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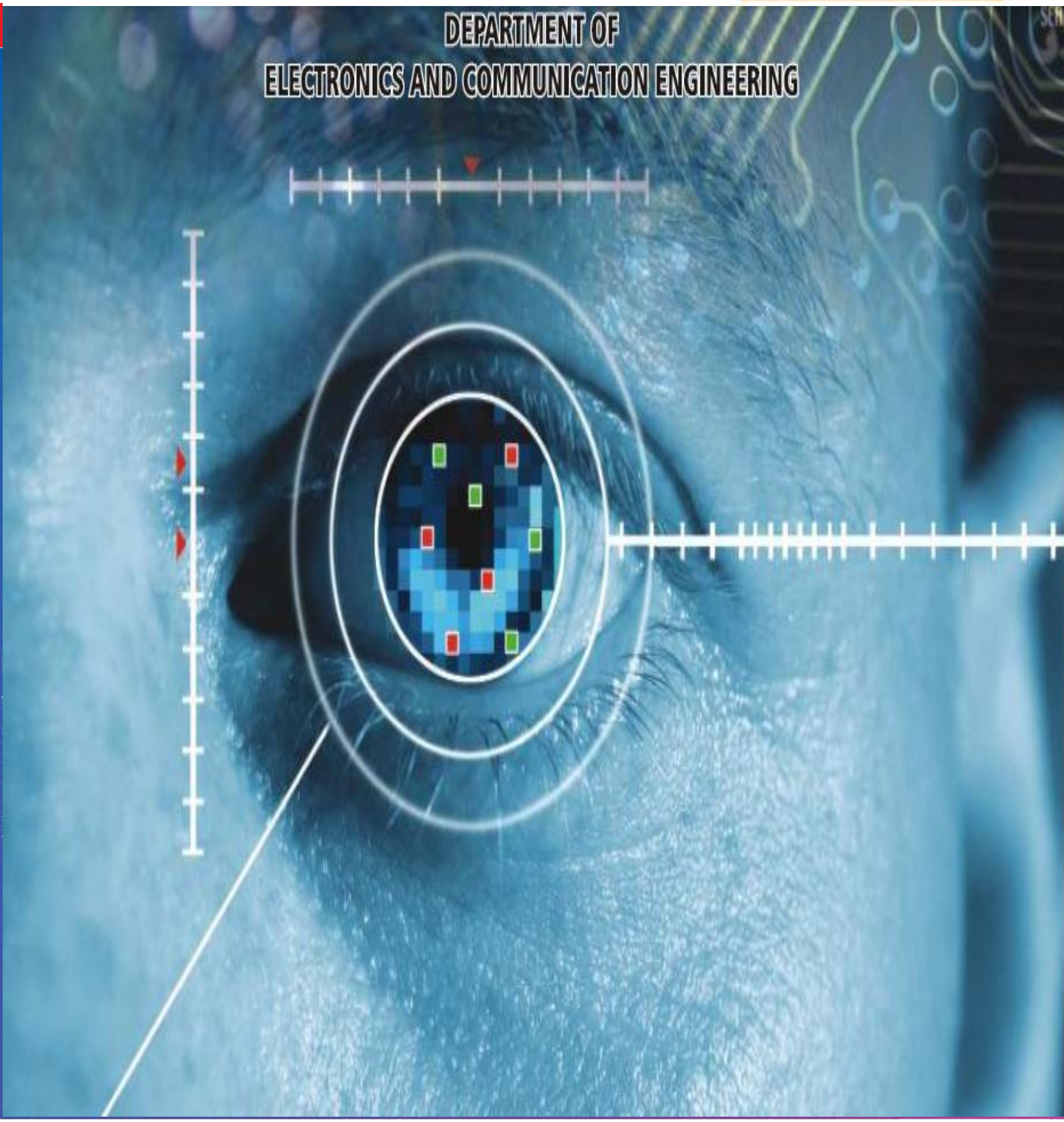
ELECSPIRE

March, 2018



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Message from Chairman

Sri Ch. Venu Gopal Reddy
Chairman, Bharat Institutions

I am quite pleased to learn about the forthcoming issue of the department magazine, 'ELECSPIRE'. This provides an intersection of great challenge and great opportunity for the students to review their efforts and to analyze their achievements in research and development. Technology is evolving at a dizzying rate and our classrooms may not be designed to keep pace with it. There may be a lot wrong in the style of education but the pages of ELECSPIRE tell the tale of all that have been a part of what is right about the education they get in ECE. As I understand, this magazine is intended to bring the inherent literary talents in the students and the teachers and also to inculcate leadership skills among them. I am confident that this issue will send a positive signal the staff, students and the persons who are interested in the educational and literary activities.

Message from Sr. Director

Prof. G. Kumara Swamy Rao
Sr Director, BIET

I take this opportunity to congratulate the editorial board for bringing out this magazine as per schedule, which in itself is an achievement considering the effort and time required. May all our students soar high in uncharted skies and bring glory to the world and their profession with the wings of education! It gives me immense pleasure to pen a few words as prologue to the first volume of the technical magazine ELECSPIRE exclusively meant for churning out the latent writing talent which bears immense potentiality of sharpening the student's skills as part of their overall personality development. I congratulate all the contributors for bringing out such a beautiful magazine.

Message from Director- Centre of Excellence

Dr R. Sree Hari Rao
Director, Centre of Excellence, BIET

I congratulate the department of ECE, BIET for bringing out the first issue of the prestigious department technical Magazine, ELECSPIRE , I am sure that the magazine will provide a platform to the students and faculty members to expand their technical knowledge and sharpen their hidden literary talent and will also strengthen the all round development of the students. I am hopeful that this small piece of literary work shall not only develop the taste for reading among students but also develop a sense of belonging to the institution as well. My congratulations to the editorial board who took the responsibility for the arduous task most effectively. I extend best wishes for the success of this endeavour.

Message from Director- Research and Developement

Dr S.K. Chaudhuri
Director-R&D, BIET

It is an occasion of great pride and satisfaction for the department of ECE, BIET to bring out the first issue of the Technical magazine ELECSPIRE. It gives me immense pleasure to note that the response to the magazine has been overwhelming. The role of a college magazine is there-fore vital in promoting what an institution offers. It brings out into the open things hitherto unrevealed. It brings to light the names of the unsung heroes and their mighty deeds. The wide spectrum of articles gives us a sense of pride that our students and faculties possess creative potential and original thinking in ample measures. Each article is entertaining interesting and absorbing. I applaud the contributors for their stimulated thoughts and varied hues in articles contributed by them

Message from Principal

Dr E. Venkat Reddy
Principal, BIET

It gives me great pleasure to know that 'ELECSPIRE', ECE's department magazine 2017-18 is ready for publication. True to its name, this magazine gives an insight into the range and scope of the imagination and creativity of our students and faculty members. I applaud the editorial team for the hard work and dedication they have invested in realizing this goal, and wish my dear students success in all future endeavors. I congratulate the team of students and the faculty for their tireless efforts that have come to fruition in the form of this magazine. I wish it all success and hope that this tradition that has been set by the current students will be carried through by the following generation of students to come.

Message from Director- Training and Placement

Dr B. Prasad Rao
Director-Training and Placement, BIET

I am happy to see the amount of enthusiasm of eminent members of the college to contribute to the magazine. Not to be outdone, our students have devoted time and plunged into creating powerful sto ing powerful stories that present a compelling, timely and honest portrait of the college and its extended family. I congratulate all the contributors for bringing out such a beautiful magazine. do appreciate and applaud the editorial team for their successful completion of this tedious yet daunting task of putting together the myriad thoughts and dreams of our students. The role of a college magazine is there-fore vital in promoting what an institution offers. It brings out into the open things unrevealed. It brings to light the names of the unsung heroes and their mighty deeds.

INSTITUTE VISION:

To achieve the Autonomous and University status and spread universal education by inculcating discipline, character and knowledge into the young minds and mould them into enlightened citizens.

INSTITUTE MISSION:

Our mission is to impart high quality education, in a conductive ambience, as comprehensive as possible, with the support of all the modern technologies and make the students acquire the ability and passion to work wisely, creatively and effectively for the betterment of our society

VISION OF ELECTRONICS AND COMMUNICATION DEPARTMENT

The vision of the Department of Electronics and Communication Engineering is to effectively serve the educational needs of local and rural students within the core area of electronics and communication engineering and develop high quality engineers and responsible citizens.

MISSION OF ELECTRONICS AND COMMUNICATION DEPARTMEN

The mission of the Department of Electronics and Communication Engineering is to work closely with industry, research organizations to provide high quality education in both theoretical and practical applications of electronics and communication engineering.

Program Outcomes

PO1:Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2:Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3:Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO:4:Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5:Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6:The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7:Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8:Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9:Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10:Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11:Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12:Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes

PSO1:Professional Skills: An ability to understand the basic concepts in Electronics & Communication Engineering and to apply them to various areas, like Electronics, Communications, Signal processing, VLSI, Embedded systems etc., in the design and implementation of complex systems.
PSO2:Problem-Solving Skills: An ability to solve complex Electronics and communication Engineering problems, using latest hardware and software tools, along with analytical skills to arrive cost effective and appropriate solutions.
PSO3:Successful Career and Entrepreneurship: An understanding of social-awareness & environmental-wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real-world applications using optimal resources as an Entrepreneur.

Program Educational Objective

Program Educational Objective 1: (PEO1)

Graduates will be able to synthesize mathematics, science, engineering fundamentals, laboratory and work-based experiences to formulate and solve engineering problems in Electronics and Communication engineering domains and shall have proficiency in Computer-based engineering and the use of computational tools design of electronics systems.

Program Educational Objective 2: (PEO2)

Graduates will succeed in entry-level engineering positions within the core Electronics and Communication Engineering, computational or manufacturing firms in regional, national, or international industries and with government agencies.

Program Educational Objective 3: (PEO3)

Graduates will succeed in the pursuit of advanced degrees in Engineering or other fields where a solid foundation in mathematics, basic science, and engineering fundamentals is required.

