IEEE Standards Education e-Magazine

The IEEE Standards Education e-Magazine: A publication for those who learn, teach, use, deploy, develop and enjoy Standards! Sponsored by the Standards Education Committee IEEE is committed to: promoting the importance of standards in meeting technical, economic, environmental, and societal challenges; disseminating learning materials on the application of standards in the design and development aspects of educational programs; actively promoting the integration of standards into academic programs; providing short courses about standards needed in the design and development phases of professional practice. Serving the community of students, educators, practitioners, developers and standards users, we are building a community of standards education for the benefit of humanity. Join us as we explore the three fundamental dynamics of standards--technology, economics and politics, and enjoy our feature articles about the use, deployment, implementation and creation of technical standards.

The IEEE Standards Education e-Magazine

3rd Quarter 2012, Vol. 2, No. 3

Table of Contents

Welcome to the IEEE Standards Education e-Magazine

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Knowledge of standards can help facilitate the transition from classroom to professional practice by aligning educational concepts with real-world applications.

IEEE is committed to:

- promoting the importance of standards in meeting technical, economic, environmental, and societal challenges;
- disseminating learning materials on the application of standards in the design and development aspects of educational programs;
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Learn more about the three fundamental dynamics of standards--technology, economics and politics, and enjoy our feature articles about the use, deployment, implementation and creation of technical standards.

What are Standards?

Technical standards are formal documents that establish uniform engineeering or technical criteria, methods, processes and practices developed through an accredited consensus process.

Standards are:

- developed based on guiding principles of openness, balance, consensus, and due process;
- established in order to meet technical, safety, regulatory, societal and market needs;
- catalysts for technological innovation and global market competition.

Join us as we explore the dynamic world of standards!

[Return to Table of Contents]

Letter from the Editor-in-Chief

Yatin Trivedi

Communication!

Ever since humans [1] started using the most primitive means of communicating with each other – be it grunts, gestures, spoken or written words – there has been an implicit need for the standard. After all, meaningful communication requires that we have a common understanding between the two (or more) parties involved in such communication. Babies implicitly begin to learn the standard of communication since birth – smile if you are happy, cry when you are hungry; then they pick up more elaborate words, sentences and descriptions for various other daily needs, eventually growing their capabilities in complex communication methods, with varying degrees of efficiency and accuracy.

Over the years, telecommunication standards have grown from its infancy (simplistic) to significant maturity (very complex). As these standards are created, there is a significant need for understanding how to implement and validate the standard. Naturally, technical universities are a great place where you can find students willing to learn from the courses offered by the professors. Sharing experiences by students and professors – in teaching courses and building projects – is a great way to increase the collective knowledge and improve instruction methods. Eventually, the graduating students must be ready to apply that knowledge in the industry and create real-world products ... and the experience gained from some of the successful and not so successful projects become the foundation for the next round of the standards. There. That's the lifecycle of the standards in the real world!

We searched through many activities in the standards development groups, university faculty and students, and industry practitioners to bring you a comprehensive set of articles in this issue of the eZine. Paul Nikolich, chairman of the IEEE 802 LAN/MAN Standards Committee explains what is 802 (a collection of standards) and how to go about learning it. David Law describes what the standards

development groups are doing to reach out to the universities. Professor Knut Blind shares his story of incorporating standardization in an existing curriculum. Taking it one step further, Professor James Irvine talks about how to teach standards without teaching them. He ought to know – he teaches the class! Mr. Bhatti and Professor Glover share their technical paper on IEEE Std 802.15.4 receiver which was one of the recipients of the student application paper grant.

Often, the industry is more concerned about topics beyond the technology or the mechanics of teaching the technology. Mr. Ganeshan shares his views about the challenges faced in Europe regarding standards education. An interesting read.

An important aspect of studying standards is to know how standards are developed. Wael Diab continues his series on Lifecycle of a standard, explaining the actual development of a standard. Appropriately, he uses IEEE Std 802.3 for wired communication as an example.

With this issue, we also start the new series of video interviews with Ms. Karen Bartleson, President-elect of the IEEE Standards Association. She talks about the importance of standards education, clearly a topic near and dear to her heart.

As always, please share your thoughts and comments. Let's learn together.

Happy reading.

Yatin Trivedi
Editor-in-Chief

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[1] I limit myself to human communication only because we do not know much about communication among other species, let alone the standards of communication among them!

The IEEE Standards Education eZine Editorial Board welcomes your comments and suggestions. Please write to us at: ezine-eb@listserv.ieee.org.

About the Editor-in-Chief

Yatin Trivedi, Editor-in-Chief, is Director of Standards and Interoperability Programs at Synopsys. He is a member of the IEEE Standards Association Standards Board (SASB), Standards Education Committee (SEC), Corporate Advisory Group (CAG), New Standards Committee (NesCom), Audit Committee (AudCom) and serves as vice-chair for Design Automation Standards Committee (DASC). For 2012, Yatin was appointed as the Standards Board representative to IEEE Education Activities Board (EAB). He represents Synopsys on the Board of Directors of the IEEE-ISTO

and on the Board of Directors of Accellera. He represents Synopsys on several standards committees (working groups) and manages interoperability initiatives under the corporate strategic marketing group. He also works closely with the Synopsys University program.

In 1992, Yatin co-founded Seva Technologies as one of the early Design Services companies in Silicon Valley. He co-authored the first book on Verilog HDL in 1990 and was the Editor of IEEE Std 1364-1995™ and IEEE Std 1364-2001™. He also started, managed and taught courses in VLSI Design Engineering curriculum at UC Santa Cruz extension (1990-2001). Yatin started his career at AMD and also worked at Sun Microsystems.

Yatin received his B.E. (Hons) EEE from BITS, Pilani and the M.S. Computer Engineering from Case Western Reserve University, Cleveland. He is a Senior Member of the IEEE.

Return to Table of Contents

Importance of Standards

President-elect of the IEEE Standards Association, Karen Bartleson discusses market-driven standardization efforts and the importance of standards education for students and practitioners. (Video will launch in You Tube (2:48))

Previous Videos

IEEE Standards Association President Steve Mills and our Editor-in-Chief Yatin Trivedi discuss three fundamental dynamics of standards--technology, economics and politics, and address the importance of having a strong foundation in understanding standards and their impact on innovation.

Part three in the three-part series (5:44)

Part two in the three-part series (4:59)

Part one in the three-part series (5:53)

Videos will launch in You Tube.

Return to Table of Contents

Feature Articles

Return to Table of Contents

Learning About IEEE 802 Standards

Paul Nikolich, Chair IEEE 802 LAN/MAN Standards Committee

3rd Quarter 2012

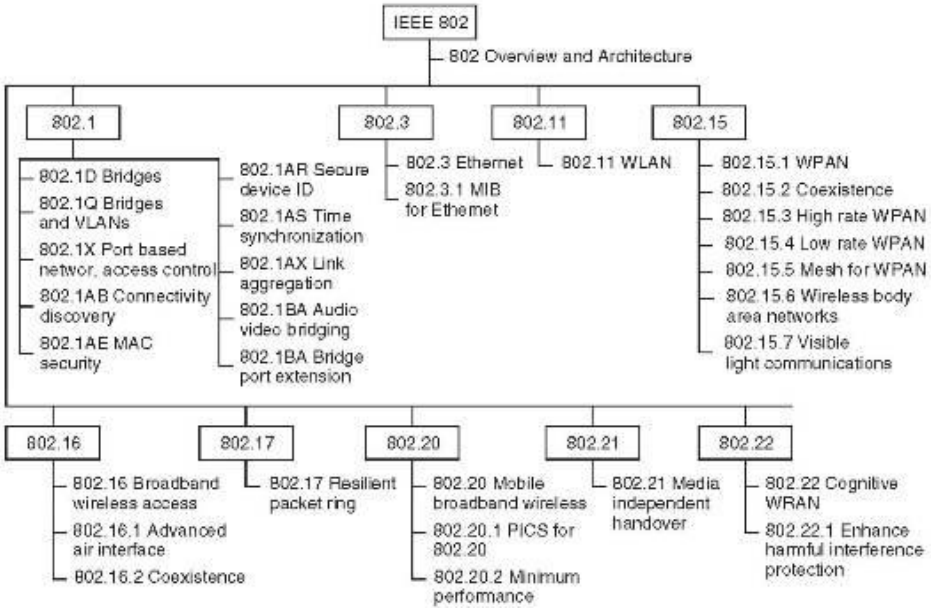
Whether you are a student, design engineer, product manager or business executive engaged in the field of high-speed wired and wireless data networking, understanding IEEE 802® Standards may be beneficial when making important professional decisions.

What is IEEE 802?

Before we dive into the value of learning about IEEE 802, let's spend a moment considering the terminology used in this article. Firstly, what is 802 [1]? 802 is shorthand for the body of work developed by the IEEE 802 LAN/MAN Standards Committee (IEEE 802 LMSC) which is comprised of ten Working Groups and about 1000 individual participants focused on maintaining over 80 active standards and actively engaged in about 50 standards development activities. The IEEE 802 LMSC work covers all aspects of packet-based data networking, mostly focused on specifying the physical layer of network interfaces (transmitters, receivers and modems) and the media access control layer (the protocols that govern the secure and reliable transmission of packets across the room or around the world). These specifications are called standards and because everyone agrees to comply to those standards, multi-vendor interoperability for data network applications became a reality about 30 years ago—and now there are IEEE 802-based devices everywhere.

Secondly, the basic unit of work in 802 is termed a "project" (a project may be initiated to develop a new standard or to amend or revise an existing standard). Before a project is authorized to begin, a concise technical scope is defined which clearly defines the functionality of the proposed project. When a project is completed, the resulting document, a draft standard, goes through a series of approvals and then it becomes an official "standard". Depending on the scope of the project, it typically takes between two to four years to complete.

The figure below shows the current Family of IEEE 802 Standards.



Who Should Know about IEEE 802 Standards?

A networking industry business executive would do well to understand the scope of the current 802 projects and where they are in the standards production pipeline because that information is a relatively good predictor of when the products and technology based on them will be entering the marketplace (typically within the next two to six years from the start of a project). For example, 802 just started an 802.3 Ethernet Passive Optical Network Protocol over Coax (EPoC) project. Technology based on this project will likely enter the market roughly two to four years from now and should have a significant impact on the wired broadband access marketplace.

A product manager would benefit from being aware of the status of the various 802 projects and standards because it will help him or her understand what functionality will be available for incorporation into products or services (ranging from components to chips to systems to entire networks and to network-related services). For example, IEEE Std 802.11 has a rich set of functionality (e.g., operating frequencies, modulation types, access protocols, security, etc.) specified in the completed standard and amendments (e.g., IEEE Std 802.11-2012 revision), as well as new functionality in soon to be completed projects (e.g., 802.11ad Enhancements for Very High Throughput in the 60 GHz band amendment).

Design engineers rely on 802 standards to define the requirements of either their design objectives or the design objectives for component suppliers used by them in

their designs. They might rely on 802 standards to specify the operating characteristics and capabilities of test equipment for the lab and the field.

But perhaps most importantly, it is typically the design engineers who are most deeply engaged in the development of 802 standards by actively participating in the development of draft standards for the myriad of active 802 projects (we have about 50 simultaneous 802 standards-related development activities going on at any point in time). They work as a large team of subject matter experts for months defining the scope of a project, for a year (sometimes longer) debating the merits of alternative techniques to meet the scope, then reaching consensus, to be followed by another year or more of drafting the standard, putting it out for intense peer review, initially internally to the group (this is called Working Group ballot), then finally for external peer review by anyone that might be interested.

Knowing how to use and apply 802 standards is crucial to any design engineer engaged in developing networking components, equipment or services; across all the technologies standardized (or in the process of being standardized) by the 802 LAN/MAN Standards Committee. The range of network functionality is too broad to describe in a few words—it includes a wide variety of bridging protocols, security, short and long range-- low and high speed wired and wireless networks, licensed and unlicensed wireless, etc. Networks based on 802 standards are globally ubiquitous and some deployment estimates have devices with network interfaces based on 802 standards are being put into service at the rate of 1000 units per second.

Lastly, we come to college students. Depending on your field of specialization, if it has anything to do with data networks, whether it is engineering, business or economics, students will find that understanding the application and relevance of 802 standards in their field will help them be better prepared for a professional career. The engineering student will be required to apply 802 standards in their jobs. The business student will be required to understand the commercial tradeoffs of utilizing an 802 standard and the cost benefits associated with them. The economics student will be required to understand the impact of 802 standards on entire market segments and with local, regional and global range.

Now that we've established the relevance of 802 standards, the question becomes: how does one learn about 802 Standards? Learning about 802 technologies, projects and standards can come from a wide range of diverse resources; for students it is in the form of material contained in textbooks, courses and the experience gained through experiments, design projects and business/economic analyses. For practicing engineers, good starting points are networking supplier data sheets, tutorials and application whitepapers. But to achieve a deep understanding of 802 standards and technologies, there is no substitute for engaging in the 802 standards development process. It is there where the interactions with world-wide experts on the full range of technologies used to implement 802-compliant equipment will occur. For product managers, it will occur via application white papers and on-line

tutorials from a variety of network equipment and service providers. For business executives learning will come from the bevy of analysts in the networking space—market research, investment analysis, economic studies and strategic trend analysts.

Given the value of understanding the current status 802 activities to the roles described above, it is clear allocating time to "learning about 802" has significant potential benefit to the data networking professional and interested student.

