobile and broadcast technologies", followed by three presentations including: "Radio Resource Management for Broadcast Services in OFDMA -Based Networks", by Dr. Patrick Hosein, from Huawei Technologies Co., Ltd., USA; "User-centric Utility-based Data Replication in Heterogeneous Networks", by Mr. Seung-Bum Lee, from Dublin City University, Ireland, and "A Low Complexity Timing Synchronization Algorithm for DTMB Standard", by Dr. Chao Zhang, from Beijing University of Aeronautics & Astronautics, China. More than 30 people from different parts of the world attended the workshop.

All the talks and presentations shared the latest technical advances, research progress as well as the development trends in the multimedia broadcasting area, which stimulated lots of off-line discussions. The workshop lasted more than four hours.

The co-chairs, Dr. Yiyan Wu and, Jian Song would like to express their sincere thanks to all the excellent work done by our TPC members as well as authors' participation. Our special thanks also go to Dr. Jintao Wang, from Tsinghua University, for his excellent support. We look forward to having more opportunities to serve our community in the future.

The day before the workshop, Dr. Yiyan Wu, went to Tsinghua University to give a seminar organized by BTS Beijing Chapter. The topics covered broadband multimedia broadcasting, IEEE BTS and how to prepare and submit papers to the IEEE Transactions on Broadcasting. The seminar lasted two hours. The talk attracted more than 50 people from industry, research institutions and universities.

ICC08 Opening Ceremony

BTS Beijing Chapter Seminar presented by Workshop Co-Chair Dr. Yiyan Wu

BTS Argentina Chapter Report

By Valentino Trainotti, Chair

On 4 September 2006 the BTS Argentina Chapter hosted a seminar on "Mobile Digital TV." The presenter was Eng. Juan Carlos Guidobono. He is the ATSC Argentina Representative and Technical General Manager of Channel 2 America TV in Buenos Aires.

At the seminar, Eng. Guidobono presented an update on Mobile Digital TV to be implemented beginning 17 February 2009 in the United States with the end of transmitting analog NTSC TV and the beginning of the digital era with the US transmission conversion to digital ATSC TV.

The seminar was held in the IEEE Auditorium / CICOMRA, 744 Cordoba Avenue, Buenos Aires. Attendance was very large and exceeded the Auditorium capacity. A follow-on Seminar on this topic will be held in the near future.

Eng. Juan Carlos Guidobono presenting his seminar to the BTS Chapter on 4 September 2008

The Argentina BTS Chapter regrets that a second seminar, scheduled for September 2008, on "The Theory and Implementation of FM Transmitters Analog and Digital" has been cancelled. The Chapter hopes that this seminar can be rescheduled for a future date.

The Chapter would like to extend its thanks and appreciation to Mr. Lyle Sprinkle of the Harris Broadcast Division for his years of support and interest in the IEEE Argentina Broadcast Technology Chapter. He has been most helpful to the Argentina BTS Chapter broadcast technology educational initiatives and seminars.

United Kingdom and Republic of Ireland Consumer Electronics and Broadcast Technology Joint Chapter

Scott Linfoot, Chair

First of all, let me say "greetings". My name is Scott Linfoot from De Montfort University, Leicester, United Kingdom. In February this year, I had the pleasure of being elected to succeed Dr Simon Sherratt in chairing the United Kingdom and Republic of Ireland (UKRI) Consumer Electronics and Broadcast Technology (CEBT) joint chapter. I would like to thank Simon for all his hard work over the past three years and I hope that I can continue the work he has started.

Well, things have certainly happened over the past 6 months and there is nothing like jumping in at the deep end to get the ball rolling. In May, we had the pleasure of inviting Thomas Coughlin of Coughlin Associates from California to take part in a tour across the UKRI section. He took part in 4 presentations over 1 week in Plymouth (UK), Oxford (UK), York (UK) and Galway (RoI). The subject matter was "Digital Storage in Consumer Devices". The presentations were well attended with some interesting discussions taking place including the debate on the future of mass storage, flash storage vs hard disks, future technology of hard drives and trends in storage requirements.

Tom Coughlin presenting at Oxford University

All in all, some interesting ideas were stimulated that gave pause for thought.

I would like to thank Tom once again for his time (it isn't a short journey over to the UK and back) and hope we can invite him again in the future.

ICT 2008 Conference Summary

By Dmitry Tkachenko, Chair

Russia Northwest (BT/CE/COM) Chapter

The IEEE Russia Northwest Broadcast Technology, Consumer Electronics, and Communications (BT/CE/COM) Chapter was a technical co-sponsor for 15th International Conference on Telecommunications (ICT 2008) that was successfully held in St. Petersburg on 16 – 19 June 2008. The conference took place in Pulkovskaya Park Inn hotel, which is conveniently located at the entrance to the city not far from the international airport. The conference was truly international. Speakers from 21 countries delivered 96 papers at the conference.

Keynote presentations on the newest trends in telecommunications, broadcast and consumer electronics technologies were made by leading experts from AT&T Labs Research (USA), Cisco (USA), Beijing University of Posts and Telecommunications (China), IHP microelectronics (Germany) and Sharif University of Technology (Iran). Topics of keynotes covered such issues as information mining and software research with applications in telecommunications industry, content creation and distribution on the network by prosumers - talented consumers and semi professional video producers, space-frequency subchannel allocation and adaptive modulation in MIMO OFDM beamforming systems, systems engineering in a converging world and emerging optical CDMA techniques and applications.

An International Workshop on Multiple Access Communications (MACOM 2008) was held on 16 – 17 June 2008 along with the ICT 2008 conference. 26 papers were delivered at the workshop on such topics as multi-user information theory, multiple access techniques, queuing theory methods, polling systems analysis, MAC protocols development and analysis as well as PHY/MAC cross-layer techniques that are relevant to broadband wireless data networks (for instance, IEEE 802.11 Wi-Fi, IEEE 802.16 WiMAX) and beyond 3G (B3G) wireless systems.

The conference was preceded by an Alcatel Lucent sponsored tutorial on foundations of network security in the next generation converged networks. Participants of the conference had sufficient time to talk with each other during coffee breaks, lunches, the conference reception and the dinner. A bus tour to the St. Petersburg city center concluded the conference program.

BTS Taipei Chapter Report

Yih-Min Chen, Chair

BTS Taipei Chapter sponsored a lecture given by Dr. Eric Lean (IEEE Life Fellow) on the topic: "Take the opportunity and create success- on the development of electronics and optoelectronics industries in Taiwan," at Yaun Ze University, Chungli on 21 March, 2008. On March 23rd, the Chapter held a meeting attended by former chapter chairs and the newly elected chair at Taipei. This informal meeting, organized by Ying Li, served to introduce the newly elected chair, Yih-Min Chen, to other former chairs: Jack S. Chang, Tyler Cheng, Che-Sheng Yeh, and C. T. Chang. It was agreed that the connections between Chunghwa Telecomm (www.chttl.com.tw/english/index.php), China Radio Association (www.cra.org.tw), and BTS Taipei would be strengthened with joint activities in the future. The following is the biography of the newly elected chair: Yih-Min Chen received his B.S., M.S. and Ph.D. degrees in electrical engineering all from National Taiwan University, Taipei, Taiwan, in 1982, 1986, and 1991, respectively. He was with the Department of Electrical Engineering (1990-2001) and the Department of Communication Engineering (2001-2003) at Yaun Ze University. Currently he is an Associate Professor in the Communication Engineering Department at National Central University, Chung-Li, Taiwan. His current research interests are in software defined radio architecture design and implementation, baseband signal processing for wireless communications, embedded software for digital signal processors, and signal processing for multiple antennas. He developed software for DAB and DVB-T receivers which were commercialized successfully, and has given short courses on DAB, DVB-T/H, and DMB-TH in Taiwan. He is on the advisory board of the alliance to promote digital television and broadcasting education (http://dtv.csie.ntut.edu.tw/).

Past and current BTS Taipei chapter chairs. From left to right, Jack S. Chang, Ying Li, Yih-Min Chen, Chi-Tai Chang, Che-Sheng Yeh, and Tyler Cheng

A BTS Profile:

Edmund A. Williams
Technical Program Chair
IEEE BTS Broadcast Symposium

For more than two decades, the IEEE Broadcast Technology Society has had the honor and privilege of Edmund (Ed) Williams serving as Technical Program Chair for the annual IEEE BTS Broadcast Symposium. Ed's leadership and extensive broadcast experience has supported the 2008 Symposium Chair, Guy Bouchard, and prior years Chairs making it possible for the BTS to annually present consistently high quality and timely technical programs with cutting edge research and practical knowledge presentations for broadcast engineering professionals working in industry and academia.

This year's IEEE BTS Broadcast Symposium Technical Program, developed by Ed in coordination with Guy Bouchard, James Fang, the Symposium Committee, and the AdCom, is especially meaningful as reflected by the Symposium's theme "Managing the Transition." The 20 year difficult and tedious transition of United States TV from analog to digital television will occur on 17 February 2009. That date marks the end of nearly 70 years of analog NTSC television and the beginning of a new, exciting era of digital ATSC television with expanded services.

The 2008 Broadcast Symposium Technical Program contains two days of timely, educational technical presentations addressing the DTV transition. Underscoring this theme, Guy and Ed arranged for two keynote luncheon speakers who were directly involved during startup of the transition. Richard Wiley, former FCC Chairman, played a pivotal role in the development of DTV by serving for nine years (1987-1995) as Chairman of the FCC's Advisory Committee for Advanced Television Systems. Ed remarked that "Dick Wiley had a way to get things done." Peter Fannon, now with Panasonic, in 1987 set up and for 10 years served as President of the Advanced Television Test Center (ATTC) that managed the testing of the multiple proposed digital and analog systems as they vied to become the next broadcast system for the United States.

Ed, 69, was born in Cleveland, Ohio and grew up in Columbus, Ohio. His 50 year career in broadcasting has had a significant impact on each year's Technical Program. He brings to bear his extensive broadcast experience in academia and industry as reflected by his work at Ohio State University and Ohio University Radio and Television, the Public Broadcasting Service, the National Association of Broadcasters, and the Advanced Television Test Center.

The BTS is extremely proud of the numerous accomplishments and important contributions Ed has made to the broadcast profession and especially to DTV.

Ed first became interested in electronics when his high school Physics teacher introduced him to ham radio in 1955. After he built his first ham station equipment and obtained his license – W8APE - Ed said "It had a stunning effect on me. I learned to understand how things work, make do with what you have, how to anticipate problems, and fix them. He subsequently earned his ABSc – Communications Engineering Degree from Franklin University, Columbus, Ohio. It was the perfect prelude to his broadcasting work for the next 50 years.

Highlights of his career include the following:

Ed participated in the Emmy Award winning PBS Captioning for the Deaf, Satellite Interconnection, and UHF Improvement Projects, and developed a terrain sensitive broadcast coverage prediction technique (AREAPOP). While with PBS and NAB he conducted lab and field tests for AM Stereo, TV Stereo, Ghost Cancelling, and managed the field testing of Advanced and Digital Television Broadcast systems. He has been a member of NAB, ATSC, IEEE standards committees, and the FCC Advisory Committee for Advanced Television Systems.

Ed produced numerous technical papers for industry symposia, and conducted experimental broadcast demonstrations of high definition for the FCC, Congress, and broadcast industry groups while working at NAB.

In 1996, while at PBS, Ed helped develop the concept of a road show demonstration of HDTV and DTV broadcasting. So did Harris Corporation and, together with PBS staff, the Harris/PBS DTV Express was created. The objective was to educate broadcast station managers and engineers at their stations about digital television technology. Harris managed the DTV express while PBS coordinated its itinerary. The mobile facility consisted of a 53 foot, 18 wheel tractor trailer containing 80,000 pounds of technical equipment that included a full DTV station with technical control and a transmission facility, plus a 20 seat briefing room. The demonstration road show, with a crew of 15, embarked on an 18 month (1997-1998), 40 city tour (including two NAB shows), with demonstrations and seminars for thousands of broadcast professionals. Ed participated as engineer and technical seminar presenter on the DTV Express.

After completing the DTV Express project, Ed returned to the PBS Strategic Services Group working with public television stations to develop their DTV transition with cost-effective DTV transmission facilities along with demonstrations and seminars. He also participated in industry standards (ATSC, IEEE) and special committees with respect to DTV issues.

Ed said "There is a big advantage of my working on the BTS Symposium Technical Program and with PBS. I had contact with many of the broadcast equipment manufacturers and many of the people directly involved with the DTV transition. As a result we had lots of high quality Symposium papers on DTV transmitters and antennas, filters and transmission lines, field and lab tests, receiver designs, standards, and others which made it possible for the engineers to understand what was going on with the DTV transition. It was a way I could apply information I had obtained from PBS and vice versa for the Symposium. It was a pretty good match."