Program Educational Objective 4: (PEO4)

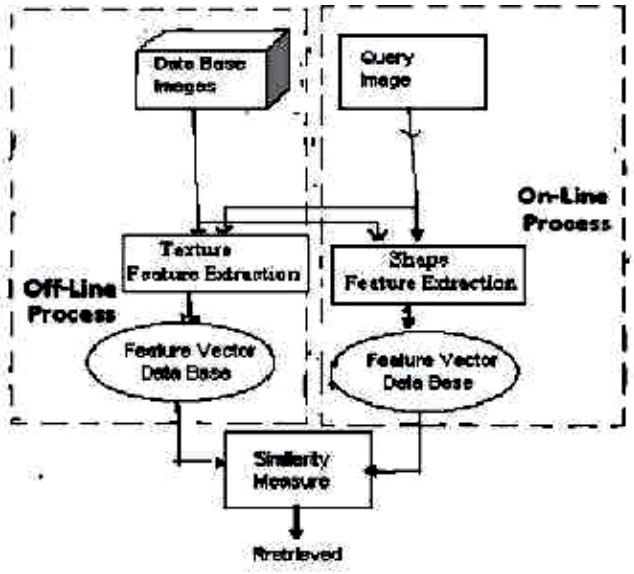
Graduates will be prepared to communicate and work effectively on team based engineering projects and will practice the ethics of their profession consistent with a sense of social responsibility.

Program Educational Objective 5: (PEO5)

Graduates will be prepared to undertake Research and Development works in the areas of Electronics and Communication fields.

High Performance Medical Image Retrieval using Multiple Features

Mrs. CH. Kranthirekha
Associate Professor, ECE Dept



Medical images are important diagnostic evidence because they Can provide imperative information about anatomical pathology. The growth of Medical images in database is enormous in the past few years when the medical digital image equipments such as CT, MRI, and PET-CT are used in the clinic works. The goals of medical information systems have often been defined to deliver the needed information to the right persons at the right time, the right place in order to improve the quality and efficiency of care process. Content Based Image Retrieval (CBIR) systems allow users to query based on the image content (color, texture, shape etc), which are analyzed and extracted automatically by computer to achieve the effective retrieval.

Content Based Image Retrieval (CBIR) systems feature can be extracted using image content (color, texture, shape, etc.).in CBMIR for diagnostic gray scale images will be used on this concept texture & shape feature are extracted.. Now medical images are mainly gray images.

Texture is a fundamental important visual feature in image description that refers to innate surface properties of an object and their relationship of the surrounding. Texture describes the structural arrangement of a region and the relationship of the surrounding regions. A wide variety of texture analysis methods have been developed. Wavelet is quite appropriate for texture description but can't distinguish the texture patterns with similar spatial directional properties. To overcome these drawback dual tree complex wavelet transform (DT- CWT) is introduced. A new Texture features along with shape features integration with clustering which provides good retrieval performance. To perform CBMIR, entire image considered as mosaic of different texture regions and representation of images at region level is more close to human perception system. Each textured region of the images in the database Call be characterized with clustering segmentation and feature vector were formed describing the texture for retrieval purpose. Shape features have been one of the most important and effective low level visual features in characterizing many pathologies. Shape feature extraction methods can usually divided into contour- based and region-based Contour-based shape feature extraction methods extract shape information from boundary of entity which contains boundary information. However, region-based shape features extraction methods which extract the interior shape information from all the pixels within entity. Commonly used contour-based shape feature extraction methods include Fourier descriptors, wavelet descriptors, curvature scale space descriptors, shape signatures, movements and function of movements etc. Fourier descriptor method is one of the most elementary and widest used methods among these contour-based shape feature extraction methods.

Asimo Robot

Mr. G. Kishore
Asst Professor, ECE Dept

Robots, the suppositious concept that has been demonstrated a million times in movies, comes to life with the brilliant exertion of Honda. ASIMO or Advanced Step in Innovative Mobility is a state-of the-art humanoid robot created by Honda in the year 2000. Aimed to be a multi-functional portable assistant, ASIMO is intended to function in real- world environments. The creation of ASIMO was envisioned to help people who are bed ridden or disabled. ASIMO beats humans in tasks which can be devastatingly dangerous for them for instance, going in hazardous areas, scrapping fires or defusing a bomb. The composition of ASIMO has been kept purely welcoming and friendly. The era of robots existence has been a topic of continuous debates and has invited numerous advantages and disadvantages of the actuality of robots but, Honda with its very first creation has proved that robots can Operate efficiently. Honda, with the joint efforts of its eccentric robotic research and development team, successfully launched ASIMO after 20 years of consecutive hard work. Following this ASIMO team continues to excel and refine their wonderful creation. Below are ASIMO's configurations:

Height: The brainy master piece stands tall with the height of 4 ft. 3 in. and weighs around 48 kg further making it a welcoming robot. The average height of ASIMO brands it a participant of comfortable conversations with the elderly and people with less mobility. Its companionable height makes it a perfect size for assisting household tasks and people confined to bed or wheel chairs.

Skills: ASIMO was tossed with a purpose of aiding the needs of the elderly and disabled as well as manage household errands. ASIMO has human like features as it can make gestures, speak and interact like humans which makes it a friendlier robot. ASIMO holds the capability to sense the movements of numerous objects while capturing visual information by it's camera eyes. Determination of direction and distance is also done by the two camera eyes of ASIMO. The former features of ASIMO enables human like features.

Movement: ASIMO is accomplished in average walking with a speed of 2.7 kilometers per hour. Talking about running speed, ASIMO can run with an average speed of around 9 kilometers per hour. The movements of ASIMO are managed by aimed Zero Moment Point control as well as floor reaction control that allows ASIMO to stay firm at a particular position and maintain it healthily. The body position, length of steps and speed are adjustable by ASIMO. ASIMO's hands, legs, waist and neck have variable degrees of movement. The degree of freedom is defined specifically of each robot and to frame further, ASIMO has 57 degree of freedom. The fundamental body parts of ASIMO like wrist, shoulder, hip joints and neck individually has around three degrees of freedom whereas, hands with one thumb and four fingers have two degrees of freedom. For determination of obstacles, ASIMO has visual sensors. In totality, ASIMO has sensors which helps it in autonomous navigation. The lower portion of ASIMO has one infrared sensor and one laser sensor. The infrared sensors help ASIMO determine the floor patterns to confirm the navigational path of strategic map while the laser sensor aids ASIMO to sense ground surface.

Other Specifications of ASIMO:

Battery: ASIMO runs on a Lithium ion battery which is fixed in its backpack and takes 3 hours to completely charge ASIMO. The battery weighs around 6 kg.

Operating Time: ASIMO can successfully run or walk for a good one hour.

Languages: ASIMO is skilled in English and Japanese language.

The latest version of ASIMO was released in 2011 which came installed with more modified sensors and more balancing powers than its previous incarnations. ASIMO's most recent update comes with dexterous hands and refined touch sensors. To conclude, artificial intelligence has brilliantly taken birth in the present generation with one live example, ASIMO which in present time imparts lectures and teachings in various colleges. ASIMO has made presence in Disneyland and also at NASA which makes ASIMO a star of every world and in the other parallel worlds.

Li-Fi: A New Paradigm in Wireless Communication

Mr. T.V. Suresh
Asst. Professor, ECE Dept

Lighting reaches nearly everywhere, so communications can ride along for nearly free. Think of a TV remote in every LED light bulb and you‘ll soon realise the possibilities of communications using visible light also dubbed as Li-Fi. Most of us are familiar with Wi-Fi (Wireless Fidelity), which uses 2.4-5GHz RF to deliver wireless Internet access around our homes, schools, offices and in public places. We have become quite dependent upon this nearly ubiquitous service. But like most technologies, it has its limitations. While Wi-Fi Can cover an entire house, its bandwidth is typically limited to 50-100 megabits per second (Mbps).

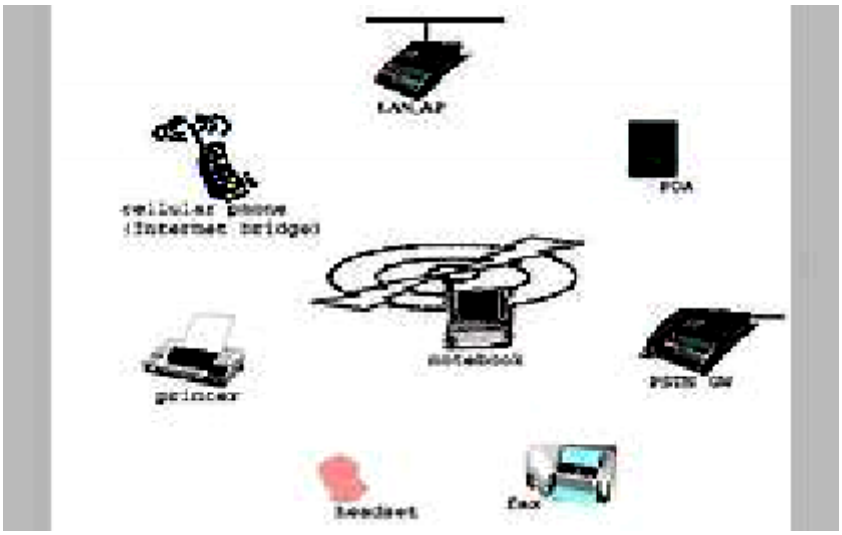
The more we become dependent upon ’the Cloud’ or our own ‘media servers’to store all of our files, including movies, music, ictures and games, the more we will want bandwidth and speed. Therefore RF-based technologies such as today’s Wi-Fi are not the optimal way. In addition, Wi-Fi may not be the most efficient way to provide new desired capabilities such as precision indoor positioning and gesture recognition. Optical wireless technologies, sometimes Called visible light communication (VLC), and more recently referred to as Li-Fi (Light Fidelity), on the other hand, offer an entirely new paradigm in wireless technologies in terms of communication speed, flexibility and usability.

Imagine yourself walking into a mall where GPS signals are unavailable but the mall is equipped with ceiling bulbs that create their own ‘constellation‘ of navigation beacons. As the Camera of your cell phone automatically receives these signals, it switches your navigation software to use this information to guide you to the ATM machine you‘re looking for; you conclude your ATM transaction and notice the Giga Spot sign for instant digital movie downloads. You pick out that new Tom Cruise movie using your phone’s payment facility, and then download within a few seconds the high-definition movie into the Giga Link flash drive plugged into the USB port of your smart phone. As you walk away, your phone notifies you that the leatherjacket Tom featured in the movie is on sale nearby. You walk over towards the show window and your image comes up on the screen, wearing that coveted jacket. You turn and pose while the image matches your orientation and body gestures for a ’digital fitting.’ When you walk into the store, the clerk hands you the actual jacket in exactly your size. First applications of Li-Fi have been put to use already, for example, in hospitals where RF signals are a threat due to interference problems with medical equipments.