New Opportunities for Students & Professors to Learn about IEEE 802

One way for college students and professors to learn about IEEE 802 is through the new IEEE 802 University Outreach Program. 802 will allow up to 30 participants, students and faculty, to attend an 802 Plenary Session for one day. The fee is $25.00 and allows the participants to visit any of the working group meetings they choose and observe the sessions. David Law provides details in his article, University Outreach & IEEE 802. The next opportunity to participate is on Tuesday, 13 November 2012, in San Antonio, TX, USA. Visit our website for future 802 Plenary sessions. In 2013 the meetings will be in Orlando, Florida, Geneva, Switzerland, and Dallas, Texas.

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[1] People often ask the significance of the number '802.' All standards are numbered. The first LAN/MAN project, initiated in 1980, was assigned the number 802 by the IEEE. 802 was simply the next number in the sequence. It could very well be called 801 or 803, etc.

Paul Nikolich is an executive consultant serving as the Chief Strategy Officer for YAS Broadband Ventures LLC in the technology, standards, intellectual property and venture investing fields since 2001. He is an IEEE Fellow and has been Chairman of the IEEE 802 LAN/MAN Standards Committee since 2000, overseeing the ratification of approximately 150 standards and 50 current projects in wired and wireless communications networking with 1500+ active members. He is a member of the IEEE Computer Society Standards Activities Board and active leader of the IEEE Standards Association. He holds several patents, serves on the technology advisory boards of companies developing emerging communications technology products and provides strategic consulting services to executives in the communications industry. In 1998 he co-founded Broadband Access Systems, Inc. (BAS), leading the development of next-generation Cable Modem Termination Systems, where he was Vice President of Technology and Standards. Prior to BAS, Mr. Nikolich has held a number of technical positions of increasing responsibility at large and small networking and technology companies beginning in 1978 (e.g., Racal-Datacom, Applitek, Motorola, Analogic). In

1978 and 1979 he received a BS in Electrical Engineering, a BS in Biology and a M.S. in Biomedical Engineering from Polytechnic University in Brooklyn, NY.

Return to Table of Contents

University Outreach & IEEE 802 Standards

David Law, Chair of IEEE 802.3 Working Group

3rd Quarter 2012

IEEE 802® standards are part of a suite of standards that are the foundation for the Internet. IEEE 802 standards such as IEEE 802.3™ (Ethernet) and IEEE 802.11™ (commonly known as Wi-Fi®) are the primary way users reach the Internet. These standards have been essential for the growth of a global economic and social model that has touched billions of lives. Many other leading edge activities with similar potential impacts are currently underway in IEEE 802.

At the March 2012 IEEE 802 LAN/MAN Standards Committee (LMSC) plenary meeting the IEEE 802 Executive Committee approved the formation of the IEEE 802 University Outreach Program. school of engineering graphic

The objectives of the IEEE 802 university outreach program are to expose both students and faculty members to IEEE 802 standards development so that they may increase their understanding of the importance that standards play within engineering technology, may feel more comfortable in participating in the process if they do in the future during their academic careers, or subsequently as practicing engineers, encourage participation in the IEEE Standards Education Committee programs such as applying for Standards Education Grants for Student Projects & Application Papers, and to create interest in including the role of standards in engineering in the academic curriculum.

IEEE 802 plenary meetings are held three times per year, in March, July, and November and the next IEEE 802 university outreach day will occur on Tuesday, 13th November 2012, at the IEEE 802 plenary meeting taking place in San Antonio, TX, USA. Prior to an IEEE 802 plenary, outreach occurs to the local universities and colleges informing them of the availability of the IEEE 802 university outreach program and stating what the students can expect to learn during the day. While this outreach occurs to the local universities and colleges, any student or faculty member that can travel to the meeting is welcome to attend under this program.

The IEEE 802 university outreach program enables a maximum of 30 participants, who are either student and faculty members, to attend at a special registration fee of only $25.00. The day starts with an orientation session about one hour long giving a

brief overview of the current IEEE 802 projects as well as the standards development process they will observe. IEEE 802 University Outreach students and faculty attendees are then free to observe sessions in progress so long as there is adequate space in the room. A list of meetings recommended for observation is supplied. The day then ends with a closing session to provide the opportunity for the IEEE 802 University Outreach participants to ask questions about what they have observed.

For more information about the IEEE 802 university outreach occurring on Tuesday 13th November 2012 at the IEEE 802 plenary meeting taking place in San Antonio, TX, USA please see http://802world.org/plenary/university-outreach/.

David Law is a Distinguished Engineer at Hewlett-Packard Networking and has worked on the specification and development of Ethernet products since 1989. Throughout that time he has been a member of the IEEE 802.3 Ethernet Working Group where he has held a number of leadership positions. He served as the Vice-Chair of IEEE 802.3 from 1996 to 2008 and in 2008 was elected to Chair of IEEE 802.3. David has been a member of the IEEE-SA Standards Board since 2005, has served as the Chair of IEEE-SA Standards Board Review Committee (RevCom) since 2008, and is currently serving as the Vice-Chair of the IEEE Standards Education Committee. In 2000 he received the IEEE-SA Standards Medallion for 'leadership and technical contributions to Ethernet networking standards' and in 2009 he received the IEEE Standards Association Standards Board Distinguished Service award 'For long term service to improve the operation and integrity of IEEE-SA governance'. David has a BEng (hons) in Electrical and Electronic Engineering from Strathclyde University, Glasgow, Scotland.

Return to Table of Contents

Introduction to Student Application Paper, "Performance Evaluation of IEEE 802.15.4 Receiver in the Presence of Broadband Impulsive Noise"

By Ian Glover, Department of Electronic & Electrical Engineering, University of Strathclyde, Glasgow, Scotland

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The bluest of blue sky research in communications engineering may proceed very satisfactorily without reference to existing standards. As James Irvine points out, however, in his article 'Standards Education Without Teaching Standards – A View From the Trenches', the requirement for at least two participants in any communications event effectively guarantees that a standard will emerge at some point between the proposal or demonstration of a new communications technology, technique or system and its widespread adoption/deployment. Much (dare I say most?) engineering research is incremental, of course, and in this context progress is often made by adapting/improving/evolving existing technologies with the evolution of standards precisely reflecting this. Other incremental research involves the application of existing technologies in new situations.

The evolution of the IEEE 802.11x family of technologies in a good example of the former. The work reported in Shahzad Bhatti's application paper 'Performance Evaluation of IEEE 802.15.4 Receiver in the Presence of Broadband Impulsive Noise' is a good example of the latter. This work forms part of a larger programme examining the electromagnetic environment of electricity substations and assessing whether this environment effectively precludes the practical deployment of wireless technologies for safety- and/or security-critical applications. There is no generic answer to this question, however. Some wireless technologies may be largely unaffected by the electromagnetic noise peculiar to substations and some may be seriously affected. The quickest way of (at least partly) answering the question, therefore, is to make it standard specific. Even then it is not necessarily possible to determine the suitability of a particular proprietary technology to a particular environment without extensive, practical trials, since the design and implementation details of the technology and the quality of the components used etc. may have a significant impact. What the standard can do, however, is provide insight into whether a technology satisfying it is capable, in principle, of realising satisfactory performing in a particular environment. As a method of selecting (or more strictly excluding) technologies for particular applications, performance simulation assuming ideal implementations of technologies satisfying particular standards has much to recommend it.

Performance Evaluation of IEEE 802.15.4 Receiver in the Presence of Broadband Impulsive Noise

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Abstract—A physical layer simulation of an IEEE 802.15.4TM transceiver is developed in accordance with the specifications detailed in the IEEE standard. The simulator is validated by comparing the bit-error-ratio (BER) versus signal-to-noise-ratio (SNR) curve found from simulation with that expected from theory. A broadband non-Gaussian impulsive noise model described by a symmetric α-stable (SαS) distribution is designed and used to assess robustness of the IEEE 802.15.4 receiver to impulsive noise.

Keywords--IEEE standards; IEEE 802.15.4; physical layer simulations; impulsive noise; Zigbee

I. Introduction

Smart electrical power grids and remote monitoring of the power systems assets have become topics of intense research interest. Wireless sensors are required in both application areas and have therefore gained importance. A wireless sensor node essentially comprises a power source, a sensing device (e.g. pressure, temperature etc.) and a wireless transceiver. The Zigbee transceiver, which is based on the IEEE 802.15.4 standard, is the most popular current wireless sensor technology and has been used in many commercially available wireless sensor network (WSN) solutions. Generally wireless receivers are designed to be optimal assuming that noise will be Gaussian. This may be a useful pragmatic assumption in many environments but in is almost certainly less useful in industrial environments where impulsive noise processes often dominate. Electricity substations, for example, represent an environment in which partial discharge due to imperfect insulation in high voltage plant may, in places, be dominant. Electromagnetic radiation resulting from partial discharge is impulsive with the potential to degrade the performance of a receiver designed to have optimal performance in the presence of Gaussian noise.

This paper addresses the performance degradation that can be expected when an IEEE 803.15.4 receiver is subject to impulsive noise. The paper is divided into five sections. Section-II addresses the IEEE 802.15.4 standard with the emphasis on the physical layer. (The complete standard includes the medium access (MAC) layer.) The implementation of the simulation described in section-III. It also describes the validation of the receiver simulation. Section-IV describes the broadband impulsive

noise model and the rationale for the adoption for this model of an SαS distribution process.

II. IEEE 802.15.4 Standard

IEEE standard 802.15.4 specifies the physical (PHY) and Media Access Control (MAC) layers of a Wireless Personal Area Network (WPAN). Zigbee is one popular short range technology and its PHY and MAC layers are designed in accordance with the IEEE 802.15.4 standard. Zigbee devices are low-power and low-cost and have short wakeup time.

A. PHY Layer

The PHY layer may operate in three different ISM (Industrial Scientific and Medical) frequency bands (868 MHz in Europe, 915 MHz in the Americas and Australia and 2.4 GHz globally). The date-rate is 20 kbit/s at 868 MHz, 40 kbit/s at 915 MHz and 250 kbit/s at 2.4 GHz.

Both PHY modes (868/915 MHz and 2.4 GHz) are based on Direct Sequence Spread Spectrum (DSSS) to achieve low power operation and increased immunity to noise/interference from nearby networks. The high data-rate in the 2.4 GHz variation is achieved using Orthogonal Quadrature Phase Shift Keying (OQPSK) in which each symbol (16-ary orthogonal) is mapped to 32 chips of a 2000 kchip/s PN sequence. The spreading PN sequences are given in [1]. In the 868 MHz mode, Binary Phase Shift Keying (BPSK) is used in which each (binary) symbol is mapped to 15 chips of a 300 kchip/s PN sequence. Receiver sensitivity is specified to be -85dBm for the 2.4 GHz mode and -92 dBm for either of the 868/915 MHz modes. Transmitted power must conform to the appropriate regional radio regulations.

III. Simulations

Physical layers (PHY) of each the two IEEE 802.15.4 transceiver modes (868 MHz and 2.4 GHz) have been implemented using Simulink/MATLAB.

Simulink blocks are used for binary data generation, modulation and error rate calculations. The functions of spreading, despreading and broadband impulsive noise generation (Section-IV for details) are implemented using MATLAB script functions. The symbol-to-chip mapping (in the spreading/despreading blocks) follows the IEEE 802.15.4 specification (see Table 27 and Table 37 in [1]). Both spreading/despreading and impulsive noise generation blocks are embedded in MATLAB level-2 s-functions. These are imported to Simulink (as user defined custom blocks) for use in the PHY simulations. A block diagram of the Simulink implementation for the 2.4 GHz receiver is shown in Figure 1.

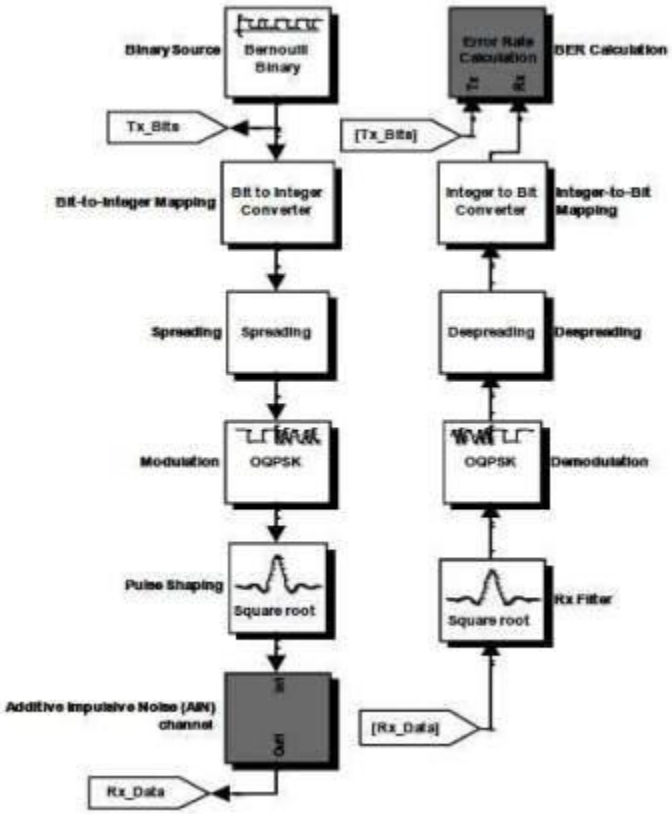

Figure 1: Simulink implementation of PHY layer of IEEE Std 802.15.4 transceiver for 2.4 GHz PHY mode

A. Validation

The simulations are validated by comparing the simulated BER versus SNR curves in the presence of white Gaussian noise with those predicted from theory for an ideal, matched filter, inter-symbol-free receiver. Figure 2 presents the validation results.