"The Public Broadcast Service and their member stations played a pivotal role in the DTV transition as they could provide demonstrations to other broadcasters in their own studios. PBS fed HD programming in DTV format to their member stations which were well enough along to put on demonstrations in their studios and on the air. They were well ahead of most commercial stations which had not taken the DTV transition step. PBS was specifically interested in DTV because it would support the PBS mission to bring high quality programming to viewers along with substantial multiple features not possible with analog NTSC.

"Public broadcasting is often on the leading edge of broadcasting technological developments and, while they often don't have the resources to make it happen themselves, with enough energy and non-financial support, they have helped the industry evolve into new eras. All along the way I had great supervisors who provided the opportunities to gain new knowledge and experience."

Ed has enjoyed the instructional side of broadcast engineering since his days at Ohio University where he taught broadcast engineering courses for 12 years.

After Ed retired from PBS in 2004, the NAB asked him to become Editor-in-Chief for the 10th Edition of the NAB Engineering Handbook. Planning, organizing and managing a detailed editorial process, along with three associate editors, was a massive effort that took over a year to complete. Introduced at the 2007 NAB Convention the Handbook is an extremely useful book and a valuable reference for all engineers working or wanting to know about the broadcast engineering profession. Completely revised, the 10th Edition of the NAB Engineering handbook consists of 2,050 pages, with 104 chapters written by 140 authors.

Ed joined the IEEE in 1980 and the BTS in 1982. He volunteered to work on the BTS Standards Committee and also the BTS Technology Committee. He served as Society Secretary, then Treasurer and finally Vice President. He was encouraged by the AdCom to assume the Presidency of the Society but declined due to his heavy workload in the DTV transition activities. Fortunately for the BTS, Ed did remain on the Technology Committee which had, at that time, only one activity – planning the Technical Program for the annual BTS Broadcast Symposium and later chaired the Symposium. He currently remains on the committee as program chair. Additionally, Ed volunteers his time and expertise to BTS activities, the AdCom, and especially the annual Broadcast Symposium.

When asked what advice he would give to today's young engineers, Ed said "Keep your mind open to new things that are going on. Allow yourself a little bit of time to do that. You can easily get bogged down in day to day activities. Take a little time to read about new things and learn the tools – to quote Stephen Covey "sharpen the saw." Learn new techniques, subscribe to the technical and trade magazines and join a couple of engineering societies. If you are academically qualified or working in the broadcast industry, hook up with the IEEE or other related organizations and get involved."

When asked about any advice to graduate engineers to consider going into broadcast engineering, Ed offered the following: "If you want to spread your wings rather than go into some narrow subject, then get involved with a broadcast facility, or a manufacturer, or consulting firm. Often you can go from manufacturing to broadcasting and some times vice versa. The graduate engineer who goes into a broadcast facility and learns how that environment operates and then goes into manufacturing provides that manufacturer with a leg up on what is needed for broadcasters."

"Being a member of the BTS provides you with the opportunity to, first of all, go to the Symposium events and to mix and mingle with people in your industry. That is the networking side of it. The other side is a high quality technical program. That is what I have always thought that the BTS Symposium provides - an excellent facility to learn. It isn't so large so you can meet practically everybody there at social events and between program breaks, plus you also have the opportunity for casual discussions with authors presenting papers. It is an informal setting. Become acquainted with them and it will help your career."

When asked about young engineers presenting papers at the BTS Symposium Ed remarked: "Now that you are a graduate engineer and have done some research or not even yet graduated, why not take a paper you were required to write and orient it to the broadcast industry or applications for the broadcast industry and produce a paper for presentation at the Symposium."

"Some of the foreign students are doing this. They come to the Symposium with a paper. It is essentially their thesis or dissertation. Not only do they complete one of their degree requirements as a result of presenting their paper, but they are also published, have traveled, and met people in their profession. Also, they gain confidence in presenting a paper in public. It doesn't get any better than that! I think the Broadcast Symposium provides a great opportunity to do that in a less than overwhelming situation. The engineer gains poise, confidence, and contacts from the event. It develops the engineer's career."

Ed said "Here is a really interesting thing for young graduates in computer science. Broadcast stations today consist of arrays of computers. With your computer science degree, you go into that facility, work their web site, and the next thing you know, you learn about the video side of it, the entertainment side, and the news side. Also you learn how important the entire operation is to the people at home receiving your programs. You broaden your experience at the broadcast facility and learn there is a wide range of technologies involved there besides IT."

In summary, Ed said "I have particularly enjoyed being on the Symposium Committee as it provides an opportunity to bring the latest technological developments from around the world to those attending the Symposium as well as providing an outlet for technical papers for budding young engineers to achieve recognition and confidence in presenting papers."

Currently Ed is enjoying retirement life in The Villages, Florida with his wife Avis and with many activities including attending amateur and model railroad club meetings, attending bluegrass music events, hitting the pool several times a week, enjoying dinner parties with friends, and taking day trips exploring the great state of Florida. Ed also plans to do some writing. In addition, he would like to carry the IEEE flag and visit some BTS Chapters as well as continuing with BTS Symposium activities.

Ed also has maintained a student scholarship fund for over 30 years at the Ohio University Center for Public Media (Radio-TV) and corresponds with people there on a regular basis.

Reflecting back on his 50 year career, especially at PBS during the DTV transition, Ed said: "During those years I was on a 'high' with excitement and interest about the new technologies and how they would benefit public television and the audience. I can now sit back, relax, and watch the fruit of that work (and the work of legions more engineers, marketers, committee workers, government regulators, and others that made it possible) on my large screen HDTV set. Cheers!"

The IEEE BTS is proud and grateful to have Edmund Williams as an outstanding volunteer and major participant in its activities. Ed has brought great credit to the Broadcast Technology Society, the IEEE, and the broadcast profession. The BTS looks forward to a long continuing relationship with Ed and is glad to know he will continue sharing his broadcast expertise, knowledge, and dedication by helping the IEEE Broadcast Technology Society accomplish educational goals serving its members worldwide.

Interview and Article
by Ted Kuligowski

An Update on ATSC-M/H

By Jerry Whitaker, VP of Standards Development, ATSC

The pace of work within ATSC to develop a mobile/handheld (M/H) system continues to accelerate as hundreds of engineers in a dozen countries work toward key upcoming deadlines. The major elements of the ATSC-M/H system have been selected and work now focuses on documenting the overall system. If all goes as planned, in September the Specialist Group on ATSC-M/H (TSG/S4) will review and approve the draft Candidate Standard document and forward it to the Technology and Standards Group (TSG) for formal consideration.

ATSC-M/H 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 may also be used for transmission of new data broadcasting services such as real-time navigation data for in-vehicle use.

About the Process

A Candidate Standard (CS) is a specification that has received significant review within an ATSC specialist group. Advancement of a document to Candidate Standard 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. The parent technology group (TSG) must approve advancement of a document to Candidate Standard status; this done by a ballot of voting members of the group. The request to issue a ballot on the ATSC-M/H documentation may happen as early as September 25, when TSG next meets.

Because the Candidate Standard phase is intended to gain real-world implementation experience, ATSC member companies are already thinking about possible steps they can take to make sure that the ATSC-M/H system functions as intended, and to identify any elements that might require additional work.

When TSG votes to elevate a document to Candidate Standard, it also sets the period of time of the CS implementation phase. While no decisions have yet been made on the CS period for ATSC-M/H, it is expected to be in the six- to nine-month timeframe. A Candidate Standard may be revised during this period, giving the specialist group the ability to address any issues that are identified during trial implementations. TSG/S4 also plans on conducting laboratory tests and field tests on the system during the CS phase. Draft laboratory and field test plans have already been developed.

TSG/S4 has divided the ATSC-M/H task into four main elements, with most of the detailed work taking place in those sub-groups. Under the ATSC structure, the sub-groups report their recommendations to the parent TSG/S4 Specialist Group, which will recommend the draft ATSC-M/H system to TSG. For ATSC Standards, balloting occurs at two levels: 1) TSG, and 2) the ATSC Membership.

The current work plan for ATSC-M/H meets the often-stated broadcaster need to announce the availability of future mobile/portable/handheld services in the first quarter of 2009. If all goes as planned, TSG will be asked to approve a ballot on an ATSC-M/H Proposed Standard by May 2009, with the ATSC process ending with final membership approval in Q3 of 2009.

Documentation

The focus of TSG/S4 right now is developing the draft specification—in ATSC parlance the Working Draft. A Working Draft is a technical document that is in development within a specialist group. Generally speaking, specialist groups create Working Drafts with the intent of advancing them along the standardization track.

In a tip of the hat to the core ATSC DTV Standard—document A/53—the final ATSC-M/H standard will be know as A/153. Like A/53, A/153 will be modular in concept, with the specifications for each of the modules contained separate Parts. As currently planned, 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 – "Presentation Framework"
Part 6 – "Service Protection"
Part 7 – "Video System Characteristics"
Part 8 – "Audio System Characteristics"

Part 1 of A/153 includes an overall system description and serves to tie the other Parts of the document together. An additional Part focusing on content protection is planned for later release.

The four TSG/S4 sub-groups have studied the various options for ATSC-M/H services and arrived at conclusions with regard to how the system should be built. They are currently focused on writing elements of the Parts listed above. The sub-groups are as follows:

- S4-1, Physical Layer Group. Led by Michael Doerr of Coherent Logix as Chair and Bruce Franca of MSTV as Vice-Chair, the Physical Layer Group is focusing on the RF, forward-error-correction, and legacy transport elements.
- S4-2, Management Layer Group. Led by Rich Chernock of Triveni Digital as Chair and Alan Moskowitz of MobiTV as Vice-Chair, the Management Layer Group is focusing on ATSC-M/H transport, signaling, announcement, streaming and file delivery, service protection, and content protection.
- S4-3, Presentation Layer. Led by Brett Jenkins of ION Media as Chair and Dakx Turcotte of Neural Audio Corporation as Vice-Chair, the Presentation Layer Group is focusing on audio coding, video cod-

ing, and image formats.

- S4-4, Systems. Led by Art Allison of NAB as Chair and Azfar Inayatullah of Sarnoff Corporation as Vice-Chair, the Systems Group is focusing on interface and project management issues.

IDOV

A unique element of the ATSC-M/H standardization work is the cooperative efforts of the Open Mobile Video Coalition (OMVC), an independent broadcast user group with a keen interest in moving ATSC-M/H forward. To support comparative evaluations of major proposed systems, OMVC conducted an Independent Demonstration of Viability (IDOV) activity, which involved testing competing systems at two locations (San Francisco and Las Vegas) on multiple full-power DTV stations. In addition to field measurement, the IDOV activity included laboratory measurements.

OMVC formed a Technology Advisory Working Group, led by Sterling Davis of Cox Broadcasting, to take the lead in coordinating the IDOV activity with the ongoing work in TSG/S4. It is important to note that the IDOV process was not a field test, as such, but instead a demonstration of the viability of various methods to accomplish ATSC-M/H services. The goal of IDOV was to see whether the proposed Physical Layer systems, in their estimation, were viable. OMVC issue a report on the findings of the IDOV activity on May 15, 2008, following conclusion of the project.

The IDOV input and discussions outside of ATSC among the various system proponents have resulted in a single Physical Layer system going forward. Because TSG/S4 has no intention of reinventing the wheel, various Parts of A/153 will reference existing standards of other standards developing organizations (SDOs). This practice not only saves valuable time in the development process, but moreover improves interoperability with other systems and devices in the field.

Get Involved

TSG/S4 is led by Mark Aitken of Sinclair Broadcast Group as Chair and Dan Borowicz of Ion Media as Vice-Chair.

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

IEEE Broadcast Technology Society Awards Program

The Broadcast Technology Society Special Service Award
Presented to individuals in recognition of special service to the Society

Matti M. Siukola Memorial Award
Presented Annually for the best paper presented at the annual IEEE Broadcast Symposium

Scott Helt Memorial Award
Presented Annually for the best paper printed in the previous years' Transactions on Broadcasting

Clyde M. Hunt Memorial Award
Presented on a discretionary basis for the best Student paper submission

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Bill Meintel
BTS Vice President and BTS Newsletter Editor
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william.meintel@mswdtv.com

Ulises A. Sanabria and the Origins of Interlaced Television Images

By James E. O'Neal, Technology Editor, TV Technology Magazine

When the long march to digital television began some 20 years ago, a goal frequently stated by some of its most ardent supporters and advocates was the elimination of interlaced video.