GI-FI

Mr. Ch. Raghvendra Vamshi
EC-IVth Year, ECE Dept

Gi-Fi will helps to push wireless communications to faster drive. For many years cables ruled the world. Optical fibers played a dominant role for its higher bit rates and faster transmission. But the installation of cables caused a greater difficulty and thus led to wireless access. The foremost of this is Bluetooth which can cover 9-10mts. Wi-Fi followed it having coverage area of 91 mts. No doubt, introduction of Wi-Fi wireless networks has proved a revolutionary solution to "last mile" problem. However, the standard's original limitations for data exchange rate and range, number of changes, high cost of the infrastructure have not yet made it possible for Wi-Fi to become a total threat to cellular networks on the one hand, and hard-wire networks, on the other. But the man's continuous quest for even better technology despite the substantial advantages of present teChnologies led to the introduction of new, more up-to-date standards for data exchange rate i.e., Gi-Fi.



Gi-Fi or Gigabit Wireless is the world's first transCeiver integrated on a single chip that operates at 60GHz on the CMOS process. It will allow wireless transfer of audio and video data upto 5 gigabits per second, ten times the current maximum wireless transfer rate, at one- tenth of the cost, usually within a range of 10 meters. It utilizes a Smm square chip and a 1 mm wide antenna burning less than 2m watts of power to transmit data wirelessly over short distance, much like Bluetooth.

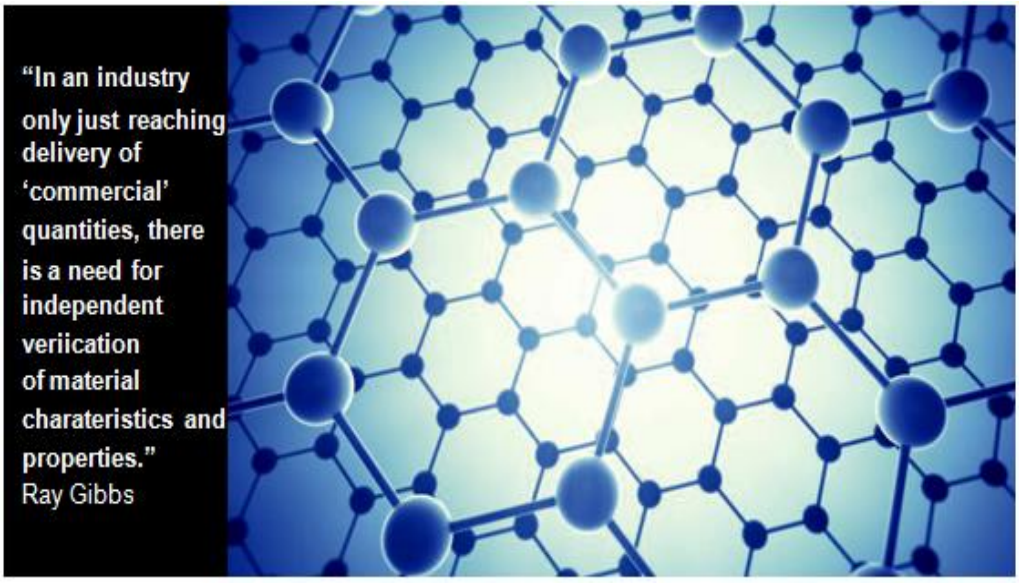
The development will enable the truly wireless office and home of the future. As the integrated transceiver is extremely small, it can be embedded into devices. The breakthrough will mean the networking of office and home equipment without wires will finally become a reality. a low cost, low power and high broadband chip, which will be vital in enabling the digital economy of the future.

Characterization Service for Graphene

Mr V. Pradeep Kumar
Asst. Professor, ECE Dept

Graphene, in its commercial form, can come as lakes, in a powder or as a liquid, but each comes with a variation in their properties, yield, and the reproducibility of the product.

For commercialization to be achieved, material standardization will be crucial but, as with all new technologies, international standards for Graphene are in their infancy. As a result, manufacturers are unable to verify that the Graphene that they are working with has the desired properties. In fact, as the market is unregulated, companies cannot even be sure what material they are buying. In response to this, the new Graphene characterization service, led by the organizations leading the standard for Graphene, will allow companies to understand the properties of the material they are working with in greater detail.



Both NPL and NGI hoping that the service will help to accelerate the industrialization of Graphene in the UK – forging the link between Graphene research and development, and its application in next generation products. According to Andrew independent Pollard, Science Area Leader verification of the Surface Technology of material Group, "Every industry is eagerly awaiting the characteristics and introduction of Graphene technologies, but the lack of standardised measurements have long been a stumbling block for wide industrial implementation.

By introducing this service, alongside the development of international standards, to the UK's emerging Graphene economy it will help to accelerate the commercialization of next generation technologies. Hailed as a 'wonder material', Graphene has the potential for improving a host of applications including inexpensive water purification systems; greener, more efficient cars and planes; flexible phones and solar cells, and even biomedical applications such as wound healing and cancer treatments. Even Internet of Things technologies are set to beneit from wider Graphene use as a result of more effective sensors. First isolated in the UK by researchers at the University of Manchester, where the NGI is based, the early adopters of grapheme technology are already seeing beneits, but in order to fulil its in the Graphene industry helping to foster Graphene innovation hubs across the UK, Ray Gibbs, CEO

at Haydale Graphene Industries, said: “As Chairman of the Joint Working Group on Graphene Standardization between China and the UK, I am acutely aware of the importance of accurate measurement and characterization of Nano-materials “This initiative will help bridge the gap between industry looking to promote its products and the consumers who need to be certain of materials and their properties. Delivery of this will ensure consistent repeatable quality materials are available, essential for commercial uptake. “In an industry only just reaching delivery of ‘commercial’ quantities, there is a considerable need for independent verification of material characteristics and properties.”

Analogue Testing Techniques

Dr Vikas Maheshwari
Associate Professor, Dept of ECE

Manufacturing test is an important part of product development and an incomplete test can result in defective parts being delivered to customers. These test escapes - the bad parts that escape test - result in parts being returned especially when target defect rates below one defective per part million (DPPM) are the goal of manufacturers. There is always an issue to be found and it's true to say that some applications are particularly sensitive to them. In addition, test is a significant component of the recurring cost of a product and directly impacts on the profitability of a design. The expense of testers and the time spent testing each die will contribute significantly to the final cost of a product. Finally, test is also a consideration in winning sockets. The better the quality of the samples delivered for prototype evaluation, the more likely the design of the product will be successful, with the caveat that test development time should not impact the delivery schedule. Compared to digital design, one of the big differences in the design methodology is how test is addressed by analogue designers. Digital designers have tools to automatically include testability into their designs. This allows them to generate test patterns and assess the test coverage and implications on the additional area overhead. These tools are based on the concept of faults. By injecting faults, the ability of test to identify failures can be analyzed and coverage reported. Coverage is the percentage of failures that the test can identify. For digital designers, the concept of faults - stuck-at-low, stuck-at-high, and traditional fault model - are sufficient to enable the automation of test.

Analogue testing

Traditionally, analogue testing has focused on the functionality and parametric performance of the die such that the circuit operates as it was designed. As a result, it has been a challenge for designers to apply the concept of faults to analogue design. Faults need to be defined for each macroscopic characteristic of the design - for example, the open loop gain fault, the offset voltage fault, and so forth. Defining the faults and the failure modes for analogue circuits has proven challenging and difficult to correlate to DPPM. An alternative approach has been proposed, called defect-oriented test simulation. Instead of trying to define faults for every circuit characteristic, the approach focuses on defects.

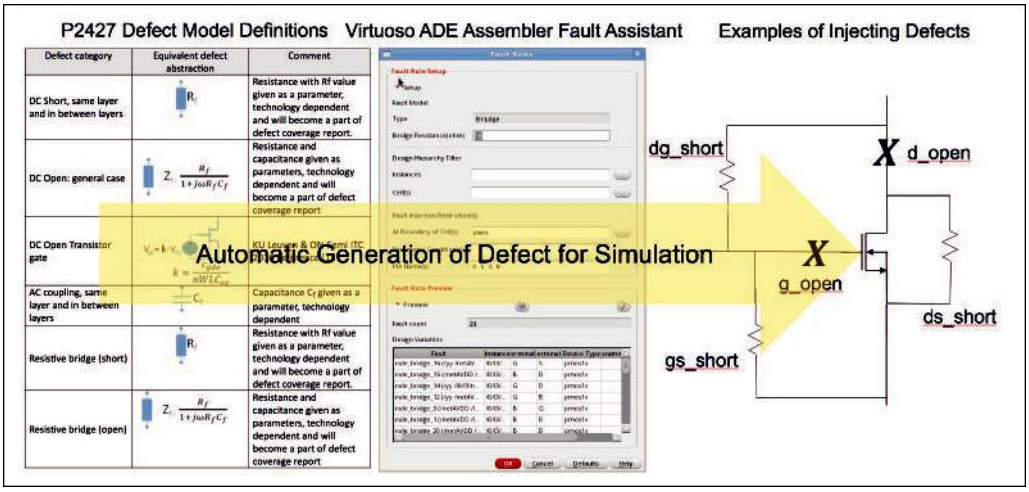


Figure 1: Generating defects for simulation

Defects may be due to issues in the manufacturing process – for example, incomplete etching of the metal that results in shorts between two adjacent metal interconnect lines going over a step. Defect-oriented testing targets such anomalies in the circuit structure while applying the stimuli, observes their effects on circuit characteristics and assesses the number of defects in the structure that may become detected during production test.