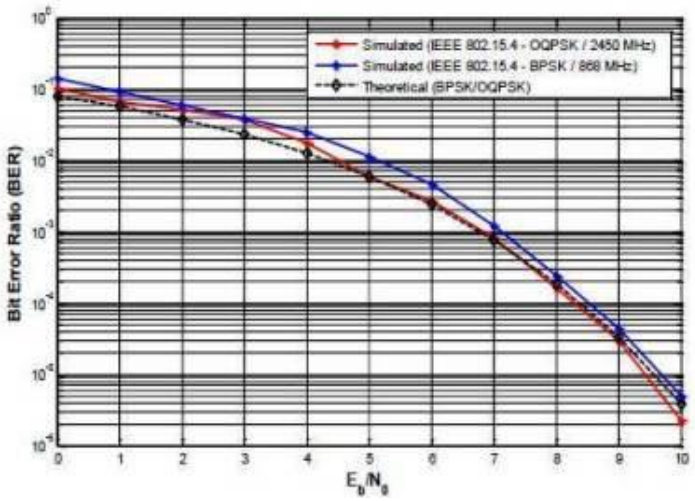

Figure 2: Validation of the IEEE Std 802.15.4 physical layer simulation

IV. Impulsive Noise Model

Impulsive noise models can be divided into two classes based on the relative bandwidth of the receiver and noise 'impulses' [2]. Narrowband impulsive noise models assume that receiver bandwidth is larger than the impulse-noise bandwidth and that, consequently, the noise pulses do not produce transients at the receiver front end. Broadband impulsive noise models assume that receiver bandwidth is smaller than the impulse-noise bandwidth and that, consequently, significant transients are produced in the receiver front end.

The Middleton Class A noise model has been popular for the statistical modelling of narrowband impulsive noise. The Middleton Class B noise model is the conceptual standard for the statistical modeling of broadband impulsive noise. Its practical application, however, is limited by its mathematical complexity and the requirement to estimate six parameters. The symmetric α-stable (SαS) process, however, can potentially be used to approximate the Middleton class B model [3]. The relationship between Class B noise and the SαS process has been established via their characteristic functions and analysis shows that the pdf of an SaS process is a close approximation to the pdf of class B noise [4].

A. Symmetric α-Stable (SαS) distribution

Cauchy introduced SαS distributions when he generalized the Gaussian characteristic function exp(-w2) to exp(-|w|α). Besides the Gaussian case (α = 2), there exists only one closed-form solution (for α = 1), sometimes referred to as the Cauchy distribution. The characteristic function of an SαS process is given by:

$$\Phi(\omega) = e^{j\delta\omega - \gamma|\omega|^{\alpha}} \qquad (1)$$

where α (1 ≤ α ≤ 2) is the characteristic exponent that determines the shape of the distribution. δ is the location parameter and γ is the dispersion of the distribution (describing the spread of the distribution around δ). For α in the range {1, 2} δ can be identified as the distribution mean, and for a in the range {0, 1} it can be identified as the distribution median.

Since there is no closed-form expression for the SαS pdf a power series expansion, derived in [4], is employed in this work. Figure 3 shows the pdf of an SαS impulsive process which is close to Gaussian near zero but decays more slowly than Gaussian in the distribution tails. (Gaussian tails are exponential but SαS tails are algebraic.) Tail thickness of the pdf depends on the value of α; the smaller the value of α the thicker the tails. Samples of impulsive noise with different values of α are shown in Figure 4.

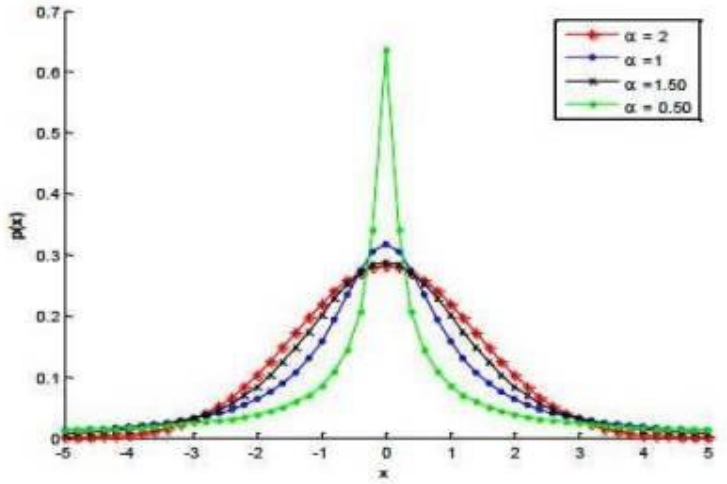

Figure 3: SαS pdfs for a different value of α

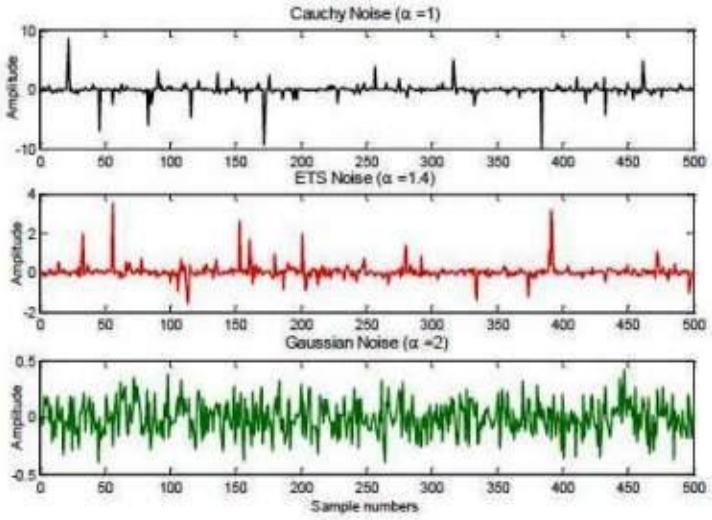

Figure 4: Noise samples

B. Generalized SNR

The SαS distribution does not have finite second order moments and all SαS signal processing is based on fractional lower order moments (FLOM) [5]. The use of a traditional signal-to-noise ratio (SNR) is therefore not possible. BER performance has thus been characterized as a function of generalized SNR (GSNR) which can be written (after [6]) as

$$GSNR = 10log_{10}\left(\frac{s}{\gamma}\right) \quad (2)$$

where s is signal power and γ is the dispersion of the SαS distribution.

V. Results and Conclusions

The performance of an IEEE 802.15.4 receiver in the presence of broadband impulsive noise is presented in Figure 5. The noise is generated using the model described in Section IV with parameters covering a wide range of noise distributions e.g. Cauchy, Gaussian and other.

BER performance is evaluated with respect to its performance in the presence of additive Gaussian noise. For the 2.4 GHz mode performance degradation, is 6 dB in the presence of impulsive noise with a Cauchy distribution (α =1) and 2 dB in the presence of impulsive noise (α = 1.4) recorded in an electricity transmission substation (ETS). The details of the ETS noise (and parameter estimation) are given in [7]. For the 868 MHz mode the performance degradation is 4 dB in the presence of impulsive noise with Cauchy distribution (α =1) and 0.5 dB in the presence of noise recorded in the ETS.

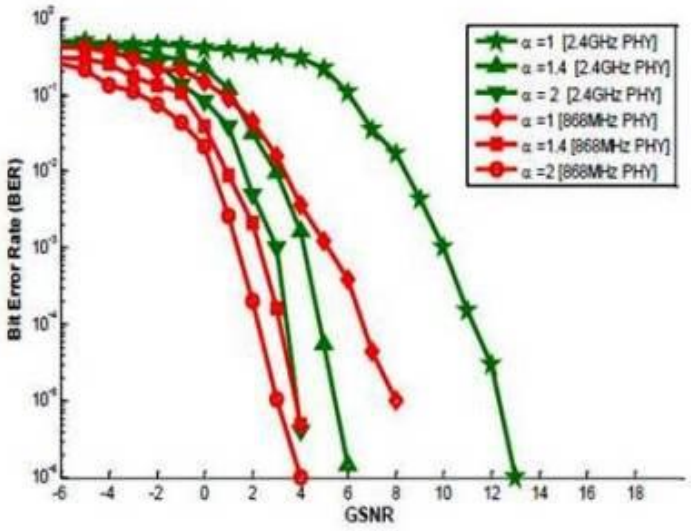

Figure 5: BER performance of IEEE 802.15.4 receiver (868 MHz and 2.4 GHz PHY modes) in the presence of broadband impulsive noise

VI. Applications

The work reported here has application in the electricity supply industry where wireless sensor equipment must operate reliably in an intensely impulsive noise environment.

Acknowledgment

The authors thank the IEEE Standards Education Committee for financial support (IEEE Mini-Grant Award) of this work.

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Shahzad A. Bhatti is currently pursuing his PhD degree in electrical and electronic engineering at University of Strathclyde (UK). He received the BEng (with Honours) from University of Engineering and Technology Taxila (Pakistan) in 2005 and the MSc in mobile and satellite communications from University of Surrey (UK) in 2007. He worked as Lecturer in Computer Engineering at University of Engineering and Technology Taxila

(Pakistan) from January 2005 to August 2006. His research interests include wireless transceiver design for industrial environments, impulsive noise modelling and wireless sensor networks.

Ian A. Glover (M'90) graduated with a BEng degree in electronic and electrical engineering from the University of Bradford (UK) in 1981 and with a PhD degree in radio science from the same University in 1987.

He started his career as a trainee technician (and later professional) engineer at the Yorkshire Electricity Board, became a Lecturer in Electrical and Electronic Engineering at the University of Bradford in 1984 and later Senior Lecturer in Telecommunications, also at the University of Bradford. From 1999 to 2006 he was Senior Lecturer in Telecommunications at the University of Bath (UK) and from 2006 he has been Reader in Radio Science & Wireless Communications at the University of Strathclyde (UK). He is currently CAPES Visiting Professor at the Federal Universidade de Campina Grande (2009 to 2010). He is the author with P M Grant of Digital Communications, Pearson Prentice-Hall (1998, 2004, 2010), which is now in its third edition. He is also editor, with P R Shepherd and Steve R Pennock of Microwave Devices, Circuits and Subsystems for Communications Engineering, Wiley, 2005. His research interests are in radio propagation, interference and noise.

Dr. Glover is a member of the Institution of Engineering and Technology (IET), a fellow of the Higher Education Academy and is the UK Member of Commission E (Electromagnetic Interference and Noise) of the International Union of Radio Science.

Return to Table of Contents

Best Practice on Education about Standardization: The Success Story at the Technical University of Berlin

Knut Blind, Berlin University of Technology

3rd Quarter 2012

In general, it is difficult to integrate new content in existing curricula of university degrees. In order to be successful, these new contents should be driven both by the supply of new content generated by research and the demand side. The demand is represented by the requirements by employers of the private and public sector. In the case of standardization, the increasing relevance of standardization has been meanwhile acknowledged especially in Germany. Consequently, more and more companies are seeking for university graduates with a background in standardization. However, in decision processes in university faculties and other boards about the composition of curricula the needs of industry are not sufficient for positioning new contents in the curricula of existing courses, because universities have not only to provide education, but also to conduct research – most favorable – at a high level. Consequently, it is helpful to conduct in parallel excellent science and research related to standardization in order to achieve a sustainable positioning of standardization in education at universities.

According to the updated overview by Swann (2010) on the economics related literature focusing on standardization (http://www.bis.gov.uk/assets/biscore/innovation/docs/e/10-1135-economics-of-standardization-update.pdf), the number of relevant publications have been tripled within the last 10 years. The overview confirmed that the research activities at the Chair of Innovation Economics at the Technical University of Berlin (http://www.inno.tu-berlin.de) sponsored by the Fraunhofer Institute of Open Communication Systems (http://www.fokus.fraunhofer.de) and linked to the Chair of Standardization at the Rotterdam School of Management of the Erasmus University (http://www.rsm.nl/research/management-of-technology-innovation/chair-in-standardisation/)produced such a significant number of

scientific papers, which resulted in a top position in the standardization research community worldwide. Especially, the very interesting, but also challenging research topic of the interrelationship between innovation and standardization is significantly influenced by Blind (see also the overview by Choi et al. 2011 http://www.springerlink.com/content/f5p95542u30u26q0/), who is also Chairman of the joint strategic Working Group to address Standardization, Innovation and Research STAIR established by the European standardization bodies CEN and CENELEC (http://www.cen.eu/cen/Services/Innovation/STAIR/Pages/default.aspx) . Furthermore, particularly the more specific issues of standardization foresight, the interface between research and development on the one side and standardization on the other side, the interrelation between patenting and standardization strategies and finally the role of standards in public procurement have attracted more and more the attention of industry and policy makers, i.e. potential employers of graduates with a background in standardization. Consequently, the research at the Technical University of Berlin addresses more applied topics, which are of high priority at the demand side, and is consequently able both to exploit synergies between research and education and to close the gap to the requirements of demand side.

On the operative level, the following steps have been accomplished in order to establish standardization as a new topic in the curricula of Bachelor and Master Courses for Industrial Engineering, Mechanical Engineering, but also for the economics students. In 2008, a cooperation Treaty between the German Institute of Standardization DIN e.V. (http://www.din.de) and Technical University of Berlin (http://www.tu-berlin.de) was signed in July 2008 in order to provide a framework for a strategic cooperation in research, like in information and communication, security or production technology, and education. Already since 2007, the chair of innovation economics offered a course on strategic standardization taught by members of the DIN management to Bachelor and Master students of all faculties of the Technical University of Berlin. In order to increase the attractiveness of the course, it was promoted university-wide via flyers informing about the content of the course. Furthermore, it was pointed out that with passing the exam a certificate "DIN-Standardization Expert Module I: Basics of Standardization" will be awarded to the students, who might use this certificate in their applications for standards-related jobs in industry. In addition to these external promotion strategies, the content of the course and its practice orientation are shaped in a way to increase its attractiveness for the students on the one hand and to address the requirements of potential employers on the other hand. The course covers the basics of standardization process and the national, European and international standardization systems as well as the role of standards for governments, but also their impacts for companies and economies as a whole.