We are now well into the age of digital and high definition television imaging and interlace is still very much with us. It seems destined to live far beyond the February 2009 date for the cessation of full power analog television broadcasting. "Standard definition" images are (and will) remain interlaced and even the highest of the high-definition pictures available off-air (1080i) are interlaced. There's no getting away from it.

So, why did we interlace in the first place?

As the computer display people are very fond of reminding us, progressive scanning is much more logical and natural. (In the fabled tale of Philo Farnsworth's first vision of television, one of his farm chores was operating a horse-drawn harrow. According to the story, the furrows being created by the harrow gave him the idea for scanning images television-wise. If the story is true, it's rather doubtful that Farnsworth gave any thought to harrowing odd-numbered rows and then going back and pulling the harrow where the even-numbered ones were supposed to go.)

Early in the scheme of things (1920s and slightly beyond), television systems did operate in a progressive line scanning mode. Interlace came later.

Most television textbooks and histories say very little about interlacing, if it's mentioned at all. Should the subject be broached, interlacing is usually explained as a way to reduce image flicker.

Now this is, in general, a reasonable explanation and one that's hardly ever challenged. It's true that interlaced scanning does go a long way in reducing flicker. However, as most of us are aware, this advantage comes with a price attached. Unless a static scene is being transmitted, there can be a considerable difference in information contained within the two fields. This is not the best way to smoothly transmit objects in motion.

Ulises Sanabria

Randall Ballard

VIDEO COMPRESSION 80 YEARS AGO

In its strictest sense, interlaced scanning is the earliest implementation of a type of video "compression," in that it allows a doubling of resolution (number of scanning lines) without an increase in the bandwidth of the television transmission channel. However, this sort of compression must be viewed as "lossy" in that half of the lines in each video frame are omitted. It is left up the viewer's eye/brain to perform the "decompression" through persistence of vision."

Trying to assign credit for the precise origin of interlaced scanning is somewhat difficult.

Should a name be associated with it, it's almost always that of the Radio Corporation of America's Randall C. Ballard.

Ballard was a talented engineer who very actively participated in RCA's program to roll out electronic television in the 1930s. And yes, he was granted a U.S. patent (no. 2,152,234) which incorporates interlacing principles.

However, in spite of the patent (which is simply titled "Television System"), Ballard was not the first to demonstrate—or even propose—interlaced scanning of television images.

Television historian R.W. Burns, in his very comprehensive work "Television: an international history of the formative years," recognizes the Ballard patent, but also cites prior art patents by Marius Latour and John L. Baird. Burns credits Latour with using the term "interlacing," while Baird settled for the much less euphonious "intercalation" to describe non-sequential scanning.

Adding to the confusion, Burns also mentions that one form of non-progressive scanning dates from 1914. (No inventor is named, but Samuel L. Hart was issued a British patent for "Improvements in Apparatus for Transmitting Pictures of Moving Objects and the like to a distance Electrically" at about that time. While this patent does describe a form of scanning, it is not directly apparent that interlacing of lines is considered.)

Burns also lists the Telefunken Company, Manfried von Ardenne, along with W.S. Stephenson and G.W. Walton, as having proposed "non sequential" scanning prior to Ballard's patent.

Such a wealth of information makes it all that more difficult when attempting to correctly place the laurel wreath in honoring an inventor.

However, Burns hesitates but little in turning the spotlight on Ballard, stating that his invention was the basis for the electronic scanning systems used by both RCA and EMI.

Burns is strangely silent with regard to another American television innovator, Ulises A. Sanabria.

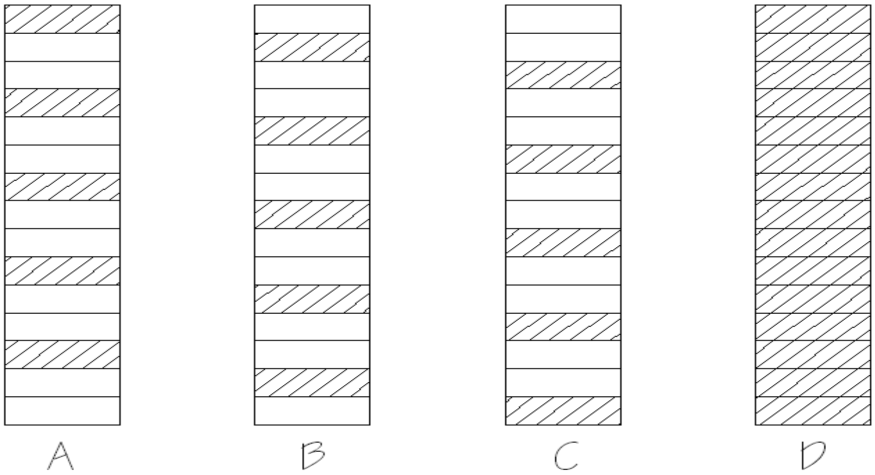


Fig. 1: Drawing adapted from Sanabria's patent illustrating the line pattern resulting from his three separate sets of apertures on his scanning disk. The completed 15 line image or field is illustrated in column D.

TELEVISION PIONEER ULISES A. SANABRIA

Sanabria was a largely self-taught American television pioneer. Something of a whiz-kid, he was hired, while still in high school, by Hearst Newspapers to work on construction of a television system in his home city of Chicago. This was in 1925. He succeeded in developing a mechanical television system, independent of the work of others in the field at the time such as Baird, Ives and Jenkins.

At this point, it's interesting to examine a patent (no. 805,848) that was issued to Sanabria on May 19, 1931. Sanabria had applied for the patent approximately two years earlier. His invention is titled "Method and Means for Scanning."

The patent contains a full disclosure for interlaced television scanning, including a figure of temporally separated individual television lines and the compilation of them into a full television image. (Fig.1)

Curiously, the patents of both Sanabria and Randall do not address reduction of television image flicker as the primary goal of their inventions.

In his patent preamble, Sanabria recognizes what he terms "memory" in electrical circuits that have a finite frequency response and that are associated with video generation. This memory effect is something that today would probably best fall under the headings of slew rate or hysteresis.

Sanabria, writing in 1929, states, "It is well known that all electrical circuits exhibiting selective frequency characteristics possess a certain amount of electrical inertia, that is any certain wave form must be repeated a certain number of times in order for this inertia to be overcome and the transient to disappear, thus permitting the signal to reach an optimum. (sic)"

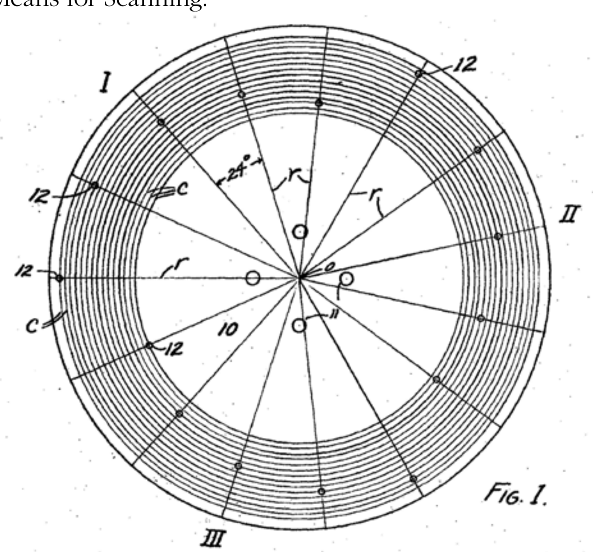


Fig. 2: Sanabria's patent drawing showing the three sets of scanning apertures

The inventor went on to say that the electrical signal repetition created by the television scanning process overcomes the "inertia" and permits signals "to build up sufficiently to effect the selective qualities of an electrical circuit," thus causing "undesirable interference due to the widening of the so-called side-bands."

From this, it is evident that the main thrust of Sanabria's invention was in minimizing sideband generation.

"I propose to eleminate (sic) this objectionable interference caused by the side-bands by interposing dissimilar wave forms so that no particular wave form will be repeated a sufficient number of times to overcome the inertia of the circuit having selective frequency characteristics, therefore, a signal is not permitted to build up to sufficient strength to be a factor within the range of practical perceptibility."

Sanabria proposed to accomplish this by using a scanning disk with three "offset" sets of holes for generating "pencils of light" to "sweep over the image or picture surfaces." (Fig. 2)

Such a scanning system would generate a 3:1 interlace.

Ballard, while expressing the advantages of bandwidth reduction in transmission (reflecting in a way Sanabria's desire to eliminate sideband energy), principally addresses the transformation of 24 frame-per-second (fps) motion picture film images to a frame rate better suited for television. (It should be noted that the television frame rate that Ballard was striving for in 1932 was 16 fps, not the 30 that came later. In his patent application Ballard says that the 16 fps rate was driven by the "retentivity of fluorescence" in the cathode ray tubes being used as display devices, something today we would refer to as phosphor decay time.)

MECHANICAL SCANNING

Despite using a CRT as a display device, Ballard, just as Sanabria had, relied on a mechanically rotated disk for scanning of images. (Fig. 3). At the time of Ballard's work, RCA's Vladimir Zworykin had not yet perfected his iconoscope pickup tube to the point that it was useful for transmitting either live or film images.

The holes in Ballard's scanning disk, unlike that of Sanabria, are not arranged as a spiral, as the linear motion of the film being pulled through the "projector" gate provides the vertical component of the scan. (The second set of apertures in Ballard's disk are used for generation of synchronizing pulses; one per line for horizontal sync and two larger apertures (slits) per rotation to generate field identification pulses.

In his patent, Ballard explains the concept of a two field per frame image and the interlacing of even and odd sets of scanned lines. This is illustrated in the patent with a drawing very reminiscent of those seen in later textbooks for explaining the interlacing principle. (Fig. 4). The major difference is that Ballard's is based on a much less detailed (approximately 80 line) image.

SIMILARITIES

In principle, the patents of Sanabria and Ballard are very similar. Both mention the reduction of flicker, yet this is not the primary reason for their inventions. Both are concerned with conserving occupied bandwidth—Sanabria possibly more so than Ballard. A major difference in the two patents is that Ballard's imaging takes place in a cathode ray tube, rather than via a scanning disk and an intensity modulated lamp. Ballard's television system is slightly more sophisticated too, in that it contains a means for generation of both horizontal and vertical synchronizing information.

It's obvious that Sanabria preceded Ballard by more than three years in applying for his interlace patent. Ballard's patent was granted nearly eight years after that of Sanabria.

So, who is really the father of interlaced television imaging?

Perhaps the real significance of an invention occurs when it can be reduced to practice.

By that metric, credit should be given to Ulises Sanabria, as he got there before Ballard. Sanabria publically demonstrated 3:1 interlaced scanning at a June 1928 radio manufacturers' trade association show held in Chicago. This event was covered in Hugo Gernsback's "Television News" magazine:

"One of the newer developments of these enterprising inventors takes the form of specially perforated discs, each disc containing three spirals of holes. In this fashion each disc scans the picture three times in one revolution and the scanning is not the usual sequence one, two, three, four, etc., but one, four, seven—for example. The second spiral of holes scans paths two, five, eight, etc., the third spiral three, six, nine, etc. It is claimed that much better definition and detail are obtained in this way."

The New York Times also reported on that trade show and mentioned that U.A. Sanabria was responsible for presenting a working television system to attendees.