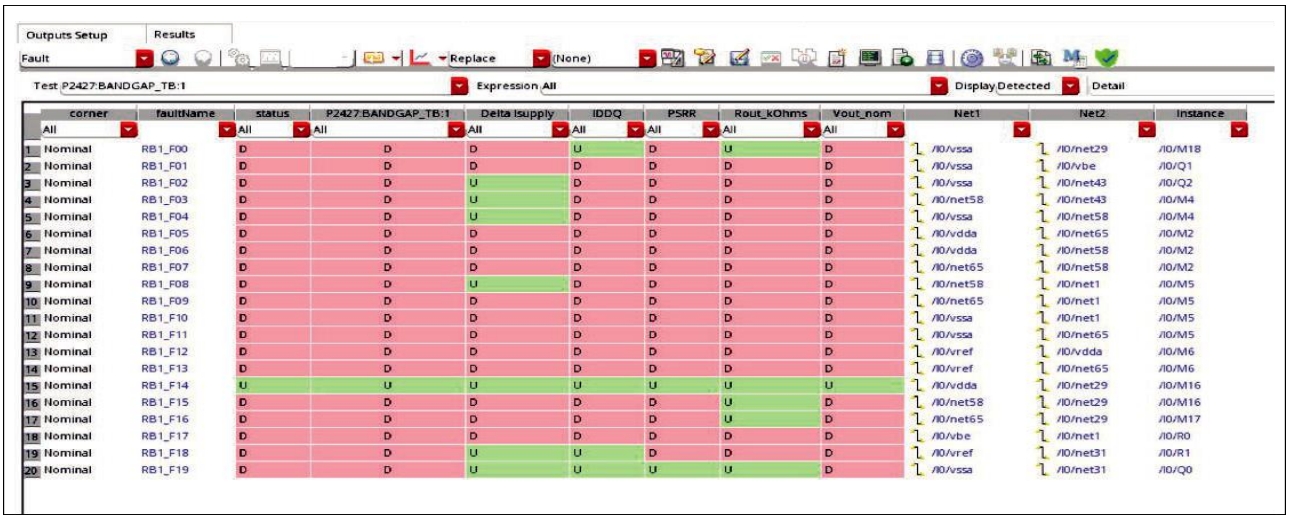
As such, defect-oriented testing does not necessarily replace existing specification-based test. It is rather seen as a means to quantify the effectiveness of a certain test and provide information as to whether action needs to be taken to improve the test quality. As this methodology has matured, an IEEE P2427 working group has been launched to define a standard for modeling manufacturing defects for simulation.

Standardizing the models for defects has allowed development of tools to perform the simulation with defects, so that analogue designers now can have a tool to simulate production test set-up and evaluate its effectiveness. Defects are modeled as low-valued resistors for shorts and high-valued impedances for opens. Figure 1 illustrates how this simulation methodology has been realized in the Cadence Legato Reliability Solution. Using the fault assistant in the Cadence Virtuoso ADE Assembler, the defect models have been converted into rules. The rules are used to define where the defects are injected into the circuit. The Virtuoso ADE Assembler generates a list that can be used by the Cadence Spectre Accelerated Parallel Simulator to perform defect simulation. Each defect is simulated, and the simulation results are compared to the test limits to determine whether the test identifies a defect. To better understand the how to simulate analogue test, let's look at an example.

The device under test is a bandgap reference. The first point to keep in mind is that the production test is being simulated. The test bench is based on the load board used in the tester and the test stimulus. The production test programme consists of f ive tests:

1. IDDQ, the quiescent power supply current
2. Vout, the bandgap reference output voltage
3. Rout, the output resistance of the bandgap reference
4. PSRR, the power supply rejection of the output voltage
5. Delta I supply, the change of the power supply current with power supply voltage

After creating the test bench, setting up the tests, and defining the measurements, the next step in the process is to use the Fault Assistant to define the rules for identifying the defects to be simulated. For the device under test, we will look for the defects caused by device failures due to junction shorts. Shown in Figure 2 are the simulation results for the device defects. The test coverage for the test program is high; however, the test misses one defect – namely fault "RB1_F11" in the picture above.



	corner	faultName	status	P2427:BANDGAP_TB:1	Delta Isupply	IDDQ	PSRR	Rout_kOhms	Vout_nom	Net1	Net2	Instance
	All		All	All	All	All	All	All	All			
1	Nominal	RB1_F00	D	D	D	U	D	U	D	/I0/vssa	/I0/net29	/I0/M18
2	Nominal	RB1_F01	D	D	D	D	D	D	D	/I0/vssa	/I0/vbe	/I0/Q1
3	Nominal	RB1_F02	D	D	U	D	D	D	D	/I0/vssa	/I0/net43	/I0/Q2
4	Nominal	RB1_F03	D	D	U	D	D	D	D	/I0/net58	/I0/net43	/I0/M4
5	Nominal	RB1_F04	D	D	U	D	D	D	D	/I0/vssa	/I0/net58	/I0/M4
6	Nominal	RB1_F05	D	D	D	D	D	D	D	/I0/vdda	/I0/net65	/I0/M2
7	Nominal	RB1_F06	D	D	D	D	D	D	D	/I0/vdda	/I0/net58	/I0/M2
8	Nominal	RB1_F07	D	D	D	D	D	D	D	/I0/net65	/I0/net58	/I0/M2
9	Nominal	RB1_F08	D	D	U	D	D	D	D	/I0/net58	/I0/net1	/I0/M5
10	Nominal	RB1_F09	D	D	D	D	D	D	D	/I0/net65	/I0/net1	/I0/M5
11	Nominal	RB1_F10	D	D	D	D	D	D	D	/I0/vssa	/I0/net1	/I0/M5
12	Nominal	RB1_F11	D	D	D	D	D	D	D	/I0/vssa	/I0/net65	/I0/M5
13	Nominal	RB1_F12	D	D	D	D	D	D	D	/I0/vref	/I0/vdda	/I0/M6
14	Nominal	RB1_F13	D	D	D	D	D	D	D	/I0/vref	/I0/net65	/I0/M6
15	Nominal	RB1_F14	U	U	U	U	U	U	U	/I0/vdda	/I0/net29	/I0/M16
16	Nominal	RB1_F15	D	D	D	D	D	U	D	/I0/net58	/I0/net29	/I0/M16
17	Nominal	RB1_F16	D	D	D	D	D	U	D	/I0/net65	/I0/net29	/I0/M17
18	Nominal	RB1_F17	D	D	D	D	D	D	D	/I0/vbe	/I0/net1	/I0/R0
19	Nominal	RB1_F18	D	D	U	U	D	D	D	/I0/vref	/I0/net31	/I0/R1
20	Nominal	RB1_F19	D	D	U	U	U	U	D	/I0/vssa	/I0/net31	/I0/Q0

Figure 2: Defects Simulation Test Result

The reason that this defect is not found by the test is that the defect is in the start-up circuit and all the tests are performed on the circuit during normal operation, that is, after the start-up circuit has turned off. Since the start-up circuit is not active when the tests are performed, it is not found. To achieve 100% test coverage, a new test would need to add a test that measures the circuit during start-up. Here we have looked at the challenges to consider in the

testability of analogue designs, and the significant progress that's been made in the methodology for simulating analogue test. Using a simple example of using defect-oriented test to simulate a production test, in order to calculate the test coverage, we've been able to demonstrate how a new low allows analogue designers to evaluate the test program along with the testability of the design early in the design low resulting in shortened test times – and thus translating into reduced production costs.

Managing Power Sequencing

Mr M.B.R. Srinivas
Assistant Professor, Dept of ECE

Microprocessors, FPGAs, DSPs, analogue-to-digital converters (ADCs), and system-on- chip (SoC) devices typically run from multiple voltage rails. To prevent lock-ups, bus contention issues, and high inrush current, designers need these power rails to be started and shutdown in a speciic order in a process known as power sequence control or power sequencing. Some designs may necessitate different sequences, but in any case, proper power-up and power-down sequencing is necessary. The various power sequencers, monitors and supervisors that have emerged to provide effective ramp up and shutdown have also adopted techniques to monitor voltage and current levels to calculate power levels in protect complex integrated circuits and sub-assemblies.

FPGAs and similar complex ICs are broken down internally into many power domains which require a specific order when starting up or shutting down the device. The core typically comprises the processor and logic foundation of the FPGA. This domain is characterized by a low voltage and high current power profile. Due to the extremely low voltage, there are very high accuracy requirements, and due to the dynamic nature of the digital load, transient performance must be excellent. Auxiliary circuitry comprises the noise-sensitive analogue circuits in an FPGA, such as phase-locked loops (PLLs) and other analogue circuit elements. Current requirements are reasonably low, but ripple voltage is a major concern and must be minimized to avoid excessive jitter and phase noise in PLLs. Starting up the power supplies for each domain in the incorrect order can cause problems and can result in damage to the FPGA. Consider that the I/O section is based on transmitting and receiving data on a tristate bus. The I/O control is handled by the core. If the I/O domain is powered on before the core, the I/O pins end in indeterminate states. If the external bus components are powered up, there may be bus contention resulting in high currents in the I/O drivers. As such, the core should be brought up before the I/O domain. Similarly, devices like power operational amplifiers have two power domains: the analogue and the digital. The digital supplies power to the amplifiers' diagnostic status lags for over-temperature and over current states and supports the amplifier enable/shutdown functionality. The device specification requires that the digital domain be powered up prior to the analogue supply so that these status lags are functional before the analogue domain is powered on. This is to prevent possible damage to the device. Power sequence methodology There are three common types of multi-rail sequencing (Figure 1). The most common is sequential where one supply rail is turned on first, followed by a delay before the next rail is turned on. The delay is set so that the first rail reaches regulation before the second rail is started. The second is ratio metric. Here, the rails start up at the same time and reach their rated voltages at the same time. This requires that the rise time of the rails be proportional to the rail voltage in order to achieve regulation at the same time. Some devices may not tolerate the Instantaneous voltage differences occurring before regulation is reached and can lead to the device drawing higher current from one supply during this period. The third approach, simultaneous startup, minimizes instantaneous differences in voltages.
A common way of implementing this method is simultaneous power up, in which the voltage rails rise together and at the same rate, with the higher rail, usually the I/O voltage rail, continuing after the lower or core voltage rail has reached its final value.

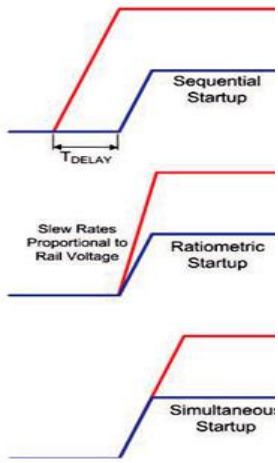


Figure 1: Diagram of Three Techn
for Sequencing Power Supplies

Regardless of the technique, the voltages must rise monotonically. Failing this, the device may not initialize correctly due to an unexpected drop in the voltage. A soft start may be applied to limit inrush currents during startup. This practice limits the current during startup, permitting gradual charging of the capacitance of the power rail on startup. Power supply shutdowns are generally specified to occur in the reverse order from the startup.