Besides this practice oriented contents, two other peculiarities have to be mentioned, which underline the application oriented focus of the course, but also increased its attractiveness for students. At first, guest lectures by standardization experts from policy, large multinationals, like SIEMENS, but also small and medium sized enterprises engaged in standardization have illustrated the practical relevance of standardization for governmental institutions and in different types of companies and industries. At second, the exercises accompanying is blocked into four appointments to attend different – often several hours lasting – standardization related events. The students have the option to participate in meetings of national, European or international technical committees in the premises of the German Institute of Standardization, DIN e.V.. By observing standardization sessions, the students have the opportunity to compare the theoretical knowledge presented in the lectures with the real practices and actual behavior of the stakeholders involved. The observations made have to be summarized and evaluated in a report, which is graded and consequently a part of the final grade of the course.

The combination of all these different strategies to raise the awareness and increase the attractiveness of the course has been quite successful. Starting with less than ten students in the year 2008, the number of students increased significantly to over 50 participants in 2010, which challenged already the administrative capacity to organize the attendance of students in the sessions of the technical committees. Consequently, a restriction of a maximum number of students had to be implemented. Overall, the total number of students attending the standardization course per semester has been stabilized significantly at a level above 50, i.e. more than one hundred students accomplishing the course per year.
Among the students attending the standardization course, an increasing number has developed a further interest in the topic leading to several Bachelor and Master theses, including some applying the ISO methodology to assess the economic impact of standards (see under http://www.iso.org/iso/about/education_and_training/benefits_of_standards.htm). Meanwhile, three dissertation theses focusing on standardization in information and communication technology, standards and trade and standardization foresight have been completed. Further PhD theses have been started and will be completed in the coming years. In addition, it has to be mentioned that one of the doctoral students completed a traineeship at the German Institute of Standardization DIN e.V. before he started his doctoral thesis funded also by DIN e.V. Finally, first students, who have completed the course, are meanwhile hired by German industry. Eventually, the link between offering a new course on standardization and the

increasing demand for graduates having some basic knowledge in standardization is starting to get established.

Despite these achievements further challenges have to be tackled in the future. First, the course has to be integrated as electives in the curricula of further Bachelor or Master courses, e.g. in information systems. Since two semesters the course is also offered in English, but it has to be promoted further, because the number of participating students has to be increased. Addressing especially English speaking und therefore foreign students has the further impact of diffusing standardization education worldwide, which might increase its acceptance also at the home universities of the foreign students. Finally, the issue of standardization is so multidimensional and broad that content for a whole master course would be available. Since standardization is already been taught also at the Erasmus University in Rotterdam and the university of Geneva, some further cornerstones already exist for the development of a possible European Master of Standardization, which could be distributed between several European universities contributing different aspects related to standardization. Such a master course would not only foster a harmonization and larger visibility of standardization education, but would be helpful in attracting good qualified and highly motivated master students, who could also contribute via their master theses to develop further a sustainable critical mass in standardization research. Furthermore, the excellence in standardization research could be fostered by international research networks, which could be closely linked to the network of universities contributing to the European and in the long term even to an International Master of Standardization. Finally, the growing number of students with knowledge in standardization could be tightened together by the establishment of an alumni network pushing the demand side of standardization education. It is necessary to tackle these challenges successfully in order to establish and promote further the education of standardization not only in the Technical University of Berlin, but in universities worldwide.

**Photo 1:
Der Eingangsbereich des TU-Hauptgebäudes. Im Vordergrund ist die Skulptur "Flügeltor" zu sehen, ein Windkinetisches Objekt, das aus zwei gleichen spiegelbildlich angeordneten Teilen besteht, die sich durch Windenergie drehen und fast zu berühren scheinen.

**Photo 2:
Blick vom Dach des Physik-Neubaus, Eugene-Paul-Wigner-Gebäude, auf das Hauptgebäude der Technischen Universität Berlin

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Prof. Dr. Knut Blind studied economics, political science and psychology at Freiburg University. In the course of his studies he spent one year at Brock University (Canada), where he was awarded a BA. Finally, he took his Diploma in Economics and later his doctoral degree at Freiburg University. Between 1996 and 2010 he joined the Fraunhofer Institute for Systems and Innovation Research, Karlsruhe, Germany, as a senior researcher and at last as head of the Competence Center "Regulation and Innovation". In April 2006 Knut Blind was appointed Professor of Innovation Economics at the Faculty of Economics and Management at the Berlin University of Technology. Since May 2008 he holds also the endowed chair of standardisation at the Rotterdam School of Management of the Erasmus University. From April 2010 he is leading the new research group "Public Innovation" at the Fraunhofer Institute of Open Communication Systems in Berlin. Besides numerous articles on standardisation he published further contributions on intellectual property rights and further innovation aspects in refereed journals.

Return to Table of Contents

Education about Standardization: A Challenge to be addressed at the European Level

By Ashok Ganesh, CEN CENELEC Innovation Director

3rd Quarter 2012

At a time when knowledge is increasingly abundant and innovation eco-systems are opening, it is crucial to raise awareness and spread the knowledge about standardization as a powerful tool to commercialize new technologies and drive future businesses. Education about standardization will be an important success factor to prepare future workers for the needs of emerging labour markets especially in developed countries, where economic growth depends on innovation. Standardization is key to reduce both technology and market uncertainties. It stimulates innovation, commercialisation and competitiveness. Education about standardization enables future employees in research organisations and technology companies to use standardization as a tool to develop the markets for their products and services. For learners themselves, education about standardization can help complement technical skills by understanding an essential market tool and preparing for the demand and need of the labour market.

Europe and the world

Many initiatives have been developed and launched in several European countries in order to foster education about standardization. However, these activities have to be scaled up so that, all over Europe, public authorities and educational institutions are aware about the benefits of education about standardization and include courses and training about standardization in their curricula.
A good example of how to do so is Asia, where there are many opportunities and incentives for students and professionals to learn about standardization during their formal education and/or professional training. For example, the Korean Standards Association's Roadmap for Lifelong Standardization Education addresses primary school, secondary school, and higher education. In 2008 the Asia-Pacific Economic Cooperation (APEC) launched a 3-year programme on education about standardization with the involvement of 8 Asian countries.

Policy context

The European institutions are aware of this situation and recently pushed for more action from Member States on education about standardization. Education is indeed a national competence.

In 2008, the European Council 'Conclusions on standardisation and innovation'[1] "encouraged the Member States to improve the position of standardization in education programmes and academic curricula, in order to familiarize students with the strategic benefits and challenges of standardization, drawing on the expertise of standardization bodies".

More recently, the European Commission's Communication on 'A strategic vision for European standards'[2] stated that: "ESOs, Member States and other standardisation bodies are expected to improve awareness and education about standardisation and potential links with research projects. Public knowledge about standardisation should be increased by means of training, awareness-raising activities and targeted workshops".

Answer from the European Standards Organizations (ESOs)

The three European Standards Organisations, CEN CENELEC and ETSI, are committed to addressing this important challenge. In 2010, the CEN-CENELEC-ETSI Joint Working Group on Education about Standardization (JWG-EaS) was created. This Joint Working Group gathers not only member National Standards Organisations from CEN, CENELEC and ETSI, but also experts from academia and business.

In its first years, the Joint Working Group has developed a policy and put into place tools to facilitate education about standardization. A great achievement has been the elaboration of two model curricula on education about standardization, one for academia, one for vocational training. These model curricula can be used by educational organizations willing to train and teach learners in standardization. Furthermore, the exchange of material and information has been made easier through the development of a repository of information and teaching materials on education about standardization.

A major challenge

The major challenge is to build on the achievements so far, to get academia and business to respond, and to achieve a better inclusion of standardization in education and learning processes in Europe. This huge challenge requires a significant scaling up of the activities on and visibility about education about standardization. Increased leadership, commitment and coordination are needed. On 29 June 2012, the three European Standards Organisations organised their first 'stakeholders consultation conference' on Education about Standardization in order to discuss how to better educate and train European learners in standards and standardization.

Elena SANTIAGO CID, Director General of CEN and CENELEC, explained the importance for Europe's economy of including standardization in educational curricula: "In the context of the current economic crisis, Europe needs more than

ever to remain competitive and innovative. Standardization contributes to competitiveness and innovation, and therefore it is crucial that we enable the current and future workforce to learn about standards. More needs to be done throughout Europe and this issue must be understood and addressed at all levels."

New impetus

During this event, the European Standards Organisations presented their future Masterplan for education about standardization, in order to open a dialogue and get feedback from stakeholders. It defines a framework for action in Europe, with European level leadership, initiatives and vision, which complement and support nationally coordinated and implemented actions. This recognises that education in general (including education about standardization) is primarily a national responsibility, and that the national education 'landscapes' are very diverse. However, bearing in mind the importance of the challenge to be addressed, there is undoubtedly a need to join forces and to coordinate action at European level.

The scope of this Masterplan will be both formal education at university and lower levels and post-formal education and training.

In order to foster education about standardization, the CEN-CENELEC-ETSI Joint Working Group on Education about Standardization will act at two levels:

- On the one hand, relevant authorities will be addressed (national education ministries, national education funding agencies, universities ... etc) in order to raise awareness about education about standardization and encourage the inclusion of courses on standardization as part of learning.
- On the other hand, incentives will be developed to address directly the final targets: the students, researchers and teachers. Through these incentives, engagement and interest for standards and standardization will be stimulated.

The success of this future Masterplan will mainly depend on how it is implemented at national level. That is why the establishment of national structures on education about standardization is strongly encouraged.

European Standards Organisations are aware that, in order to make a difference, they need to act now. Their activities will certainly benefit from collaboration and exchange of knowledge with other stakeholders engaged in education about standardization.

[1] 2891st Competitiveness Council

[2] COM(2011) 311 final

Ashok Ganesh is the CEN CENELEC Director Innovation. Ashok has worked in European standardization since 1999, supporting standardization work in sectors including aerospace, construction products and medical devices. Previously he worked at worked at the British Standards Institution (BSI) including as secretariat of several ISO and CEN technical committees.

Return to Table of Contents

Standards Education without Teaching Standards: A View from the Trenches

By Dr. James M. Irvine, Strathclyde University, Glasgow, Scotland

3rd Quarter 2012

Engineering education involves a number of related roles. As well as the key task of enabling students to learn, universities have a limited time to teach basic engineering principles and train their students in enough specific knowledge to relate this to their future careers. Given the time constraints, the latter, more vocational aspects, are often left to late in the course and may be undervalued by staff and students alike. The fact that the half life of knowledge in a typical engineering discipline is of the order of tens of months often reinforces this view. The unfortunate aspect of this is that standards education is often considered as part of this vocational training, whereas the correct use of standards is in fact a very fundamental skill and one which is very important for practicing engineers. This article discusses the practical aspects of using standards within telecoms teaching at a Scottish university, and how students are introduced to the broader relevance of standards.

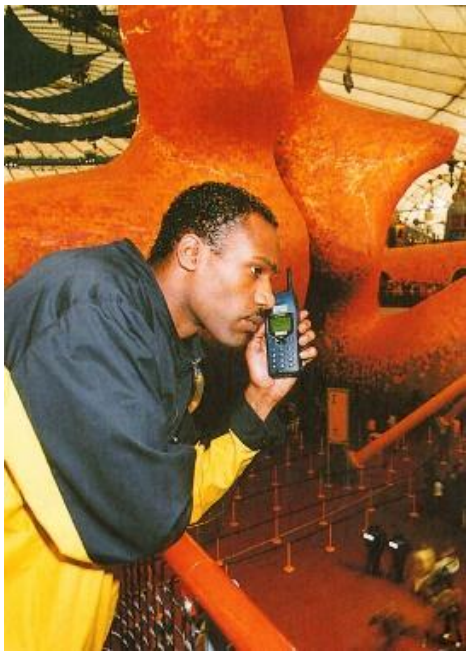
The dreaded email arrives. 'Hello James' it starts innocently enough. 'I have a request for you'. Oh dear – this isn't going well. 'I'd like an article from you for the next issue of the IEEE Standards Education eZine. The focus for next eZine is Information and Communication and Technology (ICT) standards education. I understand you actually teach a course on/using telecomm standards.'

Actually, this is the point where I could escape, as I actually don't teach a course on using telecoms standards. In fact, I teach of course entitled 'Mobile and Wireless Networks' which introduces students to aspects of cellular communications and other wireless communications technologies. I teach systems, not standards.

At one stage I did teach a course to professionals on the TETRA mobile radio standard. This was commissioned by a company who was transitioning from manufacturing analogue handsets to the new European digital private mobile radio (PMR) standard. Not only were the phones now using a radically different technology – digital modulation and time division multiple access instead of frequency modulation and frequency division multiple access – but the new standard was significantly more complex than the analogue standard it replaced. My colleagues and I had to teach the technology in four days of a week long course – the customer wanted the fifth day to introduce business aspects. I often wonder what the participants were really able to take in from what was literally thousands of pages of standards in 24 contact hours.

What was most interesting to me was not the teaching itself, but the learning experience I had to go through to teach the course. There is a great deal of truth in the statement that to really understand a subject you need to have to teach it, and I got 4 weeks of spare time to learn the standard prior to teaching the course. As someone working in the industry, I knew the principles of mobile systems well, but was ignorant of the details of TETRA's operation. I suspect that my learning experience was not untypical of an engineer assigned to a new project whose desk, or inbox, is suddenly filled with pages of standard to go through.