"The demonstration of television was made this morning at the Federation

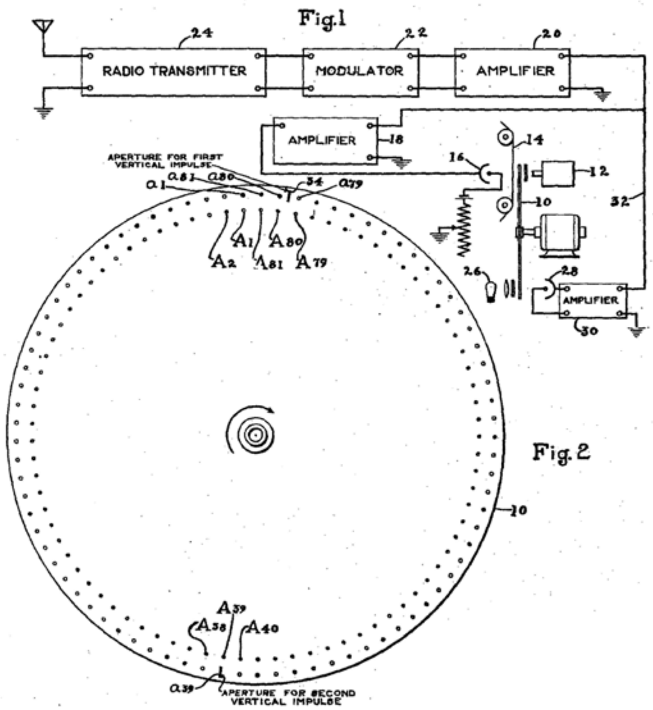


Fig. 3: Ballard's patent drawing illustrating the disk with dual set of holes for mechanically scanning 35 mm film

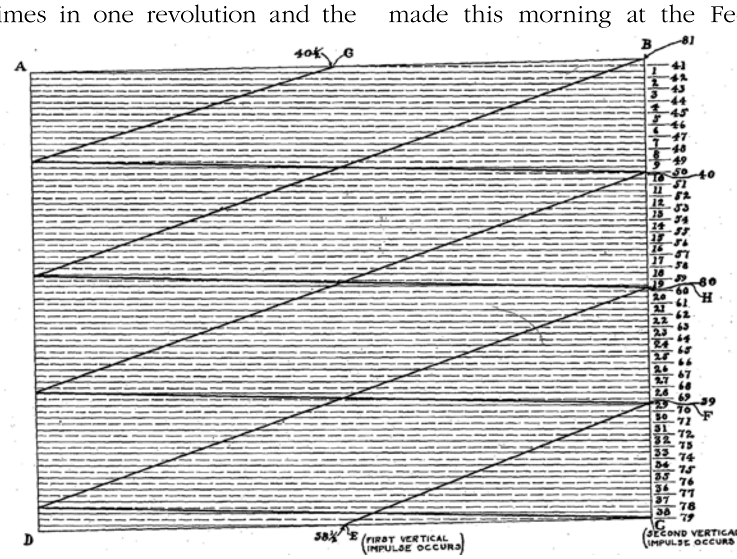


Fig. 4: Scan pattern from Ballard's patent depicting two 40 line scans being combined into a single 80 line television frame

of Labor Radio Tower at Navy Pier by the Chicago inventor of the apparatus. It was attended by Edward H. Nockels, Secretary of the Chicago Federation of Labor, and a score of radio men attending the radio show.

"The demonstration was under the supervision of U.A. Sanabria, inventor, his assistant M.L. Hayes, and Virgil A. Schoenberg."[1]

From this it's obvious that Sanabria preceded Ballard in demonstrating interlaced television, and there appears to be no evidence that any of the other inventors mentioned by Burns succeeded in reducing the concept to practice prior to Sanabria.

Little mention is made of Sanabria in television histories, yet for a time in the 1920s and early 1930s, a large part of television activity in Chicago centered around him.[2]

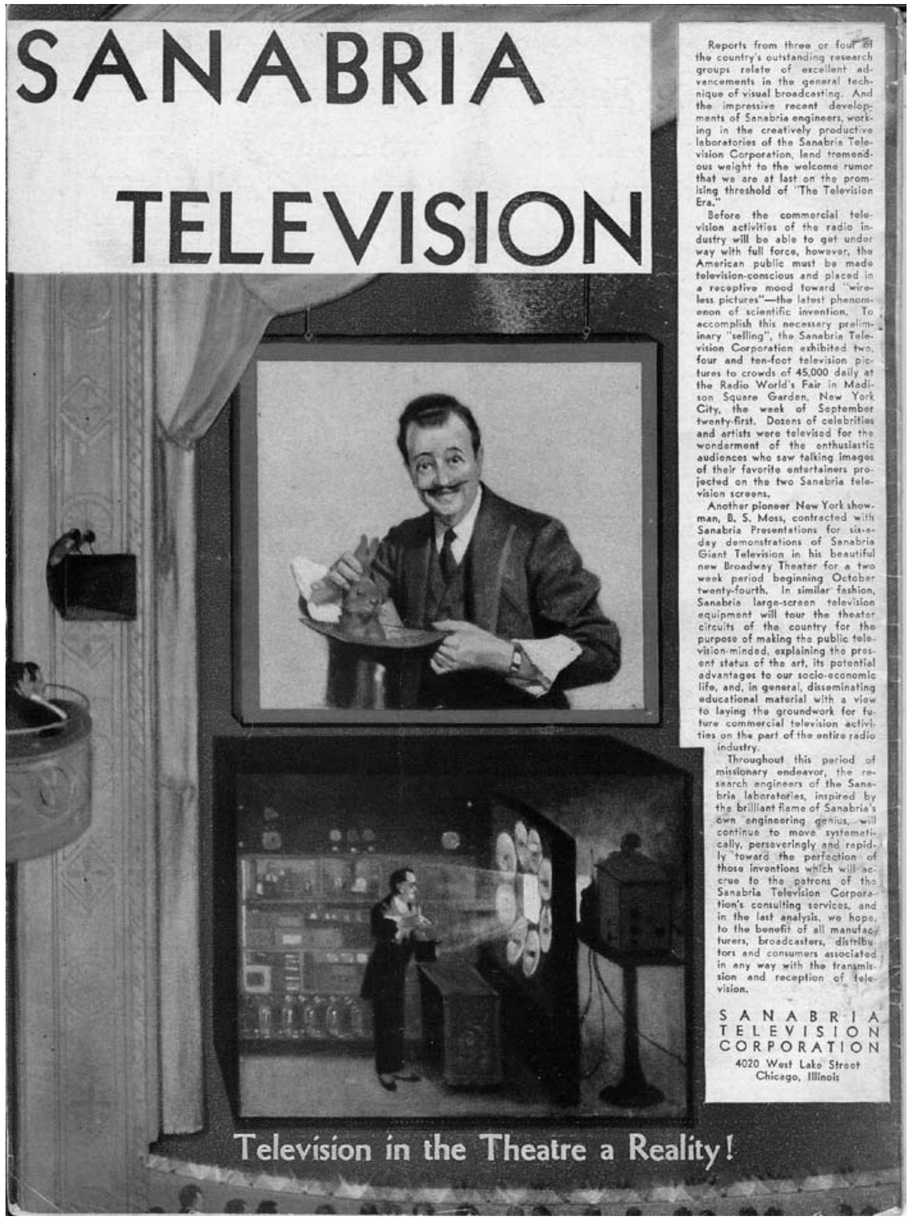
Sanabria later founded a television training institute and was employed by Dr. Lee de Forest, the inventor of the vacuum tube. Sanabria was a member of the first NTSC (convened in 1940) to set standards for U.S. television broadcasting. He was also a pioneer in constructing and demonstrating large screen television display systems. Sanabria was awarded several patents and spent his entire career in television-related work.

Acknowledgment:

The author wishes to acknowledge the assistance of Mark Schubin, television authority, historian and writer in the preparation of this article.

The author wishes to thank the David Sarnoff Library for providing the photograph of Randall C. Ballard.

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



This full page ad appeared in the March-April 1932 issue of Television News Magazine. Sanabria's company was already touting a large screen video display.

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1 "Television Method Shown in Chicago," New York Times, June 13, 1928, p. 32.

2 "Early Chicago Television," from an article written by William N. Parker in 1984 and appearing in the Antique Wireless Association's "The OTB" for August 2003; vol. 44, no. 3, p. 15.

The Irregular Terrain Model (ITM) Averaging System

By Sid Shumate, Givens & Bell

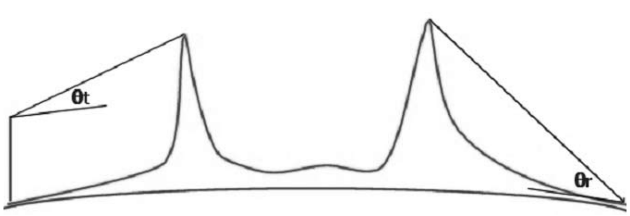
In this article, I continue to provide a conceptual overview of Longley-Rice not found in the NTIA documentation that I started in the Summer Newsletter article. Previously, I mentioned the ITM averaging system; in this article, as promised, I will describe it, while continuing to compare the original Longley Rice (L-R) Tech Note 101 (TN101) methodology to the simplified methodology in the Irregular Terrain Model (ITM) software implementation.

There are two main reasons for the ITM averaging system. The first affects the TN101 methodology, and therefore also the ITM. Summarizing from the previous article:

a. The obstruction diffraction computations are not valid close to an obstruction, where the grazing angle (see Fig. 1; the angle between the antenna to obstacle line, and the ground) becomes more than 0.2 radians, about 11 degrees. The inability to compute losses close to an obstruction is a major problem when attempting to run a terrain loss profile, when the receive site approaches, passes over, and proceeds down the far side of an obstruction into the valley beyond.

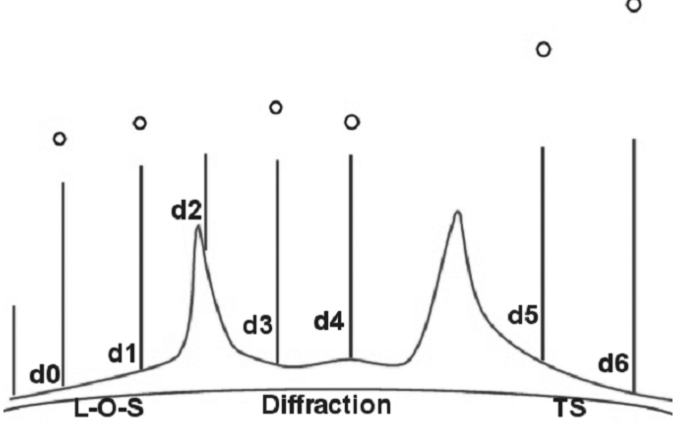
b. The inability of the ITM (as compared to TN101) to compute diffraction for a single obstacle. Two obstacles are OK, but for just one, the computation in subroutine *alos* attempts to divide by zero, resulting in a non-a-number result.

Fig. 1; Grazing Angles



The ITM attempts to get around these problems by using an averaging system. Here is how it works (refer to Figure 2.)

Fig. 2; Determining Seven "Good" Points



First Steps in the ITM Averaging System

The averaging process starts by selecting at least three, and up to seven, good calculation points along the path from the transmitter to the terrain path receive point selected, depending upon the length of the path to the selected point. See Fig. 2. The distances d5 and d6 are computed if the path length is greater than distance *dlsa*. The distance *dlsa* is the sum of the theoretical smooth earth transmitter-to-transmitter-horizon distance, and the theoretical smooth earth receiver-to-receiver-horizon distance. For an average FM transmitter height above average terrain, the distance can easily exceed 30 km, and is normally well into the actual diffraction range.

The points designated d0 and d1 are in the line-of-sight range. The point d2 is past the transmitter horizon point, which can be a smooth earth horizon or the tallest obstacle "visible" to the RF signal from the transmitter, and is initially set to be equal to the distance dlsa. The point d3 can be at or after point d2. Points d3 and d4 are therefore well into the "diffraction" range. Points d5 and d6 are in the "Tropospheric scatter" ("scatter") range. All points except d2 are selected to be far enough away from obstacles to meet the requirement that the grazing angle be less than 0.2 radians.

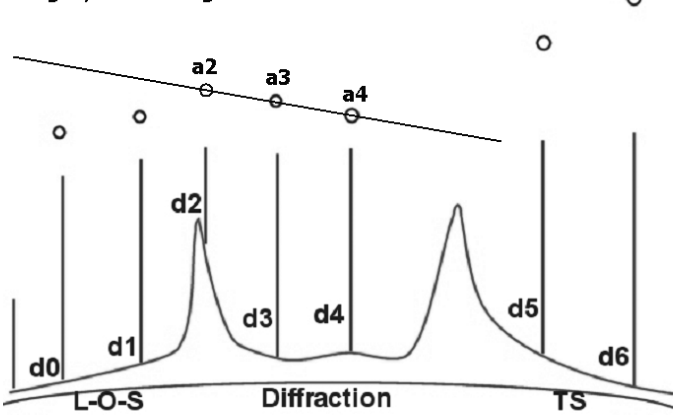
On The ITM Averaging System in the Line of Sight (LOS) Range

Despite the printout reports generated by the newer subroutine *point_to_point* (1982), the older subroutine *lrprop* where the calculations are actually done, (and which is mostly a consolidation of subroutines found in the ESSA ITS-67 report from 1968), does not, in fact, allow consideration of diffraction over obstacles until the path distance equals or exceeds the distance *dlsa*.

Calculating the Diffraction Loss Line

The subroutine *lrprop(longley-rice propagation)* calls subroutine *adiff (attenuation due to diffraction)* to compute the diffraction loss a3 at point d3, and then the diffraction loss a4 at point d4. Subroutine adiff does recognize and compute the diffraction losses based on diffraction over the highest obstacle or horizon "visible" to the radio signal emitted by the transmitter antenna, and over the highest obstacle or horizon visible to the receive antenna. The restriction is that there must be two obstacles for the ITM diffraction computations to function properly. The diffraction loss results are a weighted mix of knife-edge and rounded-edge computation. In Fig. 3, the loss values are represented by circles above the calculation point. Subroutine *lrprop* then computes a line formula (of the form x = a + by) for a diffraction loss line passing through a3 and a4, and determines the loss value a2 at point d2 by solving the diffraction loss line formula for the distance d2.