Power supply sequencing examples

Simultaneous startup is relatively easy to setup. The highest voltage output is connected to the input(s) of the lower voltage regulator(s) (Figure 2). In this example the higher voltage is the 5 volt supply. This is fed into the 3.3 volt regulator as well. The 5 volt and 3.3 volt outputs are shown as they rise simultaneously with a minimum voltage difference up to the regulation point of the 3.3 volt supply. The sequential technique is best implemented using a sequencer integrated circuit e.g. the LM3880 from Texas Instruments. The LM3880 can control multiple independent regulators or power supplies using their enable inputs. The LM3880, when enabled, will sequentially release its three output lags with individual time delays between the lag. This will permit the connected power supplies to start up. During shutdown the output lags will follow a reverse sequence. A design example using the LM3880 is shown using TI's WEBENCH Power Designer software output lags with individual time delays between the lag. This will permit the connected power supplies to start up. During shutdown the output lags will follow a reverse sequence. Output lags with individual time delays between the lag. This will permit the connected power supplies to start up.

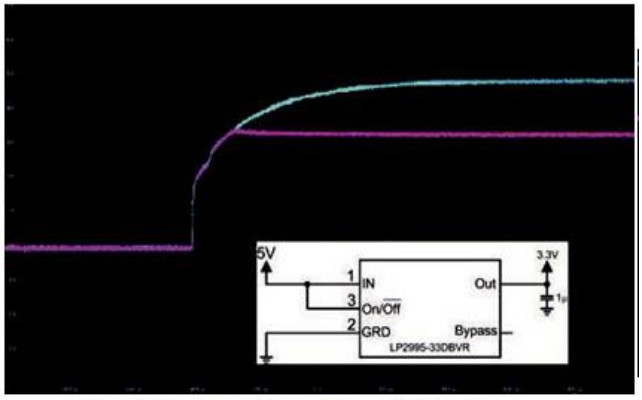


Figure 2: Simultaneous Set-up of 5 V and 3.3 V Supplies is accomplished by Daisy Chaining the Regulators

A design example using the LM3880 is shown using TI's WEBENCH Power Designer software (Figure 3). This free software tool helps the engineer design power related circuits providing schematics, bills of materials, and simulated

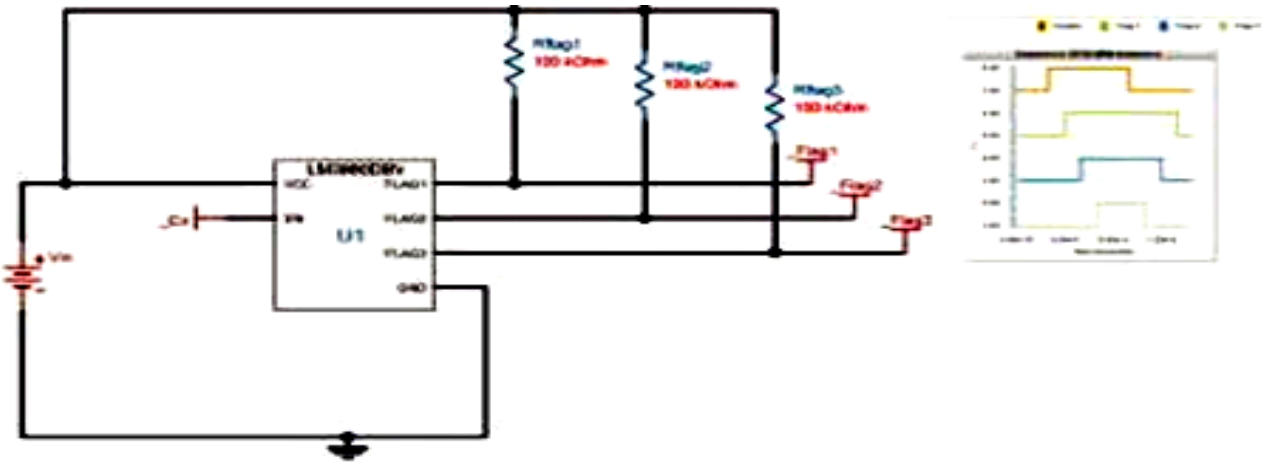


Figure 3: The Webench for Power Designer Display for LM 3880

results. The figure shows the schematic and charts, the enable, and the three lag outputs. The delay times and sequence order in the LM3880 are i xed, but are factory customizable using the built-in EPROM. A slightly more sophisticated power control device is the LTC2937 from Analog Devices. Like the LM3880, it can control the order and time delay of up to six power supplies or regulators (Figure 4). In addition to sequencing up to six power rails, it also monitors the voltages on those rails to detect over voltage, under voltage, drop outs and stalled power startups. In the event of a fault, the device can be programmed low dropout (LDO) linear regulator, three low voltage input LDOs, regulators, and three load switches. This device has 13 regulated outputs to supply the needs of the FPGA or other load device.

The buck converters include a built-in power stage, while the buck controllers require an external power stage. Both converters and controllers have integrated voltage sensing inputs to monitor the supply outputs, which can be controlled for sequencing. The load switches include slew rate control, permitting programming of the rails associated

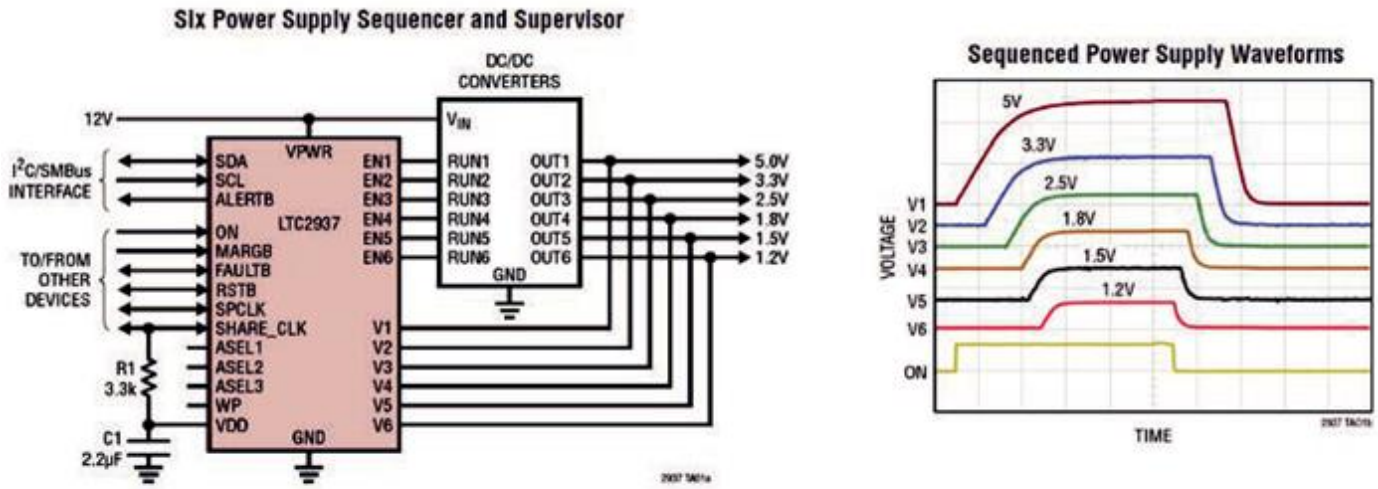


Figure 4: The LTC 2937 Controller for the Sequence of Six Power Supplies

with these switches for any of the three sequence types, sequential, ratio-metric, or simultaneous. The TPS650860 is controlled via an I2C interface allowing simple control either by an embedded controller or by an associated SoC manager. This power management IC offers leading-edge control flexibility. There are multiple methods to control the order of power startup or shutdown varying from very simple to very intricate. These differ in the number of rails controlled, precision, and range of control functions, as well as the cost.

Practical Security for the IoT

Dr Naveen Rathee
Professor, ECE Dept

As an increasing number of IoT systems are being deployed one of the key enabling technologies has been the Message Queued Telemetry Transport (MQTT) protocol from IBM. MQTT is an easy to use publish and subscribe architecture with open source servers and client such as the Mosquito server and Paho embedded client. However, many early systems have been designed without any form of communications security, sending unencrypted data packets which are easily intercepted and decoded. An important design rule for modern cryptographic systems is called "Kerchiefs principle" this states that "the security of the system must depend on the secrecy of the key not the secrecy of the algorithm". This means that you should only use well researched and trusted algorithms rather than a secret proprietary system. As engineering professionals, we should resist any governmental attempts to restrict research or the weakening of algorithms under the auspices of law enforcement. The strong advice is to use only well tried and trusted algorithms and a widely used source code library that is actively supported. This has generally meant using an open source library such as open-SSL. However such a library is not suitable for a small constrained device like a microcontroller. Here we have a much better option in the form of a cryptographic library called mbed-TLS. The mbed-TLS library has been specifically developed as a highly modular minimal footprint library for small embedded systems. The mbed-TLS library was originally developed as a commercial library called Polar SSL. In 2015 Polar was acquired by ARM and the Polar SSL library was incorporated as the security component within ARM's Mbed IoT platform. The Polar SSL library was then renamed as mbed- TLS and made free for commercial and non-commercial use available under either an Apache V2.0 license or GPL v2 license. A cryptographic library needs to provide a range of security services to enable us to design a secure system. The most obvious of these services are ciphers to ensure confidentiality of user data. While a range of ciphers are supported the current best practice is to use the Advanced Encryption Standard (AES). We also need to ensure the integrity of the data and this is done with hashing of Science and Technology (NIST). algorithms and in particular the family of Secure Hashing Algorithms (SHA) published by the US National Institute we need to be sure of who sent it. The original SHA-1 algorithm is no longer recommended for use and any new system should use SHA-2 as a minimum. We also need to provide non-repudiation, if a message is sent If two users can agree a password in advance, then we can use a Message Authentication Code (MAC) this will agree both the integrity and origin of the data. It is also possible to sign messages with public key cryptosystems. This is particularly elegant in the RSA system but there are also dedicated systems such as the Digital Signature Algorithm (DSA). Random number generation One of the corner stones of many security protocols is a cryptographically strong random number generator. A typical system will work by gathering true random data (entropy) into an entropy pool. This process is often too slow for real time communication so the random values in the entropy pool are then used as seed values for the pseudo random number generator. While the mbed-TLS library provides a range of pseudo random number generators, support for gathering random values into an entropy pool is up to the designer. So how do you know if you have a good enough random number generator? Fortunately, there is a Statistical test suite available from the US National Institute for Science and Technology which has fifteen tests which can be used to qualify your random number generator. In addition to a wide range of cryptographic algorithms the mbed-TLS library includes a set of abstraction layers which provide a high-level API for each security service. This allows you to develop a system were for example a

range of ciphers are installed while a common API is used to select a cipher algorithm from the suite installed and then use the abstracted API to encrypt and decrypt data regardless of the underlying cipher algorithm. Most of the major silicon vendors now provide Cortex-M based microcontrollers which include a cryptographic processor.