So how did we teach these design engineers the TETRA standard in four days? We didn't. We taught them the principles of the system, and in particular why certain things were chosen in the standard, and then we left the detail up to them. Aside from the fact that lecturing on page after page of a standard is mind-numbingly boring for all concerned, four days was far too short a time to cover all of the material in any depth. We dipped in and out of the relevant sections of the standards to illustrate certain points and gave an overview of how the standards related to each other, but generally speaking, the detail of a particular section of a standard is relevant to very few people.



TETRA handsets in use in the Millenium Done in London, 2000, one of its first major deployments. Photos by Simoco.

The result of that course was one of the first books on the TETRA system (Dunlop, Girma and Irvine, Digital Mobile Communications and the TETRA System, John Wiley, 1999), and an understanding that an effective way to teach standards is to relate everything back to the principles which underlie the design choices the standards make. Teaching fundamental principles is what universities are good at,

while an important objective of the whole process is teaching how to learn, and in this case, learn how to use standards.

Of course, it is impossible to teach telecommunications without considering standards, although it is interesting how many people try! In order to communicate both parties have to agree on the process, so standards are essential. However, standards are often boring. Students, particularly of engineering, are interested in solving problems, in finding out the 'why'. Standards are full of 'thou shalt's, while being stripped of the reasoning behind the choices made. It is an unhappy combination.

It is therefore essential that when dealing with standards the instructor goes beyond what the standard says and explains why a particular design choice was used. Often, that is not obvious. In fact, in many cases a technically poorer option was chosen because it was more compatible with existing solutions, gave economies of scale, or simply because it required the use of intellectual property (IP) from a particularly influential player in the standardization process. Unfortunately this requires the instructor to do their homework and understand both the technology and the politics. Often minutes of working groups are available which can give useful background, while companies will publish research results supporting their technologies.

Students often don't understand the purpose and limitation of standards, sometimes thinking they are a set of instructions for making a product rather then minimum set of requirements for allowing a product to interact with its environment. This is often reinforced by a rather shaky understanding of the business processes that drive engineering in the first place. So before teaching a standard, it is really necessary to introduce students to what standards are for.

Which brings me back to the Mobile and Wireless Networks course. This course is taught to the final year of a five year undergraduate EE Masters course, although exceptionally it is also taken by Bachelors students in their final (fourth) year. By that stage, students have undertaken various project activities and learning is less structured. Rather than teaching various wireless standards per se, the course is structured around the fundamental principles of wireless network operation, and standards are used as an enabler to show students how these principles are put in to practice. This involves students being given assignments on the standards, which they have to read and understand outside of class contact time in order to complete the assignment. In order to set the scene, the standards process is introduced early in the course along with regulatory and business aspects as part of the environment that the systems the students will eventually be designing will operate within. The requirements, constraints, technology options, solutions, performance approach works well with engineering students who are fundamentally designers and problem solvers.

My colleagues use similar assignment based approaches based on standards in other courses, for example the communication networks course has assignments which involve students reading and understanding the IEEE 802.3™ standards.

By having students read the standards themselves with the backup of lectures covering the basic technology, students have a much more realistic introduction to the process than the rather artificial process of lectures on each nut and bolt of the protocol. To ensure that students have actually read and understood the standards, various feedback methods are used. One of these is to have groups of students write summary reports (2 pages) and make presentations and answer questions on the key points of the standards. Another technique is to have students design a service and then explain how this service could be implemented on a particular system, which involves them learning the standards of that system to understand its operation and how it can be extended for their service.

The motto of the University of Strathclyde is 'A place of Useful Learning', and including standards helps students see the importance of the course material to 'real-world' engineering. Teaching standards is difficult and has limited usefulness, but using standards to help with teaching allows students to interact with and understand standards, while clearly demonstrating the relevance of the curriculum to students' future careers.

Dr. James Irvine is a Reader in the EEE Department at Strathclyde University in Glasgow. His research interests include resource management and security for wireless systems, and he works as Academic Co-ordinator within the Mobile VCE programme. Prior to this he worked on the ACTS MOSTRAIN project providing communication services to high speed trains. He holds four patents, with three more being pursued, and has authored two books. Technical Programme Chair of VTC2004-Spring in Milan, Dr Irvine was elected in 2002 to the Board of the IEEE VTS, where he is chair of the VTS Technical Advisory Committee, and President for 2008-9.

Return to Table of Contents

Standards Education Panel Session & Capstone Design

Amin Karim, DeVry University, and Howard Wolfman, Lumispec Consulting

3rd Quarter 2012

On 1 June 2012, the IEEE Standards Education Committee and ASTM jointly sponsored a panel session at the Capstone Design Conference in Champaign-Urbana, Illinois, USA. The panelists represented industry, academia and Standards Development Organizations (SDOs).

The Capstone Design Conference is held biennially to provide a forum for engineering and applied science faculty to share ideas about improving design-based capstone courses. This year there were approximately 165 attendees from five different countries and from 35 states in the US.

The goals for the IEEE-ASTM panel session, entitled "An interactive session addressing the importance of including technical standards education in engineering curricula and the needs of industry," were as follows:

1. To discuss the importance of learning standards in a global economy and employer expectations for engineering graduates.
2. To highlight the fundamentals of engineering standards including how they are developed, applied, maintained, and enhanced.
3. To detail the current ABET requirements with respect to standards in engineering curricula and spread awareness of the joint IEEE-ANSI Position Paper on the Role of Standards in the Curriculum.
4. To identify ways that current professors are including standards in the classroom, specifically how standards are being incorporated into Capstone Design projects.
5. To demonstrate a case study on selection and application of standards in a capstone project
6. To identify resources available from Standards Development Organizations (SDOs), such as IEEE, ASTM International, and ANSI, for students and professors to obtain standards documents, student grants, and other educational resources.

Panelists from left to right: Jim Olshefsky, ASTM; Bruce Harding, Purdue University; Amin Karim, DeVry University; Laura Hitchcock, The Boeing Company; Robert Noth, former President ANSI Board of Directors, John Deere; Howard Wolfman, Panel Session Moderator, Lumispec Consulting, Adjunct Professor University of Illinois

Panelists made several key points.

Standards and the Needs of Industry

From an industry perspective, knowledge of standards is very important. Standards represent baseline "state of the art" technology; use of appropriate standards speeds time to market; standards help avoid unnecessary risk in regard to product liability as well as unnecessary and more expensive regulation; standards demonstrate social responsibility; they provide access to a supply base of readily available and affordable components and reduce costs.

Standards are tools that every engineer will use regardless of industry, discipline, or job. They are the largest single source of technical data used to design, manufacture and maintain products. Standards are an important knowledge capture tool and a change management tool. They codify and communicate the technical requirements engineers are expected to follow. Standards form the basis for product definition (parts, materials, design, etc.). Manufacturing is done according to standards

(tooling, processes, calibration, testing). Quality, safety, and product acceptance are based on meeting standards. Contracts with customers and suppliers call out standards. The majority of company manufacturing instructions, process instructions, quality check lists, maintenance manuals and internal standards incorporate industry standards.

Standards codify and communicate the technical requirements engineers are expected to follow and yet new engineers know little to nothing about standards. Companies are faced with having to make up this knowledge gap with extensive internal training on standards. New engineers waste time searching for standards data, making mistakes by not following standards, reinventing processes which are already in standards, proliferating parts needlessly, and negatively impact quality, customer acceptance, schedules and budgets by not appropriately using standards.

Implications for Students and Faculty

Students need to be aware of the use of standards in material, product, system or service in solving technical problems. Faculty need to expose students to standards by incorporating across the curriculum. Students must apply relevant standard(s) in capstone or senior design projects. Faculty assessment of capstone (senior design) projects must include grading for the application of standards.

ABET — Criterion 5 - General Curriculum (2011-2012)

Criterion 5 states that "Students must be prepared for engineering practice through a curriculum culminating in a major design experience based on the knowledge and skills acquired in earlier course work **and incorporating appropriate engineering standards and multiple realistic constraints.**

Role of Standards in Engineering, Technology, and Computing (ETC) Curricula – IEEE and ANSI Positions

On 28 June 2009, the IEEE Board of Directors approved an IEEE Position Paper, IEEE POSITION PAPER ON THE ROLE OF TECHNICAL STANDARDS IN THE CURRICULUM OF ACADEMIC PROGRAMS IN ENGINEERING, TECHNOLOGY AND COMPUTING. This paper was later adopted by ANSI National Policy Committee in 2010, so it is now a joint position paper.

The purpose of the document is to define the desired role of technical standards in education within engineering, technology, and computing (ETC) academic curricula in the technical areas of interest of IEEE and ANSI. Introducing standards in the classroom will augment the learning experience by pointing students to available design tools, and to best industry practices. Student knowledge of standards would facilitate the transition from classroom to workplace by aligning educational concepts with real-world applications and market constraints.

The paper suggests the integration of standards education in the ETC curricula in a few different ways:

- By reference--that a process is covered by a standard and a citation of the same;
- By indirect introduction (principal tech. specs.) in classroom instruction, homework assignments, labs or projects;
- By direct use of a published standard in instruction, labs or projects;
- By regular use and reference to standards in large scale projects, such as in Capstone Design.

Bruce Harding from Purdue University presented a Case Study entitled, 'Simple Mechanism to Illustrate the Ubiquitous Nature of Standards,' showing that "even a simple device can require complex real-world decision-making based on the use of standards." (See presentation beginning on slide 34).

Feedback from Session Attendees

Attendees of the panel session expressed a great deal of interest in ways to obtain standards and educational resources for their students. Jim Olshefsky from ASTM listed many resources available at low to zero cost from Standards Development Organizations. This included ANSI's University Outreach Program and their StandardsLearn.org site, ASTM's Standards on Campus, and the IEEE Get Program where selected IEEE standards are available for download at no charge. (Complete lists and links are available in the presentation.)

Howard Wolfman observed that a common concern expressed by several attendees was that even though they understood and agreed with the need to facilitate the students' experience with and use of standards, the capstone design project was "late" in the students' academic career to introduce standards; and that standards should be introduced in small bites earlier in the engineering curriculum. This would then lead to an increased focus on standards in the Capstone Design Project.

Amin Karim is the Director of Academic Outreach at DeVry University. Prior to this position, he served as the national dean of the college of technology. Before joining DeVry in 1991, he served as an electrical engineer in the power and manufacturing industry and as a faculty and a department head of engineering technology program. He is a past Chair of the Electronics and Computer Engineering Technology Department Heads Association of the American Society for Engineering Education and served as a TAC of ABET evaluator for engineering technology programs. Currently, he is serving as the vice-chair of the Standards Education Committee for IEEE.

Howard Wolfman is an adjunct full professor in the Master of Engineering Program at the University of Illinois at Chicago. He received his BSEE from the University of Illinois, MBA from Northwestern University, and is a Registered Professional Engineer in Illinois. He is the principal of Lumispec Consulting, specializing in Management and Lighting Energy Efficiency. Mr. Wolfman has held numerous leadership positions in domestic and international standards and trade organizations including ANSI, IEC, IEEE, NEMA, UL and CSA. He has been a member of the IEEE Standards Board for 12 of the last 15 years, is past chairman of the Chicago Chapter of the EMC Society, past member of the Board of Governors of the EMC, IAS, and EMS Societies, past chairman of the IEEE Chicago Section, past IEEE Region 4 Director and past IEEE Treasurer.

Return to Table of Contents

Standardization: Living in the Smart Cities of the Future: eWork, eMobility and Connection to the Smart Grids

Summary of Joint IEEE-DKE Workshop

By Moira Patterson, IEEE Standards Association

3rd Quarter 2012

On 10 July 2012, the IEEE Standards Association (IEEE-SA) and DKE German Commission for Electrical, Electronic & Information Technologies of DIN and VDE co-hosted the workshop "STANDARDIZATION: LIVING IN THE SMART CITIES OF THE FUTURE eWork, eMobility and Connecting to Smart Grids" in Offenbach, Germany.

This event provided practical information on home networking, next generation mobility, smart cities, and their integration with smart grids. The event attracted more than sixty attendees, consisting of members of both organizations as well as non-members.

Reaching practicing engineers and educating them on the importance of standards is an important mission for both DKE and IEEE. By partnering in this workshop, DKE and IEEE were able to jointly address the importance of standardization among engineers working on the Smart Grid and related areas.

"IEEE has a long history of collaboration with VDE [the Association for Electrical, Electronic & Information Technologies in Germany]," says Terry deCourcelle, Senior Director of International Programs & Governance of the IEEE-SA. "This was the first joint event between our respective standardization groups, DKE and IEEE-SA, and will lead to greater collaboration."

"As products and solutions are becoming ever more complex, the successful realization of products requires the use of multiple technologies and components," explains Dr. John Kulick, Vice-Chair of the IEEE-SA Standards Board. "Standards provide the natural means for engineers to incorporate different components into their work. Familiarity with

standards allows engineers to more quickly adapt necessary technology to projects under development. This utilization of standards can lead to shortened time to market which is important in today's competitive marketplace."

Dr. Bernhard Thies, Chairman of the Board of Directors, DKE, served as moderator for the workshop, and set the tone for the discussions in his keynote speech. He highlighted the importance of smart cities and related converging technology developments, i.e. the smart grid, eMobility, smart services, and other increasingly smart aspects.

"By 2050, more than 70% of the world's population will live in cities, according to a UN World Population Prospects report," said Thies. "eMobility is key way to lower the emissions and noise levels, which will dramatically improve the quality of life of city dwellers."

IEEE-SA has extensive activities relating to these converging technologies. "IEEE-SA believes that the smart grid is too vast to be confined within any one standards development organization (SDO), and therefore it is necessary to collaborate wherever possible," said Bill Ash, Strategic Program Manager, Standards, IEEE-SA. He added "for this reason, IEEE-SA has agreements that allow adoption of IEEE Standards, joint development with other SDOs in the global standards community, and other collaborative activities."