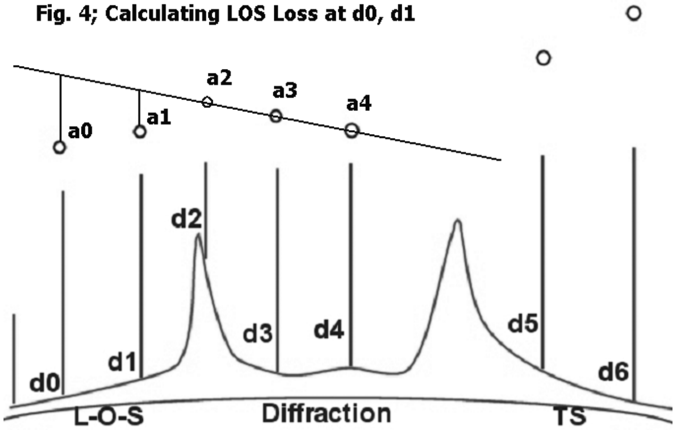
Fig. 3; Calculating Diffraction Loss Line



Calculating the Line-of-Sight Losses

Subroutine *lrprop* then calls subroutine *alos (attenuation in the line-of-sight)* twice, first to compute the loss at d1, and then at d0. See Fig. 4. Subroutine *alos* computes the loss at d1 using a weighted combination of two-ray multipath cancellation loss and the (so-called "terrain diffraction") diffraction loss at d1, the result of solving the diffraction loss line at point d1, indicated by the vertical line between the "diffraction loss" line and loss result circle a1. The weighting factor is determined by multiplying the terrain irregularity factor, delta h, (aka variable *dh*), by the frequency, and divided by the length of distance *dlsa* if *dlsa* is more than 10 km. On the second run, *alos* computes the loss a0 at point d0 in the same way it computed a1.

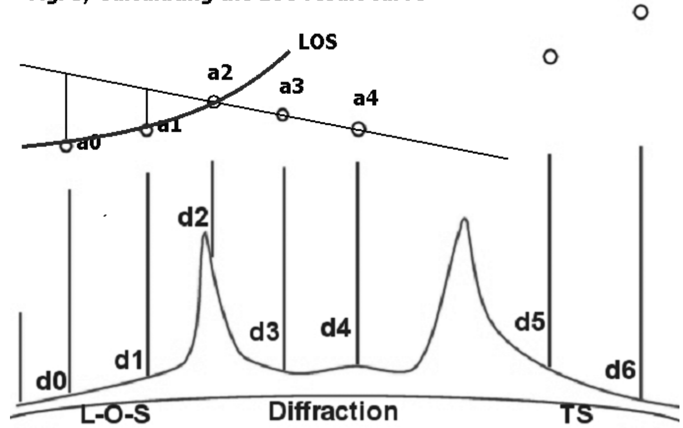
Fig. 4; Calculating LOS Loss at d0, d1



Subroutine *lrprop* then will normally use the loss values at a0, a1 and a2 to compute a curved line formula, the solved results of which are shown as the curved LOS line in Fig. 5. If any of the values derived from a0, a1 and a2 are out of the acceptable parameter ranges, the subroutine will fall back to values taken from the diffraction line formula.

If the path length is less than distance *dlsa*, the answer for the terrain point selected is taken from solving the LOS curve formula for the terrain point path distance.

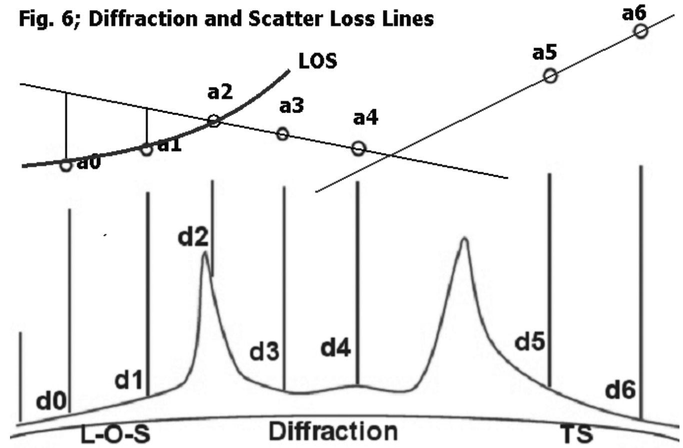
Fig. 5; Calculating the LOS result curve



Calculating the Diffraction and Troposphere Range Losses

If the path distance exceeds the distance *dlsa*, the subroutine *lrprop* calls subroutine *ascat (attenuation from scatter)* to compute the Tropospheric scatter (scatter) losses a5 and a6, at distances d5 and d6. The distance variable *dx*, represents the distance at which the diffraction losses are greater than the scatter losses, i.e. the point where the results used change from the diffraction results to the scatter results. A straight line formula for the scatter loss, similar to the diffraction loss line formula, is then calculated, with one modification; this modification makes the results match the diffraction results at the crossover point, located at distance *dx*. This scatter loss line is shown in Fig. 6.

Fig. 6; Diffraction and Scatter Loss Lines



If the path distance is between *dlsa* and *dx*, the results are found by solving the diffraction line formula for the path distance. If the path distance is greater than *dx*, the results are found by solving the scatter line formula for the path distance.

For illustration purposes, the diffraction line is shown tilting down to the right; in most cases, the LOS curve, diffraction line, and scatter line, if they are terminated at the crossover points at *dlsa* and *dx*, will form a continuous, rising curve from left to right.

To these results, the Free Space Loss is then added to obtain the full value of the attenuation losses. For display purposes, the wrap-around software used to provide inputs and process outputs from the ITM subroutines, then computes the field strength values.

Highly Averaged Results

Therefore, results in the LOS range are taken from a highly averaged smooth curve that does not take into account any obstructions, and is based on two-ray multipath computations made at two points (of which rarely is either point the location being considered) in the line-of-sight range, combined with estimated diffraction values based on diffraction losses computed beyond the horizon. If the terrain roughness factor is of average roughness (90 m. preset average) to very rough, the multipath contribution will have faded toward zero, and all LOS results are estimated based on diffraction results from well into the diffraction range, past the horizon.

Results in the diffraction range and scatter are at least based on consideration of obstructions, but they are again based on computations made at two points (of which rarely is either point the location being considered).

It appears that the point_to_point subroutine was added in 1982, either without a full realization of, or simply ignoring the fact, that the older *lrprop* and associated subroutines required major revisions and upgrades to provide computational support for position-accurate L-R signal loss predictions that fully considered obstructions. The reports exported by the point_to_point subroutine infer that the ITM does fully condsider terrain obstructions in the line-of-sight and early diffraction ranges when in fact it does not.

To provide positional accuracy and fully consider obstructions will require major modifications and upgrades to allow the elimination of this averaging system, and the computation of losses based on actual terrain conditions found at an individual point.

As a result, the results obtained have little, if any, accuracy with respect to a single chosen location. They are averaged estimates based on a very few sample loctions chosen along a terrain profile path. The response observed in the line-of-sight range that appears to be terrain-related is, in fact, a delayed, weak response resulting from variations in the computed terrain irregularity factor (delta-h, or dh) and its effect on the multipath and diffraction calculations, which I will discuss in the next article.

IPTV Standard Development at the IUT-T

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In recent years, IPTV service has been deployed or is to be deployed in many countries. Various regional organizations have already accomplished a lot of work on IPTV. Many ITU-T study groups have done work or have ongoing work on IPTV related topics. Given that IPTV is becoming an increasingly important service in the market, and that more and more ITU-T Members are facing challenges from technical as well as regulatory issues, ITU-T has received proposals to strengthen its work on IPTV standardization. As a matter of fact, some ITU-T study groups have received input contributions on IPTV. There is an obvious urgent need to increase the international effort on various issues, in particular, interoperability and gap analysis of IPTV standards. Since late 2005, ITU-T Study Group Chairmen have studied possible measures to take care of the IPTV study within ITU-T, including coordination with other Standardization Developing Organizations (SDOs). ITU is an excellent place to initiate, coordinate and harmonize global activities for IPTV standards. During the TSB director's consultation meeting on IPTV standardization [1], the consensus had been reached to support the TSB Director to create, according to ITU-T Recommendation A.7 [2], a focus group, the IPTV Focus Group (FG IPTV).

The Mission

The mission of FG IPTV was agreed during this TSB director's meeting [1] as:

"The mission of IPTV FG is to coordinate and promote the development of global IPTV standards taking into account the existing work of the ITU study groups as well as Standards Developing Organizations, Fora and Consortia."

As a starting point, the following goals of FG IPTV were developed:

- Definition of IPTV
  - Identification of scenarios, drivers and relationships with other services and networks
  - Identify requirements and define framework architecture
- Review and gap analysis of existing standards and ongoing works
  - Identification of opportunities for ITU-T
  - Identification of activities that ITU-T would encourage other organizations to pursue
- Coordination of existing standardization activities
- Harmonization of the development of new standards
- Encourage interoperability with existing systems where possible

Participating Members

According to ITU-T Recommendation A.7, FG IPTV opens to ITU member states, sector members and associates, it also opens to any individual from a country which is a member of ITU who wishes to contribute to the work (this includes individuals who are also members of international, regional and national organizations).

Working groups (WGs) and Mandates

The first FG IPTV meeting was held from 10 to 14 July 2006 in Geneva, Switzerland. From July 2006 until December 2007, a total of seven meetings were held. The FG IPTV separated its tasks into six areas corresponding to six Working Groups (WGs). Significant progresses have been made in the following six areas. Each area has produced enriched documents covering most of the IPTV worldwide development efforts:

- Architecture and requirements (WG1)
  - IPTV services requirements [3]
  - IPTV architecture [4]
  - IPTV service scenarios [5]
- QoS and Performance Aspects (WG2)
  - Quality of experience requirements for IPTV [6]
  - Traffic Management Mechanisms for the Support of IPTV Services [7]
  - Application layer error recovery mechanisms for IPTV Services [8]
  - Performance monitoring for IPTV [9]
- Service Security and Content Protection (WG3)
  - IPTV security aspects [10]
- IPTV Network Control Aspects [11] (WG4)
  - IPTV multicast frameworks [12]
  - IPTV Related Protocols [13]
- End Systems and Interoperability Aspects (WG5)
  - Aspects of IPTV end system – Terminal device [14]
  - Aspects of home network supporting IPTV services [15]
- IPTV middleware, application and content platforms [16] (WG6)
  - Toolbox for content coding [17]
  - IPTV middleware [18]
  - IPTV metadata [19]
  - Standards for IPTV Multimedia Application Platforms [20]

The mandate of WG 1 is to define service, user and architectural requirements and framework architecture, considering existing IPTV services and solutions by examining deployed scenarios and use cases based on classical IPTV and VoD uses, but also exploring domains such as NGN where more interactivity is required and where interaction with external services is a necessity.

Study items of WG1 include, but not limited to:

- Identification of use cases and architectural requirements from existing IPTV services and deployed solu-

tions and their interoperability requirements with additional services
- Identification of new use cases and service definitions
- Performing a gap analysis between use cases and existing standards
- Identification of requirements from NGN and /or other services where relevant
- Definition of a framework architecture
- Definition and Requirements for IPTV services
- Network and Service Architectures of IP TV including step-wise evolution scenarios

The mandate of WG 2 is to champion and promote the development of global QoS and performance standards necessary to ensure high end-user satisfaction, and hence high end-user acceptance, for IPTV services.

Study items of WG2 include, but not limited to:
- Identify and assess the suitability of existing material relating to end-to-end QoS and QoE for IPTV, including the following aspects:
  - End-user performance expectations, including those for users with disabilities, and associated metrics for audio/video quality and control functionality
  - Performance implications of content coding
  - Network transport and QoS mechanisms
  - Unicast and Multicast performance
  - Signalling performance
  - QoS/QoE monitoring methodologies
  - Traffic management considerations (e.g. admission control, priority, etc.)
  - Reducing the impact of traffic impairments (e.g. packet loss, bit errors)
  - Reliable service delivery and network operation
- Identify areas where further work is needed, and coordinate and harmonize activities in ITU-T, other SDOs and Fora and Consortia. For reasons of expediency, specific items may be addressed (at least initially) within the WG

The mandate of the WG3 is to provide a focus, within the FG IPTV, on the urgent needs for globally accepted IPTV security standards as the market demands.

This WG defines the security architecture, identify and if necessary initiate the development of the security mechanisms and interface specifications for IPTV, which will satisfy the business & security requirements and align with the IPTV system architecture.