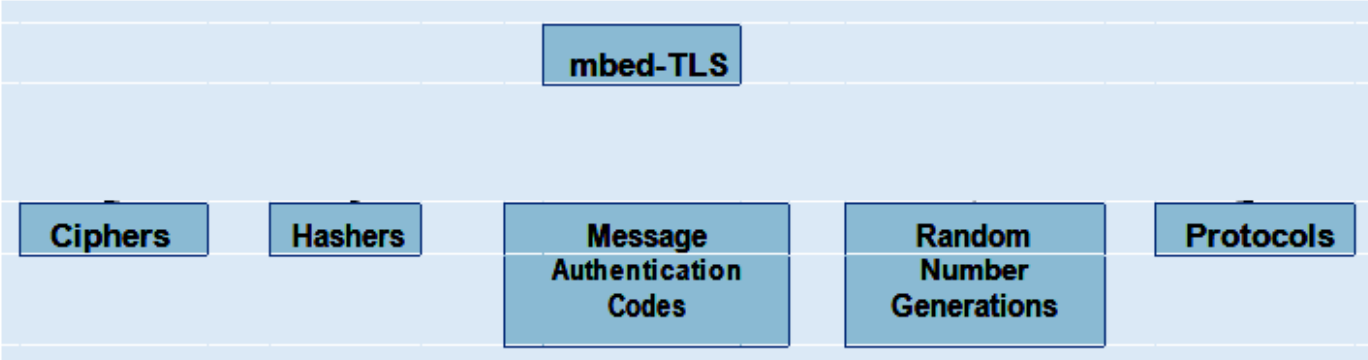


Figure 1: Security Services Provided by mbed-TLS

Typically this cryptographic processor will provide a hardware implementation of symmetrical ciphers, Hash and MAC algorithms. The mbed-TLS library provides a series of software hooks which can be enabled to use a hardware cryptographic processor in place of the software algorithm. As its name implies the mbed-TLS library is designed to support the Transport Layer Security protocol.

Algorithm Family	Cryptosystem	Security Level (Bit)			
		80	128	192	256
Integer Factorization	RSA	1024	3072	7680	15360
Discrete Logarithm	DH,DSA	1024	3072	7680	15360
Elliptic Curves	EC-DH,EC-DSA	160	256	384	512
Symmetric Key	AES,3DES	80	128	192	256

Figure 2: Comparison of Clipher Key Sizes

A key part of the TLS protocol is negotiation of a session key using public key encryption. The most widely used public key cipher is the RSA asymmetrical cipher. While this is supported by mbed-TLS it is not the most suitable system for a small microcontroller because of very large key sizes and computational effort required. Fortunately, there are alternatives to RSA such as Diffe Hillman key agreement which can be realized using elliptic curve cryptography. The use of an elliptic curve in place of a linear number line reduces the required key size and overall computational effort. To achieve the same level of security as the AES cipher with a 128 bit key requires the RSA system to have a key size of over 3000 bits while an elliptic curve implementation of the Diffe Hellman system requires a key size of just 256 bits. The simple take away here is to use elliptic curve cryptography where possible. During the initial TLS handshake the public keys of the participants are exchanged in the form of X.509 certificates. A certificate consists of user data stored in a format called “Abstract Syntax Notation 1”(ASN.1) and uses a set of “Distinguished Encoding rules”(DER) which ensure that there is exactly one way to encode the certificate data. Once created the DER binary data is then converted to base 64 and stored as ASCII characters in a Privacy Enhanced Mail (.pem) ile. If you are running your own website it is necessary to generate your own certificate and have it signed by a trusted certificate authority. However, if you are designing your own closed system it is possible to create and manage your own certificates. The mbed-TLS library contains both source code and command line tools to create and read X.509 certificates. Another useful tool is XCA. This is an easy to use windows or OS X application that allows you to create sign and manage your own X.509 certiicates and is extremely useful during development or managing small

scale systems. All of the cryptographic algorithms used in the TLS protocol have been designed for general purpose computers such as PC's and servers and as such they are not ideal for small microcontrollers. In 2013 the NSA release

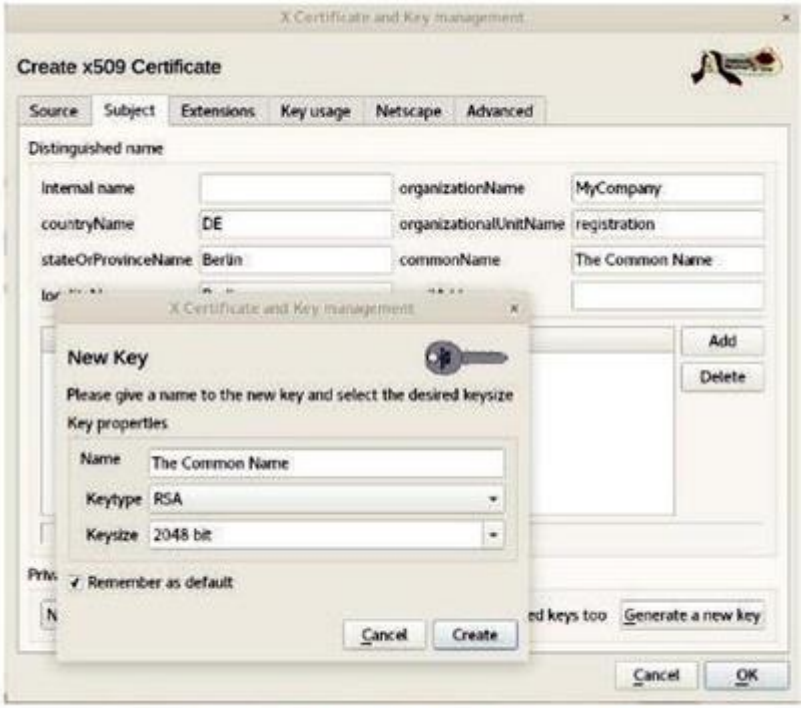


Figure 3: XCA Certificate and Key Management Tool

two new families of block ciphers called Simon and Speck. These ciphers were specifically designed for very constrained devices which would typically be user as nodes in the internet of things. The 'Speck' Cipher is designed to be a software implementation while the 'Simon' cipher has been optimised for hardware implementations. Currently there are reference implementations available and it is planned to add both ciphers to future releases of mbed-TLS. The mbed-TLS library is primarily concerned with secure communications and is part of a wider security initiative from ARM. The ARM Platform Security Architecture is a framework designed to enable developers to analyse security threats then design and implement an appropriate architecture. While this is fairly new it will be available to compliment the new generation of ARMv8-M (Cortex-M23 and Cortex-M33) microcontrollers featuring the Trust Zone security technology.

Nano-computing Paradigm: Quantum Computing Technology

Dr Neeraj Misra
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The very large-scale integration (VLSI) industry is currently moving at high speed towards miniaturization, resulting in many challenges in terms of energy dissipation and quantum effects at the nano-scale. These problems are exacerbated, when further down scaling the feature size of transistors. To overcome this limitation, rigorous research is being carried out to identify prominent alternatives. One possible solution would be to develop a robust computational paradigm based on quantum technologies. On the other hand, reversible logic is gaining in popularity due to its capability to implement quantum logic circuits. Quantum computing technology is reversible and is one of the emerging computing technologies for future computing.

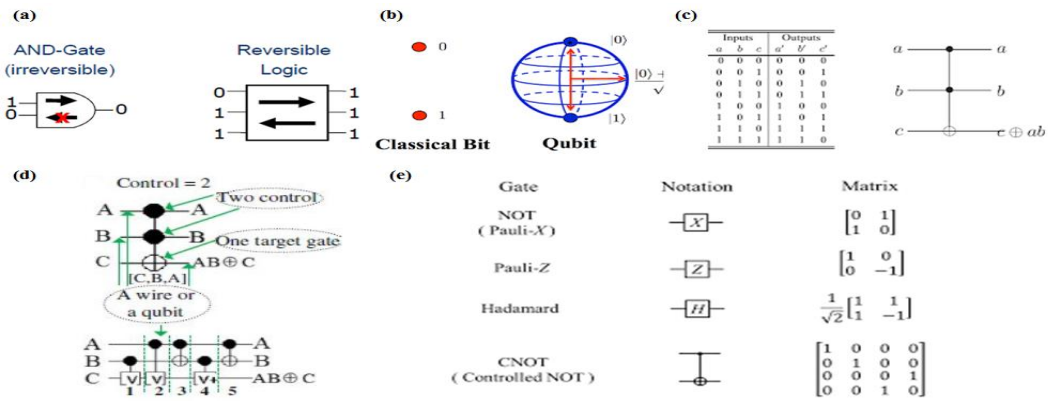

Figure 1 (a) Reversible logic (b) Qubit (c) Toffoli gate (d) Quantum cost of Toffoli gate (e) Quantum gates.

In the low power era, it is mandatory to have circuits, which help of reversible gates. As reversible logic synthesis, technology has been progressed in the digital logic circuit scenario, recovered outputs form inputs have been employed to facilitate of no loss of information. They from the new emerging era in which the low power circuit for the reversible structure. Landauer'sin 1961 concept that, logic computations that are irreversible, also produce heat (KTln2 Joules) for a single bit of information lost, where denoted symbol are standard meaning. Bennett in 1973 concept not the loss of information is known as reversible. It normally takes attention of energy dissipated due to loss of bits in logic computations. Reversible circuits can be designed using reversible gates, which have a one-to-one mapping between the inputs and outputs.Itis believed that quantum computing will become the dominant technology in the near future. In quantum computing, a bit is specified by a qubit. A quantum circuit is realized using elemental quantum gates. In fact,a quantum circuit is reversible and works with qubits. Testate of a qubit can be explicitly stated as $|\psi\rangle = \alpha|0\rangle + \beta|1\rangle$, where $|1\rangle$ and $|0\rangle$, denote logic states 1 and 0,respectively. The complex numbers α and β have the property$|\alpha|^2 + |\beta|^2 = 1$.

The scope of reversible implementations extends to include thermodynamics and adiabatic complementary metal–oxide–semiconductor (CMOS) technology. Thus, application of reversible logic is advocated in various fields, including quantum computing, nano-electro-mechanical systems (NEMS), low-power CMOS, optical computing, and nanotechnology.