DKE, which represents Germany's national positions in the International Electrotechnical Commission (IEC), tries to guide German industry in the standardization landscape of national and regional standardization. "DKE recognizes the importance of international consensus to optimize the use of standards to promote international trade and economic development," said Yuanchao Chen, DKE. She continued, "DKE also is looking to cooperate with other organizations, such as IEEE-SA, to not fence off the German market and to involve all stakeholders."

Introducing the IEEE-SA, Dr. Kulick emphasized the global nature of IEEE standards and the many ways for individuals and corporations to become involved in the standards development process. Asked about the highlight of this event, he cited "the acknowledgement that complex systems such as smart cities will require the collaboration of many stakeholders in order to be successful."

Oleg Logvinov, Director Market Development, Industrial & Power Conversion Division, STMicroelectronics, highlighted two major areas, standards developed for the powerline communication industry (IEEE 1901TM and IEEE P1901.2TM) and the new one-of-a-kind standard providing an abstraction and convergence layer for multiple media specific PHY/MAC (IEEE P1905.1TM).

"Industry-wide collaboration in the development of these standards is essential," commented Mr. Logvinov. "Standards enable interoperability, which, in turn, enables healthy competition and helps build vibrant ecosystems engaging every level of the value chain."

Thomas Sentko, DKE, introduced DKE and its smart cities activities. As the organization representing Germany in IEC, CENELEC and ETSI, DKE works very closely with these organizations. He explained that DKE contributes German expertise to the IEC standards development work, and then brings that back though the international standard and allows the German market to export globally, highlighting the crucial role of international standards.

Dr. Rolf Apel, Manager Technology and Innovation, Siemens AG spoke about the key role that smart buildings play in smart grids. Further, he discussed the important role of the Smart Grid Architecture Model as a valuable tool to map future requirements and systematically identify gaps in the area of standardization.

The segments focusing on eMobility brought a presentation from Paul Bishop of The Bishop Group about the activities of the IEEE P2030.1TM Working Group, which he chairs. The project addresses applications for road-based personal and mass transportation. He also stressed the need for global cooperation to make standards transparent to end users worldwide.

Samuel Kiefer, CEO of Kiefermedia GmbH, introduced a standard for Resonant Inductive Charging of Electric Vehicles. The presentation illustrated advantages related to wireless charging systems in the urban environment, including easy handling for consumers.

The final segment of the event was a panel session, and the audience had questions spanning the breadth of topics discussed.

Echoing the theme of the landscape of SDOs, there were questions from the audience on whether there is more competition or cooperation. When asked about this, participants from both organizations reiterated the desire to collaborate. Said Dr. Thies “This was the first time both organizations cooperated on a joint event, and we indeed talked about cooperation during the event!”

Moira Patterson is Program Manager, International Programs, at the IEEE Standards Association (IEEE-SA). She has been with the IEEE-SA for five years, and is responsible for IEEE-SA’s strategy for its European activities. The IEEE-SA is a globally recognized standards-setting body within IEEE. It develops consensus standards through an open process that engages industry and brings together a broad stakeholder community from around the world. The IEEE-SA has a portfolio of over 900 active standards and more than 500 standards under development.

Return to Table of Contents

IEEE Standards Education Grants and Student Application Papers

by David Law

Knowledge of industry standards helps facilitate the transition from classroom to workplace by aligning educational concepts with real-world applications and market constraints. IEEE encourages the introduction and use of technical standards in the classroom.

In support of the IEEE Standards Education Committee's (SEC) mission, in particular to actively promote the integration of standards into academic programs, the IEEE SEC is offering grants to both students (500 USD) and faculty mentors (300 USD) to promote the use of industry standards in projects.

These grants are offered to students in all stages of their study (e.g., undergraduate, post graduate, doctoral) and for all types of projects (e.g., design, development, research). The grant requires submission of a paper on completion of the project describing the design choices driven by, and the application of, industry standards in meeting the project goal. This provides the applicant(s) the additional opportunity of having a paper published by the IEEE.

The application process is reasonably lightweight and so far the success rate of application has been high, with the main reason for rejection being meeting the requirement to use industry standards in projects. The key to a successful application is to have a project that is based on the investigation or application of industry standards.

Simply using components that conform to a particular standard, for example using an IEEE 802.11™ WiFi Router to communicate a WiFi connected laptop as part of the project, is not sufficient. What we wish to see is a paper that highlights specific design choices in the project driven by an understanding, and application, of the industry standard(s) used.

To learn more and to apply for a grant visit http://standardseducation.org/applications/. Also, don't miss our FAQ section in this eZine, which is quite helpful.

The SEC reviews each final paper carefully and the accepted final papers are published to our Student Application Papers website. Please take some time to read through the successful papers for some inspiration.

We are also publishing "Best of Student Application Papers" in each issue of the Standards Education eZine. Don't miss the paper, "Performance Evaluation of IEEE 802.15.4 Receiver in the Presence of Broadband Impulsive Noise," by Shahzad Bhatti and Ian Glover, University of Strathclyde, Glosgow, UK.

David Law is a Distinguished Engineer at Hewlett-Packard Networking and has worked on the specification and development of Ethernet products since 1989. Throughout that time he has been a member of the IEEE 802.3 Ethernet Working Group where he has held a number of leadership positions. He served as the Vice-Chair of IEEE 802.3 from 1996 to 2008 and in 2008 was elected to Chair of IEEE 802.3. David has been a member of the IEEE-SA Standards Board since 2005, has served as the Chair of IEEE-SA Standards Board Review Committee (RevCom) since 2008, and is currently serving as the Vice-Chair of the IEEE Standards Education Committee. In 2000 he received the IEEE-SA Standards Medallion for 'leadership and technical contributions to Ethernet networking standards' and in 2009 he received the IEEE Standards Association Standards Board Distinguished Service award 'For long term service to improve the operation and integrity of IEEE-SA governance'. David has a BEng (hons) in Electrical and Electronic Engineering from Strathclyde University, Glasgow, Scotland.

Return to Table of Contents

Applying for IEEE Standards Education Grants

3rd Quarter 2012

The IEEE Standards Education Committee (SEC) offers grants of US $500 for students (per project) and US $300 for faculty mentors to help complete senior, undergraduate or graduate projects. Projects may be for design, capstone, development or research in which an industry technical standard(s) was applied to complete the project. Students report on the results of these projects by writing and submitting a Student Application Paper. The papers detail which industry technical standard(s) was applied (analyzed and implemented). Each paper highlights specific design choices in the application of various technical standards and describes the resulting product, process, or service. Final papers accepted by the SEC are published to our Student Application Papers website.

Applications for the grants may be submitted at any time throughout the year, however the next upcoming deadline is 15 October 2012. Deadlines for 2013 are: 30 January, 15 March, 15 June, 15 October.

Frequently asked questions about the IEEE grants

1. **What are the grants for?** The grants are to help support students at colleges and universities worldwide with their design projects. The funds are generally used to purchase much needed materials to help students' projects succeed. The one absolute requirement is the projects include the application of industry standards.

2. **Who can apply?** Any college-level student planning to incorporate industry standards or specifications into their projects, and are in need of additional financial support. Keep in mind that students must produce a final paper, a Student Application Paper, that will be submitted to the Standards Education Committee (SEC) for review. If the SEC accepts the paper, it is published to the IEEE's website.

3. **Do I need to be an IEEE member and do the standards we use have to be IEEE standards?** The answer to both of these questions is no. The standards education grants are for all students worldwide, and as long as your project is using the appropriate technical standards for your project, the SEC requirements have been met.

4. **How are the grant applications evaluated?** The SEC carefully evaluates each application package and according to the following criteria: (a) completeness of submission package; (b) quality of student abstract; (c) quality of faculty endorsement; (d) whether the project meets the intent of the Standards Education Grant.

5. **How do I apply?** Visit our Student Application Papers website: http://standardseducation.org/applications/ for more information. The application and instructions are also linked below.

    - Application and Instructions (DOC, 82 KB)
    - The next upcoming deadline for applications is 15 October 2012.

Read successful final Student Application Papers.

Return to Table of Contents

IEEE Standards Lifecycle Part Deux: A Closer Look at the Standardization Phase

By Wael Diab

Third Quarter 2012

Introduction

In our article on the standards lifecycle in the 2nd Quarter 2012 issue of this eZine, an overview of the entire lifecycle was provided [1]. To recap, the lifecycle consists of the pre-standardization phase, the standardization phase and the post-standardization phase. These are complemented by other areas and tools like intellectual property management and e-tools.

In this issue we will take a closer look at the standardization phase, traditionally the heart of the process. To help illustrate the process examples will be drawn upon from the popular IEEE 802.3™ Ethernet Working Group [2].

Standardization Phase

The standardization phase can be broken down into 6 major areas: initiate, mobilize, draft, ballot, approve and maintain. We will take a look at each of these areas in detail.

Initiate

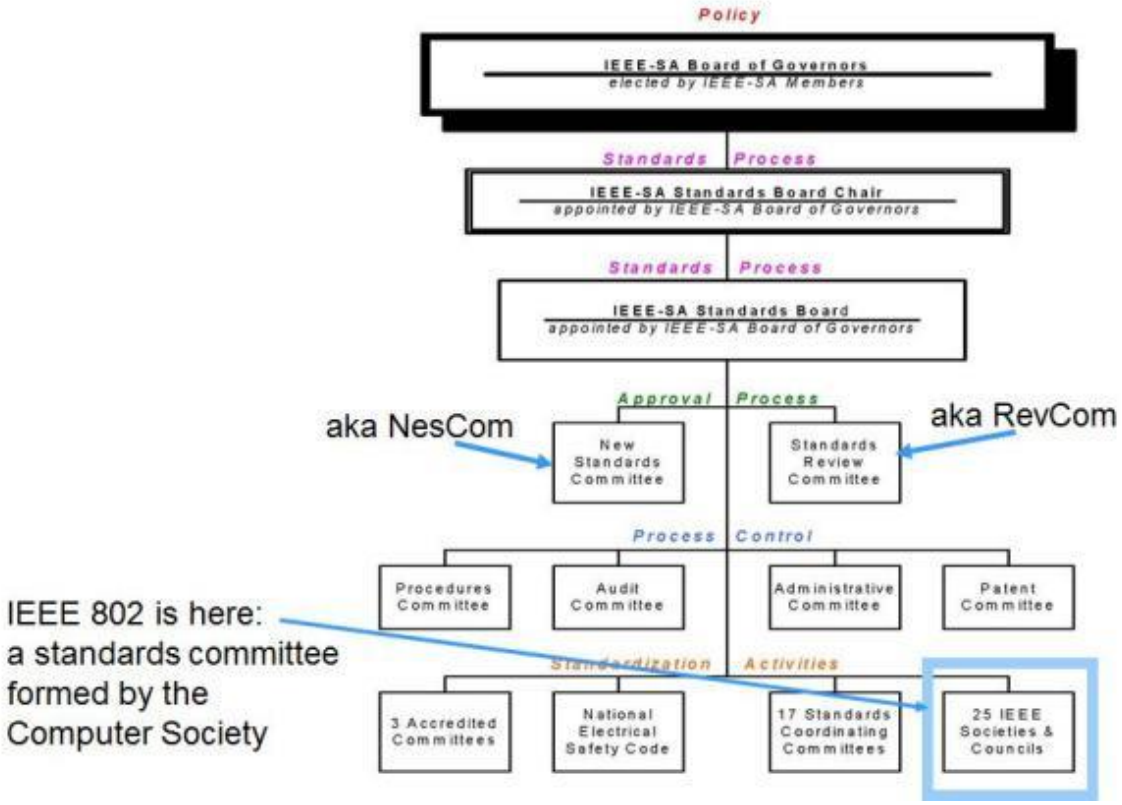
This sub-phase marks the start of the work. There are many ways to get into this sub-phase, however, there is one outcome at the end. The best way to think about this phase is like a process funnel. At the output of the funnel are the formal initiation documents of the standards work and then next step, which is to mobilize.

Within the IEEE Standards Association (IEEE-SA) the initiation document that needs to be completed is the project authorization request, also known as the PAR. "A PAR is document that states the reason for the project and what it intends to do."[3] Amongst other things, a PAR will identify who the "sponsor" of the project is and what working group will take care of performing the work. Sponsors are typically IEEE societies or committees within those societies that are engaged in standards activities. In addition, other entities like the Corporate Advisory Group, Standards Coordinating Committees or other groups can also sponsor. Work is typically sponsored by the group where the project's scope is aligned with that of the project.

As noted earlier, in preparation of the PAR documents in this stage, there are multiple routes that a group can take. On example is the formation of a "Study

Group" within a sponsor or working group for the duration of 6 months to allow interested parties to get together to prepare and gain support of their sponsor.