Study items of WG3 include, but not limited to:
- Analyze the security threats
- Describe the security requirements
- Identify the security architecture, trust models, function modules and interfaces
- Identify the authentication, authorization, content protection and other security signal process mechanisms
- Identify and initiate the development of the security interface specifications

Security areas cover content security (e.g. digital rights management, content protection and conditional access); subscriber security (e.g. authentication, authorization); network, IPTV service infrastructure and end-user device security (e.g. authentication, authorization); service security (e.g. authorization).

WG4 focuses on following areas:
- Naming, addressing, and identification aspects (e.g. identification mechanism of source or distributor for IPTV)
- Control and signaling mechanisms (e.g. multicast/unicast and distribution control function, admission and attachment control function, resource control function, mobility control functions as well as session and service control function)
- Content distribution and data plane aspects. These include network protocols and mechanisms to support non-real time and real-time delivery of content and information in support of IPTV applications
- Access & home network issues: functions and signaling that may be required for IPTV that depends on home, access and home network technologies being used
- Related issues
  - Various access and core transport scenarios for multicasting
  - Interface protocols of UNI, NNI, and SNI where identified by architecture
  - Multicast VPN including multicast group management
  - Interworking aspects of Multicasting under heterogeneous environments
  - Control signaling for QoS/QoE

Areas of study of WG5 include:
- IPTV end system implementation scenarios and Applications:
  - The relationship between IPTV end system & home network (i.e., integrated television, set-top-box, media center PC, etc.), and what services are supported by IPTV end system
- Terminals:
  - Test/interoperability – procedures/criteria for potential independent testing facility to verify performance/conformance to appropriate standards.
  - Investigate basic functional architecture of the IPTV terminal.
- Remote management:
  - Scope how remote management (services/content) is authorized/requested by the consumer in a vertical (OEM) and horizontal. (Retail) markets– and the relationship with the provider. Collaboration with other appropriate SDOs will be imperative. Important investigation will be whether or not remote management be access network agnostic/service provider agnostic.

The mandate of WG6 is to identify and define middleware platforms, including applications, content formats, and their uses, that facilitate effective and interoperable use of an IPTV system for presenting and interacting with IPTV services.

For WG6, the aspects of service which are particularly relevant are discovery, navigation, selection, acquisition, delivery and presentation including interaction, of content.

Examples of these aspects include:

- Metadata, i.e. the descriptive data about content
- Content navigation applications, such as IPG and enhanced EPG
- Navigation, channel and menu processing,
- Content discovery
- Content presentation and execution engines
- Digital broadcasting middleware (DBM)
- Audio and video coding

Major Developments

Definition of IPTV

Consensus was reached during the first FG IPTV meeting on the IPTV definition [21]:

"IPTV is defined as multimedia services such as television/ video/ audio/text/graphics/data delivered over IP based networks managed to provide the required level of QoS/QoE, security, interactivity and reliability."

Advantages and Challenges of IPTV in the Competition

The advantages and challenges of IPTV reside in the differences between existing broadcasting TV, cable TV and satellite TV [22]. IPTV differentiates from traditional broadcasting TV in many ways. Table I lists some major differences between these two services.

Table I. Comparisons between traditional broadcasting and IPTV

Traditional broadcasting TV	**IPTV**
Service not guaranteed	Guaranteed QoS/QoE
One way	Two-way (interactive)
Simultaneous channel streams	Selected channel bundles
All content flow downstream	Contents remain in network
No management	Managed DRM, billing, etc.

Comparing with existing cable TV and satellite TV, IPTV distinguishes itself with full interactivity, high personalization and flexibility as shown in Table II.

Table II. Comparisons between cable TV, satellite TV and IPTV

Cable TV	Satellite TV	**IPTV**
Limited interactivity	None	Full interactivity
Limited user centric (VoD)	Not user centric	User centric (PVR, NPVR, VoD)
Broadcast carries all channels all the time	Broadcast carries all channels all the time	Broadcast carries only channels being watched at given time
Limited content	Limited content	Unlimited content

IPTV is not TV that is broadcasted over the Internet. There are actually confusions between Internet TV and IPTV. Table III illustrates a comparison between the two.

Table III. Comparisons between Internet TV and IPTV

Internet TV	**IPTV**
Potentially supranational or worldwide	Local (limited operator coverage)
PC oriented (file transferring)	TV oriented (real time)
Depend on coding	Real SDTV/HDTV
High level viewer involvement	Low level viewer involvement
Best effort quality, QoS not guaranteed	Controlled QoS, "broadcast" TV quality
PC	Set-top box with a television display
Unsafe	Users are authenticated and protected
Content usually is unprotected	Media is protected
Any users (generally unknown)	Known customers with known IP addresses and known locations

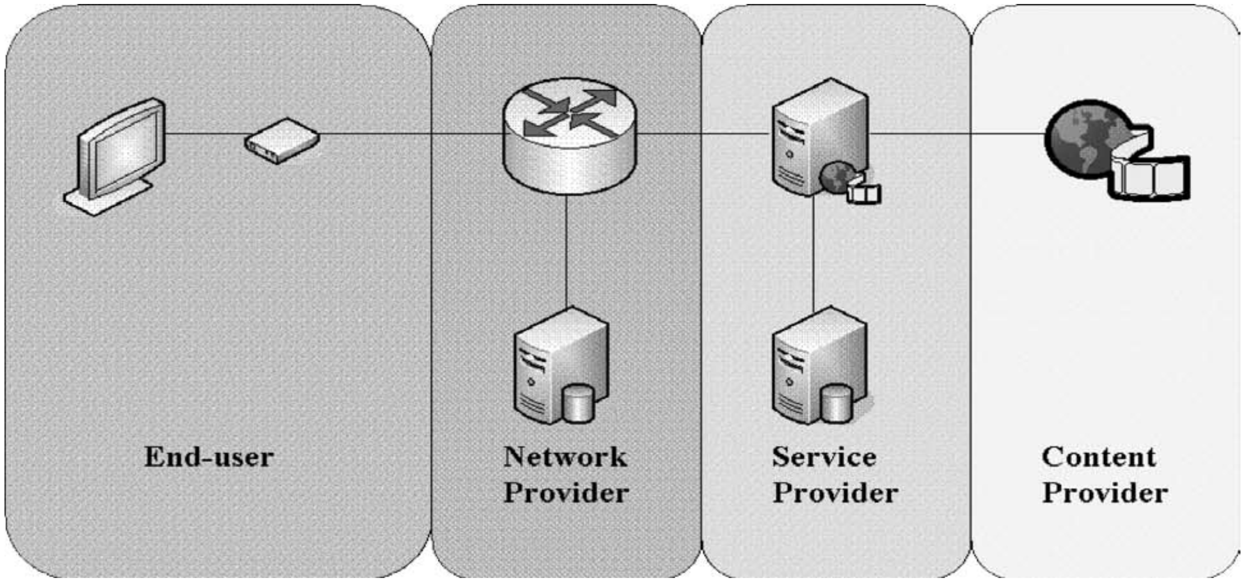

Figure 1: IPTV Domains

IPTV Domains

Four IPTV domains are identified (illustrated in Figure 1):

- **Content Provider**: The entity that owns or is licensed to sell content or content assets.
- **Service Provider**: A general reference to an operator that provides telecommunication services to customers and other users either on a tariff or contract basis. A service provider may or may not operate a network. A service provider can optionally be a customer of another service provider.
- **Network Provider**: The organization that maintains and operates the network components required for IPTV functionality. A network provider can optionally also act as service provider.
- **End User**: A human being, organization, or telecommunications system that accesses the network in order to communicate via the services provided by the network.

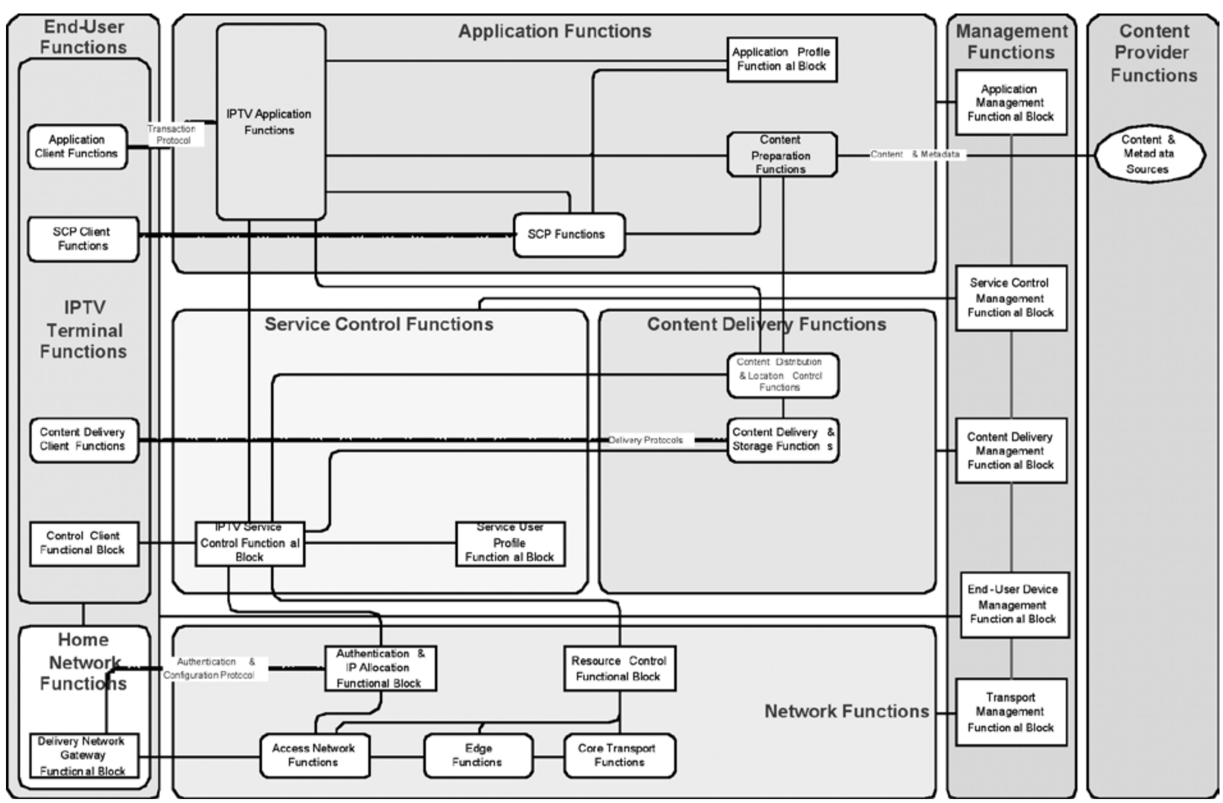

Figure 2: IPTV Architectural Overview

IPTV Architectural Approaches

Three IPTV architecture approaches are identified that enable service providers to deliver IPTV services:

- **Non-NGN IPTV functional Architecture (Non-NGN IPTV)**: This architecture is based on existing IPTV network components and protocols/interfaces. The technology components, protocols and interfaces used in this IPTV architecture are already in widespread use and hence this approach is a representation of typical existing IPTV networks and services. This architectural approach may be used as the basis for evolution towards the other IPTV architectures listed below.
- **NGN-based non-IMS IPTV Functional Architecture (NGN-Non-IMS IPTV)**: This architecture utilizes components of the NGN framework [23] reference architecture as identified in [24] to support the provision of IPTV services, in conjunction with other NGN services if required.
- **NGN IMS-based IPTV Functional Architecture (NGN-IMS-IPTV)**: The NGN-IMS based IPTV architecture utilizes components of the NGN architecture including the IMS component [25] to support the provision of IPTV services, in conjunction with other IMS services if required.

IPTV Functional Architecture Overview

Figure 2 provides an overview of the IPTV functional architecture. Functions and functional blocks described in this clause are common to all architectural approaches.