Low Power Philosophy: Quantum Technology = Green Computing

Paint-on Semiconductor Glows Brighter

Mr K. Vinay
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Researchers from Georgia Tech have discovered a way to create more desirable optoelectrical properties using a hybrid semiconductor material, halide organic-inorganic perovskite (HOIP). This comprises of two inorganic crystal lattice layers with an organic material between which acts like a sheet of rubber bands, making the crystal lattice into a wobbly, but stable surface.

According to the team, HOIPs could be painted on to make LEDs, lasers or even window glass that could glow in any colour. Lighting with HOIPs requires little energy, and solar panel makers could not only boost photovoltaics' eficiency but slash production costs. An electron has a negative charge, and an orbit it vacates after having been excited by energy is a positive charge called an electron hole. The electron and the hole can gyrate around each other forming a kind of imaginary particle, or quasi-particle, called an exciton.

"The positive-negative attraction in an exciton is called binding energy, and it's a very high-energy phenomenon, which makes it great for light emitting," Prof. Silva explained.

When the electron and the hole reunite it releases the binding energy to make light. But usually, excitons are very hard to maintain in a semiconductor. "The excitonic properties in conventional semiconductors are only stable at extremely cold temperatures," Prof. Silva continued, "but in HOIPs the excitonic properties are stable at room temperature." Excitons get freed up from their atoms and move around the material. In addition, excitons in an HOIP can whirl around other excitons, forming quasi-particles called biexcitons. The uncommon participation of atoms of the material in these 'dances' with electrons, excitons, biexcitons and polarons creates repetitive nanoscale indentations in the material that are observable as wave patterns and that shift and flux with the amount of energy added to the material. The key observation in the study is that the wave pattern varies with different types of excitons. The indentations also grip the excitons, slowing their mobility through the material, and all these ornate dynamics may affect the quality of light emission, the team concludes.

Smart Homes

Mr E. Sai Teja
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The smart home space has promised to transform the way we live and is seen as a serious business opportunity for technology companies. But while there are a host of devices that are now available, from voice assistants to smart appliances, it's still a market that is yet to really cross the starting line. There are a number of reasons for this. Consumers are concerned with safety and security; they want devices that work flawlessly and that are interoperable – today interoperability tends to be limited to a device speaking to an app or to a hub device, such as the Amazon Echo; too many consumers don't yet perceive the value of the connected home and, at the end of the day, too many devices on the market are just too expensive. But things appear to be changing according to new research from IDC, which suggests that the global smart home market is set to grow by almost a third this year.

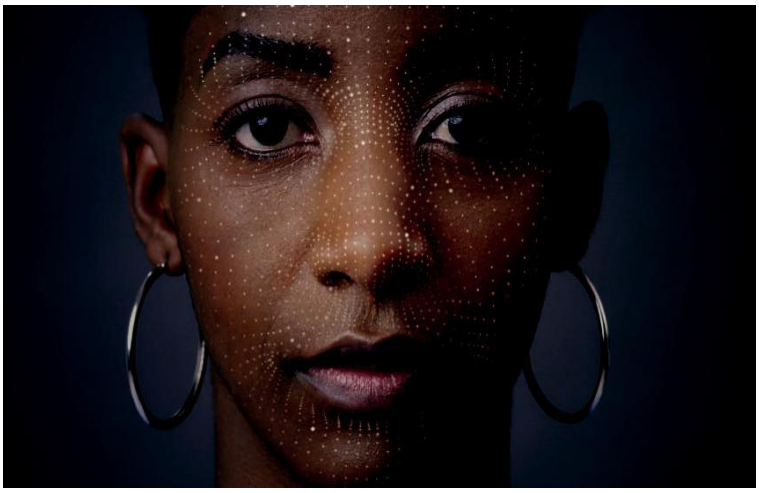
It predicts that manufacturers will have sold over 640 million smart devices by the end of 2018. As for the future it says that in four years, annual sales could reach as many as 1.3 billion devices with voice control driving that growth. If those figures are accurate then that would mean that on average every sixth person, regardless of age, could own a smart home device. Smart speakers such as the Amazon Echo or Google Home are the fastest-growing category and while the record of 100m devices was broken this year, forecasts indicate that as many as 230m smart speakers will be sold in four years. Smart lighting, thermostats, door intercoms and security systems are also becoming increasingly popular. The Amazon Echo, Google Assistant and ULE-based products are all seen as helping to drive growth and, perhaps, we are reaching a tipping point with manufacturers better navigating the challenges associated with the market. But challenges do remain. Maybe we should stop talking about the smart home being simply about gadgets, and start talking about it as being something that's embedded in a much wider, smarter community

Mobile 3D Sensing

Mr D. Nikhil Sagar
B.Tech.-IIIrd Year, Dept of ECE

Many of the key technologies behind advancements in mobile devices, including smart phones, tablets and wearable's, are based on the ubiquitous use of light. This does not only include visible light such as display lighting or lash applications. Gesture recognition, iris scanning or facial recognition are just a few examples of how invisible infrared light can be used in mobile devices. What role can VCSEL technology (vertical-cavity surface-emitting laser) play in this space?

First, what is VCSEL? A VCSEL is a semiconductor-based laser diode which radiates the light vertically to the surface of the semiconductor chip, as opposed to edge-emitting laser diodes, where the light exits at the edge of the chip. As a surface mountable component, VCSEL combines the characteristics of a LED with those of a laser. VCSEL technology has been established and matured within the data com industry, serving in data infrastructure links for more than 15 years. The technology can also be used as an array – a composite of several hundred or even thousand VCSELs – for example a chip with 500 apertures of 1 mm x 1 mm, glued and bonded like a normal LED.



VCSEL use in biometrics

Biometrical user identification methods are the most reliable and secure access options that are currently available. They are an alternative to complex password management tools for mobile device security, access control, and increasingly authentication for mobile payments and other transactions. The need for these solutions is driven by users increasingly managing all aspects of their digital lives via their Smartphone and other mobile devices which accelerates the development progress. Biometrics make use of human characteristics, such as specific structures within the iris, facial features or fingerprints. Sensors identify these characteristics and compare them with previously stored biometrical data. In order to function reliably in mobile devices, infrared light is required to illuminate the target area. This technology was already being used in access control systems, with most countries using it for immigration purposes. But with a growing miniaturization of infrared LED technology the adoption in mobile and consumer devices has been gaining speed. Now VCSEL technology is complementing infrared solutions enabling the utilization of these applications in a wider market.

New application fields

VCSEL technology is not a new invention, but has been used previously for data communication. Recently, a multitude of application opportunities in different markets have been identified. The decisive features of the surface

emitter are the lower production costs compared to edge emitters and the superior beam quality but lower output power. VCSEL technology is primarily used for application fields like smart phones, drones and Augmented and Virtual Reality (AR & VR) devices where high-speed modulation is an advantage. 3D sensing applications such as facial recognition, especially for consumer devices, are viewed as key market drivers. LED inside anticipates that the global infrared laser projector market for mobile 3D sensing is forecast to grow to around $1.9 billion by 2020.

VCSEL operating principles

The beam shape of a VCSEL is a circular spot, compared to the elliptical shape of FP-EEL (Fabry-Perot Edge Emitting Laser) and DFB (Distributed Feedback laser diodes). The optical resonator of a VCSEL array is only 4µm, compared to approx. 600 – 1200µm for FP-EEL (depending on the optical power) and 1000 – 2000µm for a DFB (depending on the optical power). Compared to the temperature sensitive wavelength of an FP-EEL, VCSELs suffer way less wavelength shift under the influence temperature changes VCSELs can be modulated with high frequencies, making them useful for optical fiber communications. In addition to the high beam quality of low-power VCSELs, an important aspect is the low beam divergence, compared with those of edge-emitting laser diodes, and the symmetric beam profile. This makes it easy to collimate the output beam with a simple lens, which does not have to provide a very high numerical aperture. Much higher powers can be generated with VCSEL arrays. A VCSEL array with many thousand emitters (with a spacing of some tens of microns) can emit several tens of watts continuous-wave. The effective beam quality is, strongly reduced in this case, as the emission comes from a larger area while the beam divergence equals those of a single emitter (which is, although still substantial, smaller than for an edge-emitting laser). Such devices can generate high output powers with a high wall-plug efficiency and thus compete with diode bars and (combining multiple arrays) even diode stacks based on edge- emitting semiconductor lasers. Their emission line width is very small, and the emission wavelength has a lower temperature dependence than those of a conventional laser diode. Quite high peak powers are possible in pulsed operations with nanosecond to microsecond pulse durations.

Mobile 3D sensing

Current solutions for mobile 3D sensing include structured light and time of light (ToF). One of the most recent smart phone models uses structured light with its dot projector producing several ten thousand dots of infrared lights on the face. Then the infrared camera receives the light reflected back from the face to create a 3D facial landscape. Additional application ields include autofocus and proximity functions in cameras, especially in smart phone cameras. 3D sensing is also being integrated with AR and VR – for smart glasses or future Smartphone's and other mobile devices, including drones. Due to its broad range of advantages such as a very small footprint, relatively low costs, optical efficiency, low power consumption, wavelength stability and high modulating rates, VCSEL technology could be key for a wider adoption of applications such as 3D sensing in the mass market. Although the technology offers many advantages compared to existing technologies, it is not the best solution for all segments. It should therefore be viewed as an expansion of infrared and other light-based technologies. In order to help customers and clients choose the best suited solution for each application field, leading providers of optoelectronics components are looking to complement their infrared technology portfolios with a growing number of VCSEL solutions. VCSEL technology can be used in numerous applications including a wide range of markets for end customers. The technology is primarily deployed for application fields where high-speed modulation is an advantage – like cameras or biometrics. There are already first application examples with VCSEL available in the consumer mobile device segment.