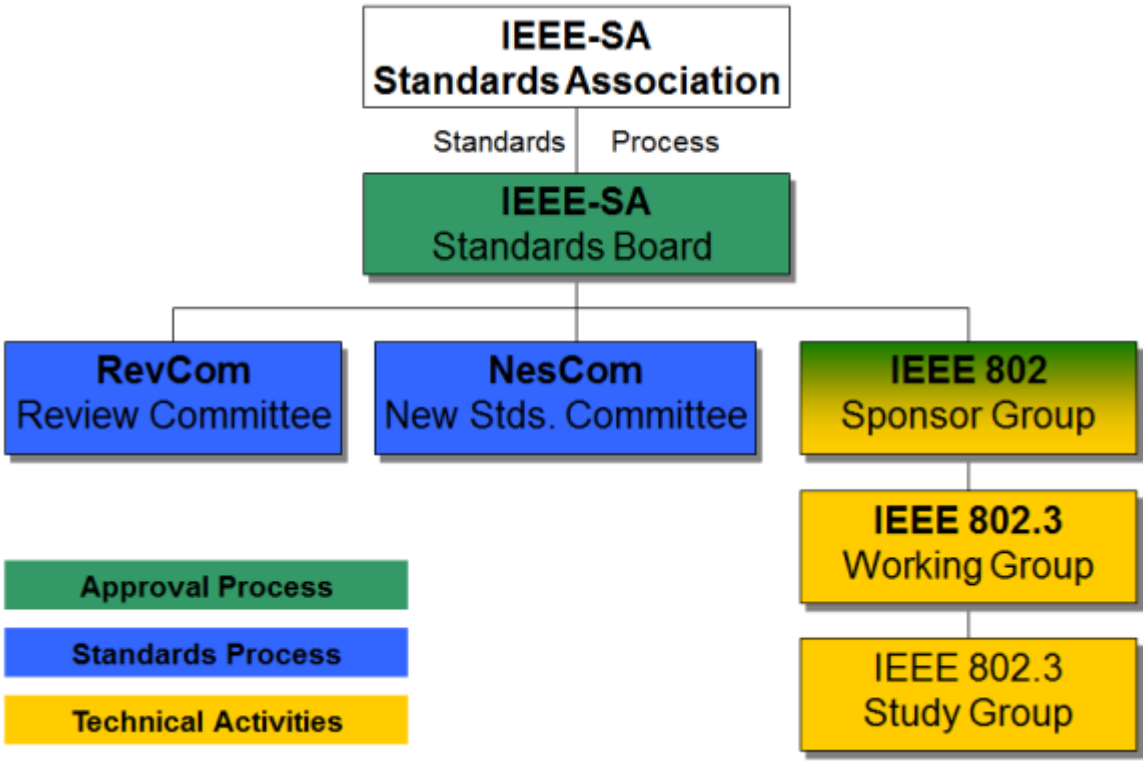
Figure 1: IEEE-SA Organization Structure and Where IEEE 802 Fits In [4]



Some sponsors may have additional requirements to starting work which is captured in their governance documents.

By way of example, in IEEE 802.3, the process often starts with a "call for interest" or CFI, where a member of the working group brings forward a question for the working group to weigh whether or not there is interest to study the work. This is typically accompanied by a consensus building presentation to help inform the members about the new area and if the call is successful it results in the formation of a study group with IEEE 802.3 to look at the question and prepare the PAR and related documentation [5].

Figure 2: Example of IEEE 802.3 Study Group Organization Structure [6]



Mobilize

This is the sub-phase that brings together the stakeholders with their proposals to address the project scope. In many aspects this is where both the structure of the group that will perform the formal work is formalized and the deep technical discussions begin.

The PAR which was mentioned in the last sub-phase is forwarded by the sponsor to the IEEE-SA Standards Board for consideration and approval via the IEEE-SA Standards Board standing committee called the New Standards Committee (NesCom) which will look at the document and make a recommendation to the Board. Upon approval of the PAR, the technical work can start. In cases where the work is seeking to add or expand existing work, as is commonly the case in IEEE 802.3 via the amendment process, a working group already exists and that group will look at how to best organize the work. In other cases where a new working group is to be set-up, the approval of the PAR will allow the sponsor to form a working group that will perform the work. While there is an additional step of bootstrapping a new working group, one of the tools available to participants in the IEEE-SA are baseline governance documents for working group operation that the standards board has developed to help aide with the startup.

In either case, the detailed technical work may be done by the working group itself or by a sub-group. In the cases where the working group may have a lot of work going on or if the scope of the project is wide, sub-groups is a common way to go through the day-to-day work. Within IEEE 802.3, a group called a “Task Force” is formed, in other working groups like IEEE 802.1TM, “Task Groups” can be formed.

Once organized, the main technical function of the working group will be to start soliciting and considering proposals to meet project requirements. Note that working groups operate under the principles of the IEEE-SA including openness and make it easy for interested parties to join.

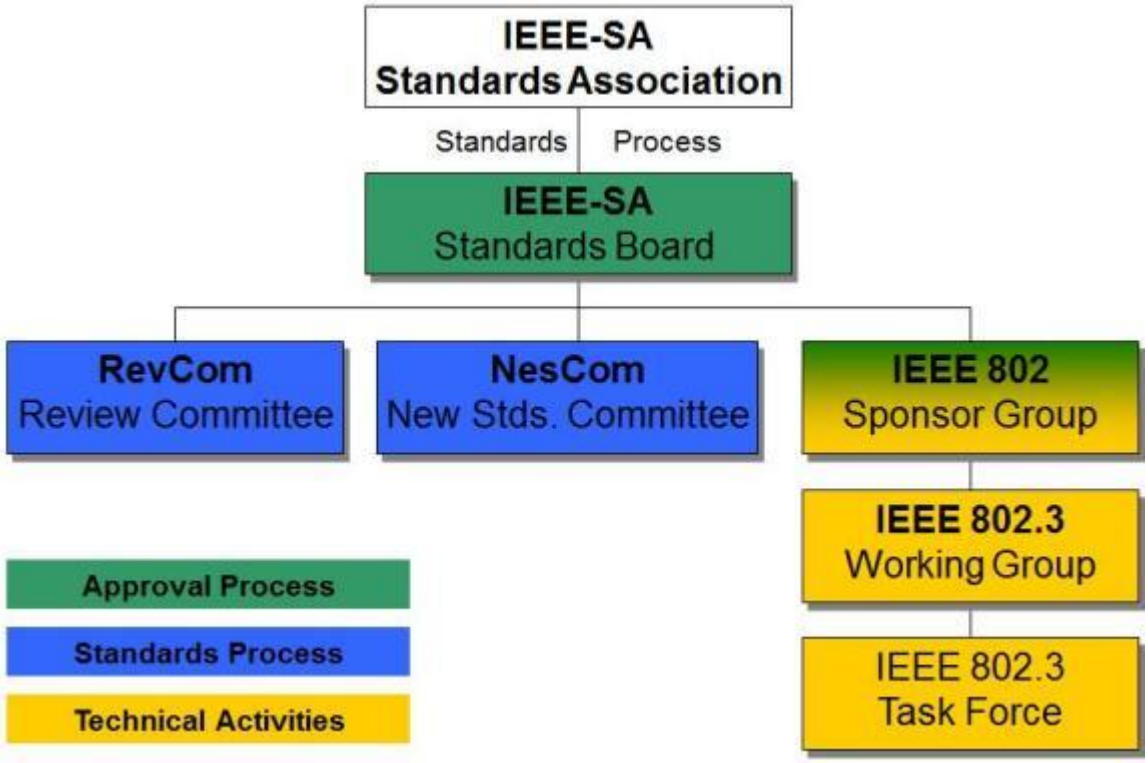
Draft

This is the sub-phase that involves translating the ideas and proposals into a document that will eventually turn into a standards interoperability document otherwise known as the standard.

This frequently starts with taking the consensus proposals and translating them into what looks like a document by providing an outline of the various clauses and filling in the content. Depending on whether or not the project is amending an existing standard or is writing one from scratch, there may be some constraints on the former along with instructional statements on what areas of existing text need to be modified, replaced or amended. In addition, the group needs to be careful in the use of certain words like shall/may/should so that the interoperability requirements and what is normative [7] and required vs. normative and optional vs. informative [8] (non-normative) is clear. There is a certain amount of art to writing a standard and the IEEE-SA staff is always helpful in assisting the working group with questions that arise.

The next step is the formal balloting of the standard; however, in its review of the document in preparation for the next stage, the group may wish to informally collect comments on the draft to help prepare it. By way of example, in IEEE 802.3 a task force review is conducted to ensure that the document is technically complete. It is then balloted in the working group in preparation for the sponsor ballot to ensure that the document is stable. These additional steps in IEEE 802.3 have in part ensured that the quality and stability of new work remains high over time.

Figure 3: Example of IEEE 802.3 Task Force Organization Structure [9]



Ballot

This is the sub-phase that deals with building consensus around the document through a review process that allows the participants to comment on the document. As eluded to earlier, this process starts when the sponsor feels that the document is stable enough to proceed to the formal balloting.

The step can be thought of as a series of smaller steps starting with the formation of a "ballot group". The ballot group will consist of interested parties or individuals in the project and is balanced by category (e.g., producer, user, general interest, etc.). Note that the group is open to IEEE-SA members [10] and is designed to allow for participation beyond just the working group that developed the standard.

Another step is the actual ballot process where the draft is put out for a vote. A ballot is opened up and the participants from the ballot group are asked to vote on the draft standard and provide comments. While comments will be considered from anyone, binding comments and ballot votes that count towards the approval threshold may only be submitted by ballot group members.

The final step is for a ballot resolution committee, which may take the form of the working group or a subgroup, to meet and consider the comments submitted along with proposing responses. Based on the review of the comments or for other

reasons, the working group may then make changes to the draft document and iterate on the above set of steps until the process concludes.

The IEEE-SA provides a web-based tool called myProject which aids the balloters in submitting their votes, comments and keeping abreast of the development of the standard that they are participating in.

Ballot Thresholds

One of the first things new participants ask is what the ballot thresholds are. There are multiple requirements, all of which speak to the strength of the process.

- Response rate: A 75% or greater response rate is required for the ballot to be valid. [11]
- Abstention rate: An abstention rate of less than 30% is required for the ballot to be valid.
- Approval rate: For the ballot to pass, a 75% approval rate is required. [12]

Approve

This is the sub-phase of the standard that involves the process for gaining final approval of the document. Approval is given by the IEEE-SA Standard Board.

Once balloting completes, the sponsor of the standard can initiate the final approval step by forwarding the draft standard to the IEEE-SA Standard Board via the Standards Review Committee (RevCom), one of its standing committees. During this step, a review of the process that the document development went through to ensure that the policies and procedures applicable were properly followed is done. For instance, it is not uncommon for RevCom to look at the responses to binding comments associated with disapprove votes in order to ensure that the proper process of recirculation, if applicable, was followed and that a response to the balloter was indeed written.

As with NesCom, once RevCom completes its review, it will make a recommendation to the IEEE-SA Standard Board. If the Standards Board approves the draft standard, the standard is considered approved and will go to the IEEE-SA professional editorial staff for formal publication.

The working group chair may also want to consider nominating participants for awards and certificates of appreciation to those that played a vital role in the development of the standard once it is approved.

Maintain

This is the sub-phase of the process that involves the maintenance of the document. This could include anything from revising the document, dealing with errata, doing a corrigenda or amendment to the base document as the need arises.

An erratum is typically a typographical or editorial error that can be corrected by issuing an errata sheet. A technical error on the other hand would require that the change be balloted again and this can be done as part of a revision project, amendment project or a corrigendum project. The latter is a special kind of project whose scope is limited to fixing an error in the document.

In addition to errors, there may be a need to revise the standard to update the standard, add to it or revise the entire document. Other projects may involve amending the base standard, which is quite common in IEEE 802.3 for new work. Note that some of these steps may cause a re-start of the steps highlighted above (e.g. to do a revision, corrigendum or amendment).

Finally, there is also a validity period of 10-years for the standard after which if nothing is done, it would be moved into an inactive state.

Process Flexibility, Mobility and Re-Use

As noted earlier, there are a large number of sponsors and a very large number of working groups within the IEEE-SA. Both the process and tools available to the participants make it very easy for participants to re-use that knowledge in other areas. Meaning that the bulk of the process one learns and the tools stay the same between groups and across sponsors. This makes it very easy to start new work or move into a new area.

One example of the flexibility is that the IEEE-SA standardization process allows for two kinds of voting: individual and entity. The method is selected on the PAR form and the bulk of the process , tools and rules that apply, with the exception of who may vote, remains the same making it very easy to use either method. Similarly, if an individual member wanted to ballot on a computer society 802 sponsored standard or a communication society sponsored standard, he/she will find that the tools at sponsor ballot are exactly the same!

IEEE-SA Website

The IEEE-SA website is a great resource for learning more about the standards lifecycle. As noted in the last edition, this website has recently gone through a major set of changes and now has a brand new look. If you are interested in reading more, please go to: http://standards.ieee.org/develop/index.html.

Final Thoughts

In future editions of the eZine we will delve into more details about the other major phases providing examples and tying it back to the lifecycle website.

The IEEE and the IEEE-SA is a unique organization when it comes to the governance and participation in the standards lifecycle as it is open to virtually any volunteer to participate making a truly international organization for participation and governance. This concept is reinforced through the implementation of the lifecycle.

[1] Diab, Wael William, IEEE Standards Lifecycle, IEEE Standards Education e-Magazine, 2nd Quarter 2012.

[2] http://www.ieee802.org/3/.
[3] http://standards.ieee.org/develop/par.html

[4] Taken from the IEEE 802 newcomer orientation presentation. See http://www.ieee802.org/orientation.shtml.

[5] In IEEE 802.3, in addition to the PAR, the study group prepares answers to the 5 criteria that include things like economic feasibility and technical feasibility as well as broad project objectives that the working group will hold the future task force to.

[6] Taken from the IEEE 802.3 working group's study group template presentation. See http://www.ieee802.org/3/WG_tools/templates/index.html.

[7] From the IEEE-SA Standards Board Operations Manual Section 6.4.1: Normative material is information required to implement the standard and is therefore officially part of the standard. See http://standards.ieee.org/develop/policies/opman/sect6.html.

[8] From the IEEE-SA Standards Board Operations Manual Section 6.4.1: Informative material is provided for information only and is therefore not officially part of the standard. See http://standards.ieee.org/develop/policies/opman/sect6.html.