- **End-User Functions**: The end-user functions are comprised of IPTV Terminal Functions and the Home Network Functions.
    - IPTV Terminal Functions (ITF) are responsible for collecting control commands from the end-user, and interacting with the Application Functions to obtain service information (e.g. EPG), content licenses, and keys for decryption. They interact with the Content Delivery Functions to receive the IPTV services. They also provide the capability for content reception, decryption, and decoding.
    - Home Network Functions provide the connectivity between the external network and each IPTV terminal device. These functions include IP connectivity, IP address allocation and configuration from the Network Functions to the IPTV terminal devices. All data, content, and control traffic must pass through the Home Network Functions in order to enter or exit the end-user's IPTV Terminal Device. The Home Network Functions serves as the gateway between the IPTV Terminal Functions and the Network Functions.
- **Application Functions:** The application functions are comprised of the following Functions and Functional Blocks:
    - **IPTV Application Functions** provide the server side functions of the IPTV applications. One of the roles of these functions is to allow the IPTV terminal functions to select, and purchase if necessary, content.
    - **Application Profile Functional Block** stores the profiles for the IPTV Applications.
    - **Content Preparation Functions** prepare and combine the content such as VoD programs, TV channel streams, metadata, EPG data, as delivered by the content provider functions, into the required delivery format.
    - **Service & Content Protection (SCP) Functions** control the protection of the services and content. Content protection includes control of access to content and the protection of content using methods such as encryption. Service protection includes authentication and authorization of access to services and optionally protection of the services using methods such as encryption.
- **Service Control Functions**:
    - **IPTV Service Control Functional Block** provides the functions to handle service initiation, modification and termination requests, perform service access control, establish and maintain the network and system resources required to support the IPTV services requested by the IPTV terminal functions.
    - **Service User Profile Functional Block** is used for storing service profiles and generating responses to queries for service profiles. It also performs basic data management and maintenance functions.

• **Content Delivery Functions**: The content delivery functions receive content which was sent from the content preparation functions and deliver it to the end-user functions using the capabilities of the network functions. The content delivery functions are comprised of the two functions: (1).Content Distribution & Location Control Functions, (2).Content Distribution & Storage Functions.

• **Network Functions:** The network functions are shared across all services delivered by IP to end-user functions. They provide the IP layer connectivity in order to support IPTV Services.

- **Authentication & IP Allocation Functional Block** provides the functions to authenticate the delivery network gateway functional block which connects to the network functions, as well as allocation of IP address to the IPTV terminal functions.
- **Resource Control Functional Block** provides control of the resources which allocated for the delivery of the IPTV services through the access network, edge and core transport functions.
- ***Access Network Functions*** are responsible for (1) aggregating and forwarding the IPTV traffic sent by the end-user functions into the edge of the core network and (2) forwarding the IPTV traffic from the edge of the core network towards the end-user functions.

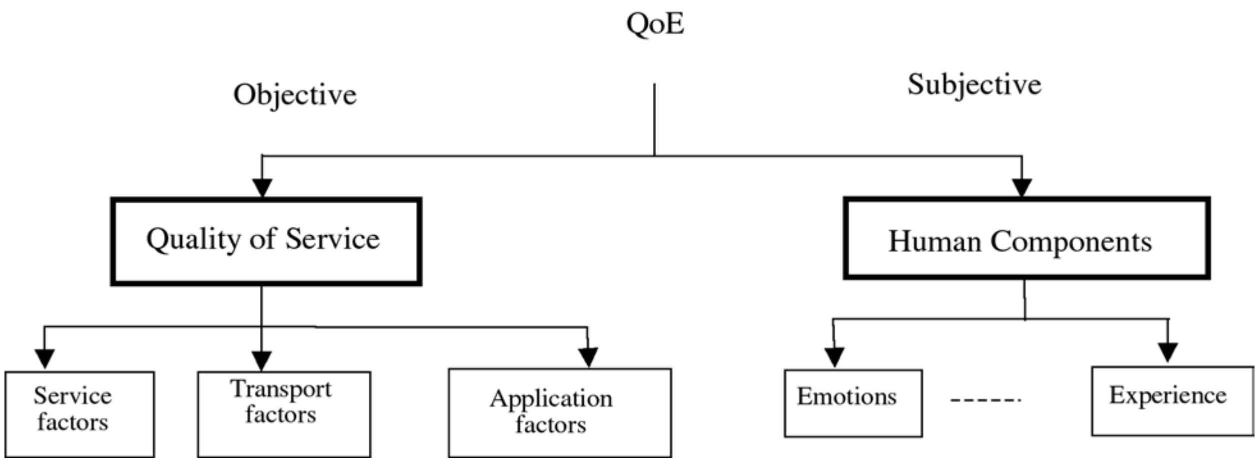

Figure 3: QoE Dimensions

- **Edge Functions** are responsible to forward the IPTV traffic aggregated by the access network functions towards the core network, and also to forward the IPTV traffic from the core network to the end-user functions.
- **Core Transport Functions** are responsible for forwarding IPTV traffic throughout the core network.

- **Management Functions:** The management functions manage overall system status. This set of functions may be deployed in a centralized or distributed manner, and is required for each of the main functional groups.
- **Content Provider Functions:** content provider functions provide the content and associated metadata to content preparation functions. They contain the content & metadata sources which include content protection right sources, content sources and metadata sources for the IPTV services.

Various IPTV architectural options and more detailed architectural descriptions can be found in [4].

Quality of Experience (QoE) Dimensions

QoE is defined in [26] as the overall acceptability of an application or service, as perceived subjectively by the end-user. It includes the complete end-to-end system effects (client, terminal, network, services infrastructure, etc) and may be influenced by user expectations and context. Hence the QoE is measured subjectively by the end-user and may differ from one user to the other. However it is often estimated using objective measurements.

Contributing to the QoE are objective service performance measures such as information loss and delay. Those objective measures together with human components that may include emotions, linguistic background, attitude, motivation, etc determine the overall acceptability of the service by the end-user. Figure 3 shows factors contributing to QoE. These factors are organized as those related to quality of service and those that can be classified as human components.

Quality of Service (QoS) is defined in [27] as the collective effect of performance which determines the degree of satisfaction of a user of the service. In telecommunications, QoS is usually a measure of performance of the network itself. QoS mechanisms include any mechanism that contributes to improvement of the overall performance of the system and hence to improving end-user experience. QoS mechanisms can be implemented at different levels. For example at the network level it includes traffic management mechanisms such as buffering and scheduling employed to differentiate between traffic belonging to different applications. Other QoS mechanisms at levels other than the transport include loss concealment, Forward Error Correction (FEC), etc.

In general there is correlation between the subjective QoE (e.g. measured by the MOS) and various objective parameters of service performance (e.g. encoding bit rate, packet loss, delay, availability, etc.).

Typically there will be multiple service level performance (QoS) metrics that impact overall QoE. The relation between QoE and service performance (QoS) metrics is typically derived empirically. Having identified the QoE/QoS relationship, it can be used in two ways:

1. Given a QoS measurement, one could predict the expected QoE for a user.
2. Given a target QoE for a user, one could deduce the net required service layer performance.

To ensure that the appropriate service quality is delivered, QoE targets should be established for each service and be included early on in system design and engineering processes where they are translated into objective service level performance metrics. QoE will be an important factor in the marketplace success of triple-play services and is expected to be a key differentiator with respect to competing service offerings. Subscribers to network services do not care how service quality is achieved. What matters to them is how well a service meets their expectations for effectiveness, operability, availability, and ease of use.

Application Layer Error Recovery Mechanisms for IPTV Services

Application layer reliability is an important aspect for IPTV services. Data being delivered over IP networks may suffer from packet losses. In case of the delivery of video and audio data errors such as packet losses or bit errors being exposed to the media decoder generally degrade the IPTV service quality. Moreover, losses in the metadata such as electronic program guide (EPG), electronic content guide (ECG), and interactive user data may cause more severe problem in IPTV service. Retransmission, forward error correction (FEC), and hybrid combinations of both are recognized mechanisms for error recovery. More detailed descriptions on error recovery in various IPTV applications (e.g. streaming, downloading, etc.) can be found in [8].

IPTV Performance Monitoring Points

IPTV domains can be further divided into specific monitoring domains in Figure 4. Within each domain, different aspects can be monitored at each domain boundary as outlined below.

A whole performance monitoring system is recommended to include a performance monitoring management platform. This platform manages individual or some domains and collects parameters from monitoring points, performs performance analysis, and generates reports.

- **Point 1 – PT1**: demarcates the domain border between content provision and IPTV control. It should aim for source video quality monitoring, source audio quality monitoring, and metadata verification.
- **Point 2 – PT2**: demarcates the domain border between service provider and network provider. It should aim for original streaming quality monitoring, such as audio-visual quality monitoring, IPTV service attribute monitoring, and metadata verification.
- **Point 3 – PT3**: demarcates the IP core and IP edge networks where monitoring of IP-related performance parameters, such as network performance monitoring.
- **Point 4 – PT4**: This point is closest to the user where monitoring the quality of streaming, audio-visual quality, and IPTV service attribute monitoring are important.
- **Point 5 – PT5**: This point is at the final end-point and directly relates to end-user QoE. Monitoring audiovisual quality and IPTV service attribute monitoring are important.

Service Security and Content Protection

In [10], threats, requirements, architecture, and mechanisms that pertain to security and protection aspects of IPTV content, services, networks, terminal devices, and subscribers are described.

IPTV security architecture is composed of:

- **Content protection architecture** is to delineate the flow and processing of information pertaining to content usage rights and information required to manage and facilitate such rights. It focuses primarily on two functional areas: (1). Service and content protection functions. (2). End-user functions.
- **Service protection architecture** focuses primarily on authentication and authorization of subscribers, delivery network gateways and other end-user devices, as well as control signaling and content interchange encryption.

IPTV Terminal Device Architecture

General functional architecture of IPTV terminal device is shown in Figure 5 [14].

A brief explanation of each component/functional entity in

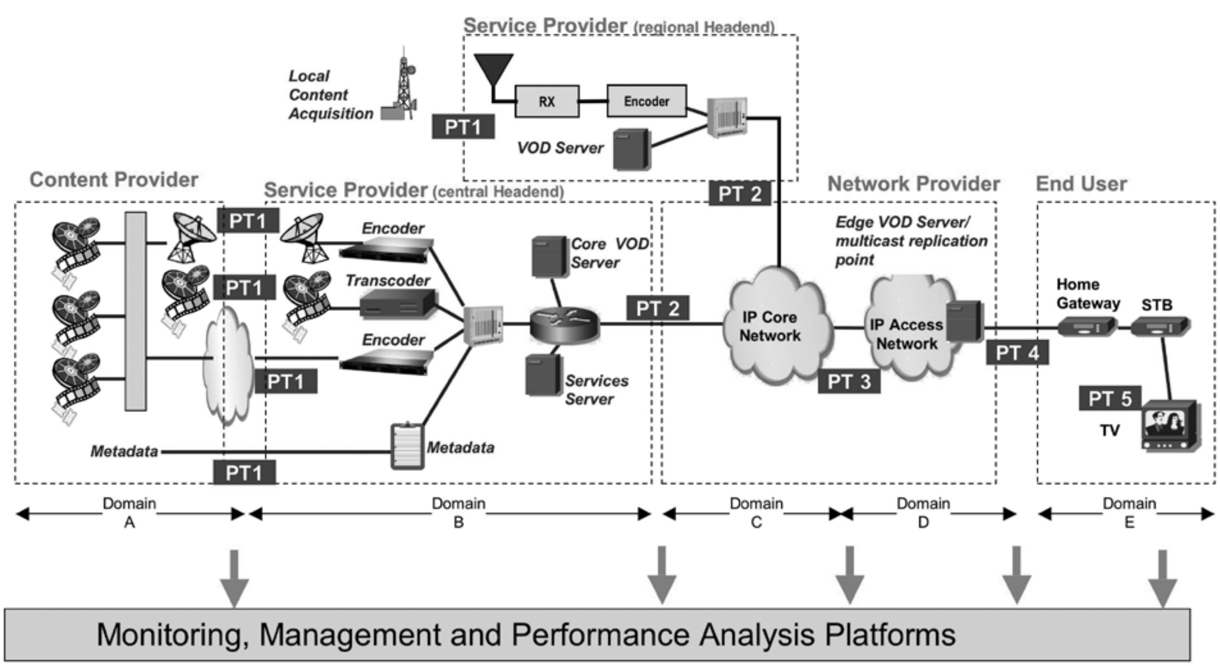

Figure 4 - Monitoring Points

Figure 5 is presented below:

- **Residential Gateway (RG):** A logical element that acts as a bridge between the access network (within the IPTV Network) and the home network. RG provides in-premise and aggregated security management as well as provisioning and addressing services for logical elements within a compliant IPTV network.
- **Network Interface** includes the following functions:
  - Processing of layer 2 functions.
  - Processing of TCP/UDP and IP packets.
  - Handling of the control flows
  - IPTV terminal device attachment and initialization process.
  - Management and reception of content over the BC-TD interface (for the connection to a broadcast network).
  - Management and reception of content over the NW-TD interface (for the connection to the IPTV Network).
- **SCP (Service and Content Protection)** includes the following functions:
  - Handling of authentication mechanisms including key exchange and processing.
  - Creation of content tracing information to be bound to the content, if required by the content provider.
  - Embedding of content tracing information, or enforcing subsequent embedding of content tracing information, if required by the content provider.
  - Processing of SCP entitlement issues.
  - Descrambling of input stream.
- **Demux/Mux** is responsible for the following functions:
  - De-multiplexing of video, audio, and data streams.
  - May include Re-multiplexing functionality to combine video, audio, and/or data streams, for potential distribution over the Home Network.
  - Embedding of content tracing information if required by the content provider.
- **Decode block** is responsible for:
  - Decoding the compressed video and audio streams.
  - Decoding textual data i.e. closed caption.
  - Embedding of content tracing information if required by the content provider.
- **Output Interface** is responsible for handling graphics overlay and on-screen display for applications. If the IPTV terminal device includes display functionality, the interface for an external display device is optional.
- **HN (Home Network) Interface** is responsible for managing the TD-HN interface. It provides services of encryption and decryption of content streams for storage, display, and propagation to home network. It's also responsible for transferring applicable SCP rights/privileges throughout the home network.
- **Storage entity** is responsible for the caching/storage of content and other application data. It may be implemented internally or externally.
- **Applications** include the software components capable of enabling functional and observable behavior, such as the GUI, EPG, VoD Controls, and other service related applications. Some applications are responsible for basic management of the IPTV TD, such as power management and event management. Others are responsible for supporting services, including but not limited to SCP applications, plug-

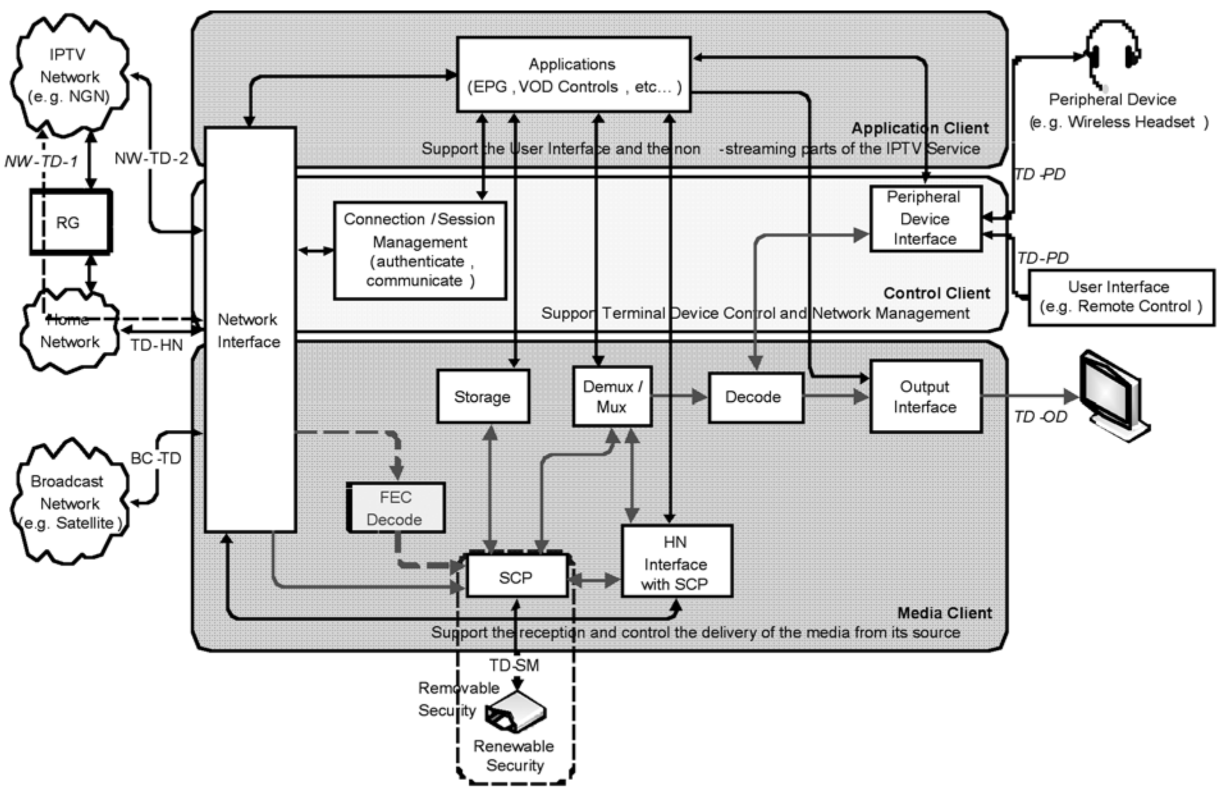

Figure 5: Functional Architecture Block Diagram of IPTV terminal device

in applications, browser applications, media player applications, and graphical user interface (GUI) applications.

- **Peripheral Device Interface** is responsible for interaction between the user devices and the appropriate applications.
- **User Interface**: A user interface is a combination of software and hardware components through which a user can interact with the user input functional entity [ITU-T F.902]. It can manifest itself in forms as a remote control, a keyboard, etc.
- **Connection/Session Management**: The Connection/Session Management functional entity is responsible for authentication, communication, and management of the connection to the IPTV server through the IPTV Network (i.e. NGN). It's also responsible for managing the protocols necessary to stream and control the flow of media and other contents arriving at the IPTV terminal device, using protocols such as IGMP and RTSP.
- **FEC Decode** functional entity is responsible for decoding a received signal using the redundant data sent by the sender, without the need for the IPTV TD to request more information from the sender, in order to aid in ensuring QoS.
- **Renewable Security** functionality may be used in a system where renewable security is required or desired. Renewable security encompasses removable (e.g. Smart Card, Cable Card) and/or downloadable (e.g. DCAS) security.
- **Peripheral Devices** including video camera, wireless headset, Bluetooth USB adapter, or other component, may be used by the end-user to interact with applications.

IPTV Middleware Architecture

The IPTV middleware supports the variety of functionalities (e.g. EPG, PVR, gaming, etc.) provided by the IPTV architecture to the IPTV terminal devices. Figure 6 depicts an overview of the IPTV middleware architecture. Its components are described in the following.

- **IPTV Application Layer** is the layer where operators and third parties provide services and applications. These services and applications include EPG applications, VOD, linear TV streams, PVR, games, Internet applications as well as other value-added services.
- **API layer**: A set of interfaces for service providers or manufacturers to build specific applications and be presented on a granular basis for a variety of purposes.
- **IPTV Middleware** is divided into a service platform middleware and a terminal middleware linked through a Bridge. The IPTV middleware invokes the lower layer resources (e.g. network interfaces) to control them, and provides APIs for upper layers. The IPTV middleware also provides some specific functions:
  - Resource management function, a functional module to manage system resources in IPTV terminal devices and servers.
  - Application management function, a functional module to manage the life cycle of the applications and interaction operations between them.

Optionally, the terminal middleware implements a multimedia application platform and a presentation engine.

- **Resource Abstraction Layers (RAL)** is to make the middleware independent of lower software and hardware layers. The resources abstracted in RAL include:
  - Software resources, such as drivers and OS
  - Hardware resources, such as computing devices, CPU, storage devices, firmware (e.g. codec), rendering devices (e.g. display, speaker), IO devices.

IPTV Metadata Service

Figure 7 illustrates metadata flows between metadata sources and client side metadata applications, including user navigation methods and interactive program guides.

The metadata server is the entity responsible for aggregating metadata sets produced by content providers or service providers to describe services and content, as well as metadata sets generated or registered by metadata clients to describe end-user preference or

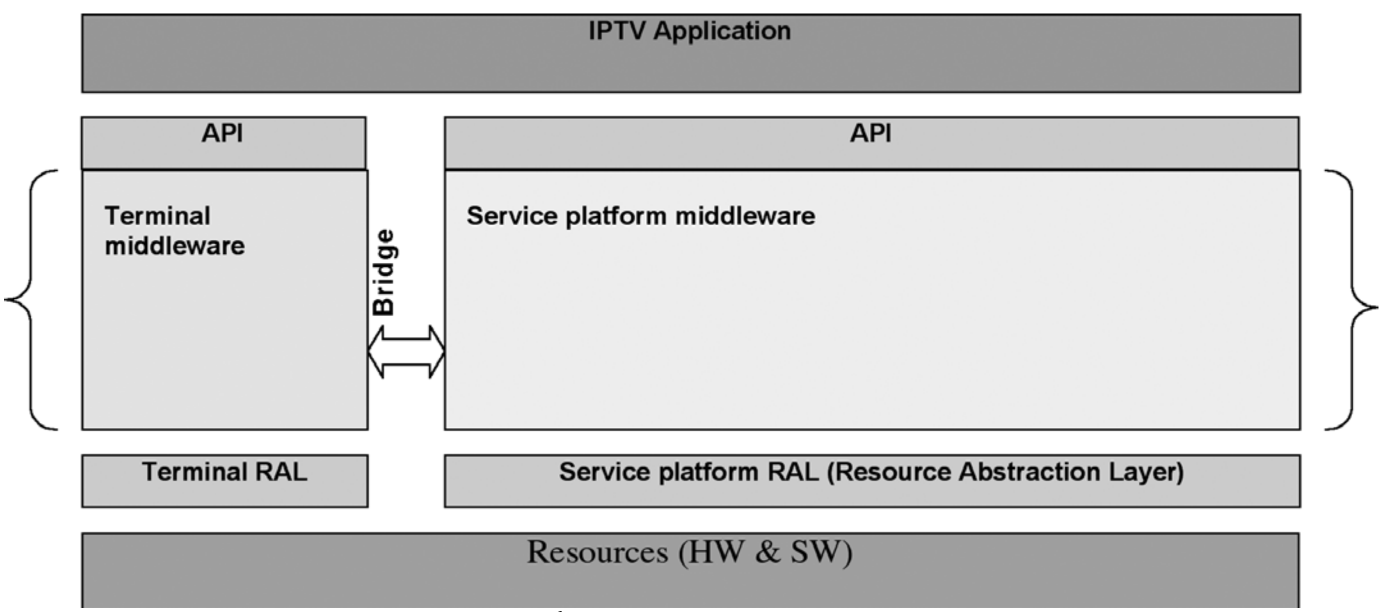

Figure 6: IPTV Middleware Architecture

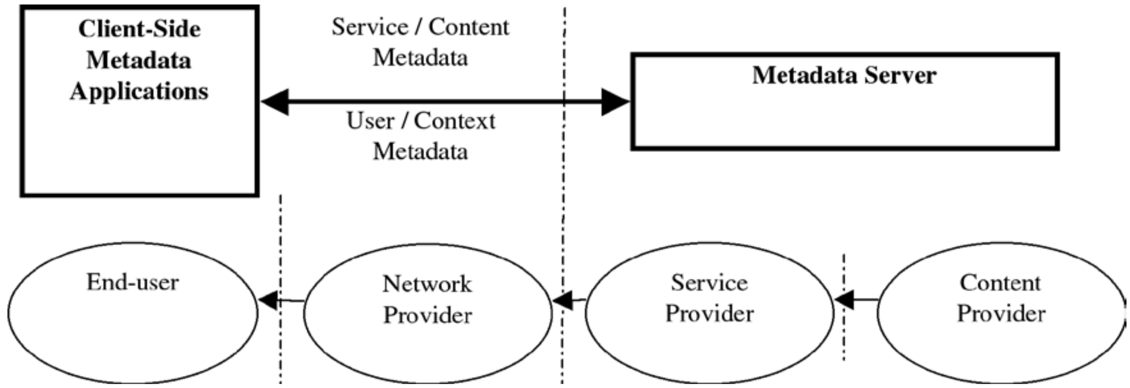

Figure 7: IPTV Metadata Service Overview

context. These metadata sets are maintained in the database managed by the metadata server. The metadata maintained in the metadata server's database is accessed by, delivered to or contributed from metadata clients through metadata delivery and exchange protocols. These clients are typically categorized as Web-based navigation servers maintained by the service provider or client-side applications running on the IPTV client. The Web servers provide web-pages to the IPTV client through logical interfaces between the service provider and end-user domain. These pages are consumed by Web browsers to aid end-users in obtaining their preferred content. Metadata directly consumed by a client-side metadata application is used for providing the network-transparent user interface for navigation, for example, a content overview listing integrated with local content storage management. The metadata server also stores and manages end-user profiles or context metadata required to support content or service adaptation.

The ITU-T's effort on IPTV continues under the IPTV Global Standards Initiative (IPTV-GSI) umbrella. FG IPTV documents have been transferred to the appropriate study groups via ITU Study Group 13. The conclusion of the work of the FG IPTV in such a short time is an impressive achievement by some of the world's foremost experts in the field. During upcoming IPTV-GSI events, regular ITU-T working methods and procedures will apply by means of the work carried out by the experts of the relevant Study Groups in face-to-face meetings where global standards will be developed.

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