[9] Taken from the IEEE 802.3 working group's task force template presentation. See http://www.ieee802.org/3/WG_tools/templates/index.html.

[10] Note that the non-SA members can also participate but they would need to pay a per-ballot fee

[11] Response rate includes Abstentions

[12] Approval rate does not include Abstentions

Wael William Diab serves as Senior Technical Director in the Office of the CTO at Broadcom Corporation. In this role, Diab is responsible for defining the technical strategy for the Infrastructure & Networking Group (ING). Prior to Broadcom, Diab served at Cisco in various technical, architectural, and business leadership roles, focused on next-generation networking products and technologies. Diab holds BS and MS degrees in Electrical Engineering from Stanford University, a BA degree in Economics from Stanford, and an MBA with honors from the Wharton School of Business. He has developed over 300 patents and patents-pending in the networking space, with over 95 issued patents in the United States.

Diab also is a Senior Member of the IEEE and was unanimously elected and reelected as the Vice-Chair of the IEEE 802.3 Ethernet Working Group, serving in that position since 2008. Diab is a member of the IEEE-SA Standards Board, a member of the IEEE Standards Education Committee (SEC), was elected to the IEEE-SA Corporate Advisory Group (CAG) in 2010 and has served as its Vice-Chair since March 2012. He also serves as the IEEE-MGA liaison to the IEEE-SA and participated on a number of efforts on the IEEE-SA Board of Governors (BoG) sub-committees.

Named winner of the 2011 TechAmerica Innovator Awards for his leadership in Green Technology, Diab was recognized by the David Packard Medal of Achievement and Innovator Awards for his leadership in the development of Broadcom's Energy Efficient Networking solutions. In 2011 Wael was selected to participate in the National Academy of Engineering (NAE)'s 2011 EU-US Frontiers of Engineering. In 2012 he received Computerworld Honors Laureate award on behalf of the work at Broadcom for Energy Efficient Ethernet.

Return to Table of Contents

Overview of IEEE Standards Development

Getting involved in the development of IEEE standards provides you the opportunity to network with industry peers, broaden your understanding of industry and technology, and gain familiarity with the content of standards in which you are involved—facilitating early compliance and anticipating market requirements.

There are many ways to get involved in IEEE standards. You can:

- Submit project request—to start a new standard.
- Join working groups—to develop standards.
- Join invitation pools—to express your interest in voting or balloting on standards.
- Become a member of a balloting group—to vote on the technical integrity of the standard.
- Become an individual or corporate member of the IEEE-SA—to get connected to a community of standards developers and users.
- Become a member of our governance—to ensure the standards process has been followed and to help set the direction of the IEEE-SA.
  » IEEE-SA Standards Board
  » IEEE-SA Board of Governors

Each IEEE standard follows a set path from concept to completion, which adheres to the principles of due process, openness and consensus. These principles allow for equity and fair play so no one interest category dominates the process, and any organization or person with a desire to participate in a proposed standard can do so.

Visit the IEEE Standards Association Second Life site to learn more about the IEEE Standards Association and development process.

Return to Table of Contents

IEEE Standards Education Funny Pages...

This cartoon appears in the book "Ten Commandments of Effective Standards" by Karen Bartleson. Reproduced with permission from Rick Jamison. © Rick Jamison.

Contributions

Have something amusing (cartoon, video) related to standards you'd like to share? Contact our IEEE eZine staff editor Jennifer McClain at j.mcclain@ieee.org.

Return to Table of Contents

Recent and Upcoming Standards Education Events

LEADING GLOBAL STANDARDS ORGANIZATIONS ENDORSE 'OPENSTAND' PRINCIPLES THAT DRIVE INNOVATION AND BORDERLESS COMMERCE

IEEE, IAB, IETF, Internet Society and W3C Invite Other Standards Organizations, Governments and Companies to Support Modern Paradigm for Global, Open Standards

PISCATAWAY, N.J., and WASHINGTON, D.C., United States; GENEVA, Switzerland, and http://www.w3.org/, 29 August 2012 - Five leading global organizations—IEEE, Internet Architecture Board (IAB), Internet Engineering Task Force (IETF), Internet Society and World Wide Web Consortium (W3C)—today announced that they have signed a statement affirming the importance of a jointly developed set of principles establishing a modern paradigm for global, open standards. The shared "OpenStand" principles—based on the effective and efficient standardization processes that have made the Internet and Web the premiere platforms for innovation and borderless commerce—are proven in their ability to foster competition and cooperation, support innovation and interoperability and drive market success.

More....

IEEE Workshop on Engineering Standards

The day-long workshop will be held at City University London on 18 September 2012 to promote Standards education among the masses. The workshop is free and is open to all students and professionals. Session includes a Consensus-Building Group exercise. FUN!

Location: City University London, Northampton Square, London EC1V 0HB, United Kingdom

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Joint ITU/IEEE Workshop on Ethernet -- Emerging Applications and Technologies, 22 September 2012, Geneva, Switzerland

Workshop is to strengthen coordination and cooperation between IEEE and ITU-T in the areas of access and core networking.

International Symposium on Standards in Engineering and Technology (ISSET) at Delhi Technological University, India, 4-6 October 2012

The symposium will focus on the standards in the fields of Smart Grid, Nuclear Power and Computer Technology, with keynotes on standards in the aforementioned three areas to be delivered by eminent industry professionals involved in standards development.

Register today!

ITU Telecommunication Standardization Sector (ITU-T), the Global ICT Standardization Forum for India (GISFI), Dansk Standard (DS), and Aalborg University's Center for TeleInFrastruktur (CTIF) joint Standards Education Workshop at Aalborg University, 8-9 October 2012

The workshop is to build on the outcomes of the ITU Webinar on Standards Education hosted by ITU-T on 30 April 2012, with the objective of exploring the standardization curricula currently offered by different academic institutions.

If you would like to share information or announcements about any recent or upcoming events related to Standards Education, please contact our IEEE eZine staff editor Jennifer McClain at j.mcclain@ieee.org.

Return to Table of Contents

Call for IEEE Standards Education eZine Contributions

The IEEE Standards Education eZine Editorial Board invites contributions from industry practitioners, educators and students on topics related to education about technical standards.
Interested parties may submit an inquiry or article abstract for consideration to the Editorial Board at any time throughout the year via email to: ezine-eb@listserv.ieee.org.

Abstracts should be no longer than 500 words and final articles should be no more than 2,000 words.

Particular areas of interest include, but are not limited to:

standardization activities in technical areas such as Networking Standards;
impact and development of standards in various regions of the world;
best practices and ideas for incorporating standards into the classroom and curricula.
Final contributions should include a 100 word biography of the author(s) and a high-resolution (JPEG) picture. All illustrations must be provided in a high-resolution (JPEG) format. References to all copyrighted material must be properly cited.

Return to Table of Contents

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Return to Table of Contents

IEEE Standards Education eZine Editorial Board

Yatin Trivedi, Editor-in-Chief, is Director of Standards and Interoperability Programs at Synopsys. He is a member of the IEEE Standards Association Standards Board (SASB), Standards Education Committee (SEC), Corporate Advisory Group (CAG), New Standards Committee (NesCom), Audit Committee (AudCom) and serves as vice-chair for Design Automation Standards Committee (DASC). For 2012, Yatin was appointed as the Standards Board representative to IEEE Education Activities Board (EAB). He represents Synopsys on the Board of Directors of the IEEE-ISTO and on the Board of Directors of Accellera. He represents Synopsys on several standards committees (working groups) and manages interoperability initiatives under the corporate strategic marketing group. He also works closely with the Synopsys University program.

In 1992, Yatin co-founded Seva Technologies as one of the early Design Services companies in Silicon Valley. He co-authored the first book on Verilog HDL in 1990 and was the Editor of IEEE Std 1364-1995™ and IEEE Std 1364-2001™. He also started, managed and taught courses in VLSI Design Engineering curriculum at UC Santa Cruz extension (1990-2001). Yatin started his career at AMD and also worked at Sun Microsystems.

Yatin received his B.E. (Hons) EEE from BITS, Pilani and the M.S. Computer Engineering from Case Western Reserve University, Cleveland. He is a Senior Member of the IEEE.

Amin Karim is a visiting professor at the college of engineering and information science at DeVry University. Prior to this position, he served as the national Dean of the College of Technology at DeVry. He is a past Chair of the Electronics and Computer Engineering Technology Department Heads Association of the American Society for Engineering Education and served as a TAC of ABET evaluator for engineering technology programs. He is a member of the IEEE Standards Education Committee.

Wael William Diab serves as Senior Technical Director in the Office of the CTO at Broadcom Corporation. In this role, Diab is responsible for defining the technical strategy for the Infrastructure & Networking Group (ING). Prior to Broadcom, Diab served at Cisco in various technical, architectural, and business leadership roles, focused on next-generation networking products and technologies. Diab holds BS and MS degrees in Electrical Engineering from

Stanford University, a BA degree in Economics from Stanford, and an MBA with honors from the Wharton School of Business. He has developed over 300 patents and patents-pending in the networking space, with over 75 issued patents in the United States.

Diab also is a Senior Member of the IEEE and was unanimously elected and reelected as the Vice-Chair of the IEEE 802.3 Ethernet Working Group, serving in that position since 2008. Diab is a member of the IEEE-SA Standards Board, a member of the IEEE Standards Education Committee (SEC), was elected to the IEEE-SA Corporate Advisory Group (CAG) in 2010 and has served as its Vice-Chair since March 2012. He also serves as the IEEE-MGA liaison to the IEEE-SA and participated on a number of efforts on the IEEE-SA Board of Governors (BoG) sub-committees.

Named winner of the 2011 TechAmerica Innovator Awards for his leadership in Green Technology, Diab was recognized by the David Packard Medal of Achievement and Innovator Awards for his leadership in the development of Broadcom's Energy Efficient Networking solutions.

Bruce Harding is professor of mechanical engineering technology and coordinator of professional practice at Purdue University.

Professor Harding's scholarship and engagement activities revolve around the development and application of American National and ISO standards dealing with Technical Product Documentation (TPD) as it broadly relates to product realization, green manufacturing and other technical aspects of product lifecycle management (PLM).
He is active on a number of American National standards developing committees, and chairs the US Technical Activities Group (TAG) to ISO. He is ASME vice-president for Standardization and Testing, overseeing development of American National Standards for fasteners, geometric dimensioning and tolerancing, metrology, tools, pallets, threads, gaging, plumbing fixtures, metal mill products, chemical pumps, instrumentation, performance test codes and others.

Internationally, he has served as a US Delegate to APEC and has served as the Head of Delegation to ISO Technical Committee meetings in North America, Asia, Oceania, and Europe. Currently he chairs the 62-country ISO/TC10 committee on Technical Product Documentation, whose Secretariat is based in Sweden. The committee writes worldwide standards for technical product documentation for PLM.

Editorial Board Corresponding Members:

David Law is a Distinguished Engineer at Hewlett-Packard Networking and has worked on the specification and development of Ethernet products since 1989. Throughout that time he has been a member of the IEEE 802.3 Ethernet Working Group where he has held a number of leadership positions. He served as the Vice-Chair of IEEE 802.3 from 1996 to 2008 and in 2008 was elected to Chair of IEEE 802.3. David has been a member of the IEEE-SA Standards Board since 2005, has served as the Chair of IEEE-SA Standards Board Review Committee (RevCom) since 2008, and is currently serving as the Vice-Chair of the IEEE Standards Education Committee. In 2000 he received the IEEE-SA Standards Medallion for 'leadership and technical contributions to Ethernet networking standards' and in 2009 he received the IEEE Standards Association Standards Board Distinguished Service award 'For long term service to improve the operation and integrity of IEEE-SA governance'. David has a BEng (hons) in Electrical and Electronic Engineering from Strathclyde University, Glasgow, Scotland.

Donald Heirman is president of Don HEIRMAN Consultants which is a training, standards, and educational electromagnetic compatibility (EMC) consultation corporation. Previously he was with Bell Laboratories for over 30 years in many EMC roles including Manager of Lucent Technologies (Bell Labs) Global Product Compliance Laboratory, which he founded, and where he was in charge of the Corporation's major EMC and regulatory test facility and its participation in ANSI accredited standards and international EMC standardization committees.

He chairs, or is a principal technical contributor to, US and international EMC standards organizations including ANSI ASC C63® (immediate past chairman), the Institute of Electrical and Electronics Engineers (IEEE), and the International Electrotechnical Commission's (IEC) International Special Committee on Radio Interference (CISPR). He was named chairman of CISPR in October 2007. He is a member of the IEC's Advisory Committee on EMC (ACEC) and the Technical Management Committee of the US National Committee of the IEC.

In November 2008 he was presented with the prestigious IEC Lord Kelvin award at the IEC General Meeting in Sao Paulo, Brazil. This is the highest award in the IEC and recognizes Don's many contributions to global electrotechnical standardization in the field of EMC. He is a life Fellow of the IEEE and an honored life member of the IEEE EMC Society (EMCS) and member of its Board of Directors, chair of its technical committees on EMC measurements and Smart Grid, vice president for standards, past EMCS president, and past chair of its standards development committee. He is

also past president of the IEEE Standards Association (SA), past member of the SA Board of Governors and past member of the IEEE's Board of Directors and Executive Committee. He is also the Associate Director for Wireless EMC at the University of Oklahoma Center for the Study of Wireless EMC. Currently he is a voting member of the Smart Grid Interoperability Panel and its Testing and Certification Committee. In addition he is a focus leader on the NIST Electromagnetic Interoperability Issues Working Group which is providing EMC recommendations for Smart Grid equipment and systems.

IEEE Standards Education eZine Editor: Jennifer McClain

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Return to Table of Contents