Battery Anxiety

Mr. I. Ravi Kumar
Associate Professor, Dept of ECE

As mobile devices become more capable the more power hungry they become, yet the research that has been undertaken into extending the capabilities of battery technology seems to have reached its limit. The term 'battery anxiety' was coined by LG last year, following a survey it conducted on mobile charging habits, that revealed 90% of respondents suffer with this modern 'ailment'. Portable, wireless charging seems the obvious remedy but while there has been a surge in research into this technology and, according to the Wireless Power Consortium (WPC), there has been an increased uptake in wireless charger users, there remains a number of problems in the widespread adoption of this solution. A meta material start-up currently developing technology in the wireless charging field, acknowledges the potential of the wireless charging market, but suggests that there are a number of challenges preventing it from being widely adopted. The problem, according to Ivanov, is the user experience – by this he means not just how the device charges, but where charging is available. "To date wireless charging has been little more than a gimmick," according to Ivanov. "A lot of the wireless charging solutions available require the user to place a device directly in alignment with a wireless charger. But, as every wireless charger needs its own unique power supply, users will still

effectively have to rely on being close to a cable. So why use wireless charging at all? "Imagine going into a coffee shop and being able to place your device on a table and know it will be charging, even if there are others also charging their devices on the same surface," Ivanov muses. "And with no need to line it up perfectly or for you to carry your own personal wireless charger," he adds. LG's survey on charging habits mirrored Ivanov's thoughts, pointing out that among the consumers it had questioned, around 1,600 across the UK, US, Germany and China, there were "high levels of interest in seeing wireless charging beyond the home and car". "This is the world we are trying to create at Meta boards," Ivanov explains. The meta materials company has developed a patented prototype that enables wireless charging through any surface (apart from metal) without the need to directly align two devices. It can also charge multiple devices on one surface from one power source." Ivanov suggests that the state of wireless charging is evolving in much the same way as that seen when the modem was replaced by Wi-Fi. "While the modem and Wi-Fi offered the same solution, there was a difference in how the technology worked," he explains. "Wireless charging is at the 'modem stage', we want to bring it to the 'Wi-Fi stage'." Qi vs. Air fuel Currently, there are two global wireless charging standard bodies:

• The Wireless Power Consortium (WPC) and the
• Alliance for Wireless Power (A4WP).

WPC operates the Qi certification, while A4WP is responsible for Air fuel. Although both are accepted wireless charging standards, they work in slightly different ways.

Qi is the standard for inductive charging and is found in most mobile phones. “It is based upon a one-to-one relationship with the charger and the device, relying on precise alignment,” says Ivanov. Airfuel differs in terms of how it charges and how many devices it can charge, and this is achieved through resonant and RF technology. It also operates in a higher frequency than Qi. Resonate charging enables greater spatial freedom, as well as the ability to charge multiple devices at once. Moreover, it lets the user charge devices through a range of materials including wood and stone. Whereas the RF charging technology provides low power to devices from a distance (up to a metre).

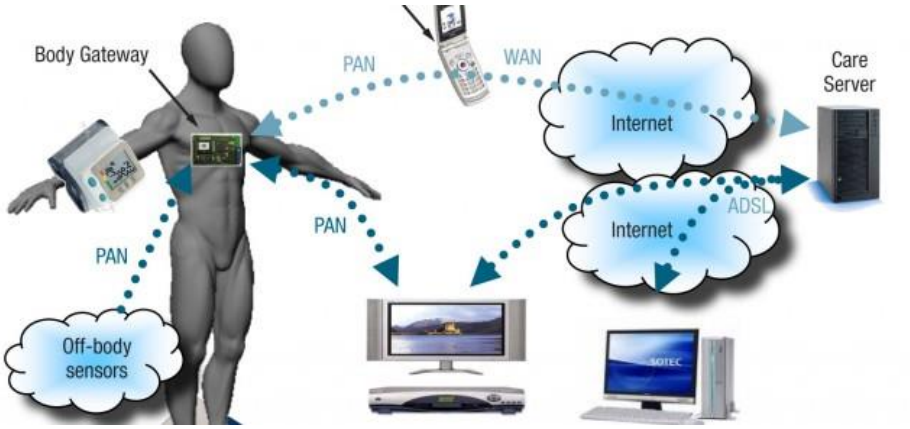
Qi is the standard found in most mobiles because it’s easily integrated into mobile devices and a more affordable option than Airfuel, explains Ivanov. Despite its popularity, he believes that Qi has prevented significant progress in terms of wireless charging. According to Ivanov, Airfuel is the future and “we will see more OEMs switching back to this technology”. However, he identifies one key issue with the standard. “The surface is one big coil, emitting an electromagnetic field everywhere. You don’t want an electromagnetic ield where it doesn’t need to be because it can damage a device. “Moreover, Air fuel is restricted in terms of dimension, with a maximum surface size of A3. “In our irst product, a met aboard (surface) consisted of an array of coupled resonators, responsible for generating a dynamic magnetic field and other components to implement control. “Such a system is a metamaterial environment, where waves of inter-element excitation can carry power and data,” says Ivanov. “In terms of our current solution, each resonator is formed from a spiral printed inductor and tuned to a specific frequency using appropriate capacitors. One of the resonators is designated to be the ‘driver’ and it is fed power at the chosen frequency. The power is coupled around the board by implementing a number of control mechanisms.” He continues, “When a load, such as a mobile phone in need of charging, is placed on the surface, a software-based algorithm is used to direct power/lux to that load and is able to minimize flux where it is not needed. “Crucially, one or multiple devices can be charged anywhere on a meta board simultaneously without the need for device alignment.” Creating a surface To create this ‘surface’, Meta boards built its own set of development and simulation tools to solve problems such as how to control power lowland design coils with the right characteristics. “Integrating all the desired features into one product is not a straightforward task and some of the features or principles of their implementation can contradict each other. “A good example of that is the compromise between efficiency of wireless power transfer and the maximized area coverage of a large charging surface,” admits Ivanov.

But he remains confident in the solution, pointing out that the difficulties associated with it, and the solutions Metaboards has come up with, are why “it’s not been done before”. Once the environmental conditions are known – the thickness of the table, the material used, etc. – the design can be tailored accordingly to maximize the performance, suggests Ivanov. “In our current implementation all the electronic components are populated on the underside of the surface. The top (power transfer side) of the surface comprises printed components only so the surface is essentially planar. This makes it ideal for retrofitting/integrating on the underside of tables and bars etc., or as a separate product. “It is also possible to make it non- planar/conformal to other surfaces.” The surfaces themselves are made using the same standard production materials and processes that are used in other consumer products, so there are no additional costs associated with using custom manufacturing processes and exotic materials. Ivanov points to the consumer market as the company’s core audience, explaining that once the technology is ready for commercialization other verticals could be explored. “The main aim is actually to license the concept,” says Ivanov.“To do that, we need to create the proof and give confidence to others.” For now, Ivanov says Meta boards is designed to be integrated into surfaces such as tables or into walls, whether in commercial premises or in the home. But, he also sees potential in the flexible electronics market too, suggesting the technology could one day be woven into fabrics.

The Wearable Doctor: Digital Health

Mr. R. Basavraju
Asst. Professor, ECE Dept

In the past decade technology has started to play an increasingly important role in the provision of healthcare, whether that's in the form of wearable devices, home diagnostic applications or remote monitoring devices. Many powerful artificial intelligence (AI) tools are now being embedded into both mobile and wearable devices enabling users to collect data on their bodies to better manage their health and well-being. According to a recent survey in the UK, these health and fitness focused technologies are being used by more people to achieve their fitness goals. The survey, from Laptops Direct. co.uk, found that among those questioned 37 percent thought their choice of tech products would help them to reach their fitness goals. Those devices seen as most helpful were wearable fitness trackers (34%) and smart watches (26%) followed by smart phone apps; heart rate monitors and lowers tech wearable trackers, that simply monitor the users heart rate, were also listed. Commenting Mark Kelly, marketing manager at LaptopsDirect.co.uk, said: "From using fitness trackers whilst walking to work to apps that plan meals, it's clear that adults in the UK are turning to technology to help them reach their 2019 fitness goals." It's true to say that wearable



technology has garnered plenty of headlines, both positive and negative, but many of the early lessons learned are now poised to deliver real benefits. Beyond simple wearable fitness devices, health monitoring applications have seen a string of product and service innovations that offer real-world benefits to the user. For example, a new wearable assistive technology from Control Bionics is helping people suffering from paralysis and loss of speech to better communicate with friends, family and clinicians. The 'Neuro-node' device is said to be the first wearable electromyography (EMG) device and is able to use EMG signals to control a paired computer, tablet or smart phone. Essentially a wireless keyboard, the Neuro-node connects to a device via a Nordic nRF52832 Bluetooth Low Energy System-on-Chip (SoC), users are able to send emails, access the Internet and watch online entertainment via the device.

Wearables slow-down

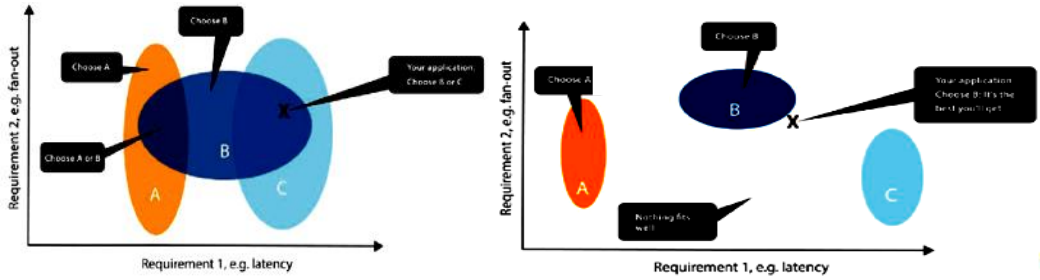
Research from Tractica, a market research company that focuses on human interaction with technology, expects the wearable device market to exceed $95billion by 2021 with total shipments expected to exceed 560milliion units and this despite last year when growth in the market dipped to single figures. This slowdown was ascribed to weak demand for basic step-counting wearables, but analyst IDC is predicting that double-digit growth will return this year as smart watches and new form factors start to gain acceptance in the market. "There is certainly plenty of innovation on display in the wearables space, such as Microsoft's Glabella Project," said Martin Keenan, Technical Director at Avnet Abacus. "Glabella is essentially a pair of glasses that monitors the heart rate at three sites on the wearer's head. In addition, the prototype incorporates optical sensors, processing, storage, and communication components, all of

which are aimed at precise monitoring of the wearer's pulse transit time. "The Microsoft team believe that this can be used to reliably establish the wearer's systolic blood pressure, but in a far more convenient package than the current alternative of a cuff-based oscillometric device." The ability to monitor blood pressure throughout normal daily activity, as well as mine the data within that continuous measurement could represent a significant health benefit for millions, suggested Keenan. Another heart-based innovation is Apple's new watch, which now features a full electrocardiogram (ECG) and which has been approved by the FDA and AHA. "In theory this should enable casual users to monitor their heart for anomalies and test for atria fibrillation – the Watch OS will even create a PDF you can send to your doctor," enthused Keenan. FDA Commissioner Scott Gottlieb said on Twitter that the agency "worked closely with Apple as they developed and tested these apps, which may help many users identify health concerns more quickly. "Health care products on smart watches may help users seek treatment earlier and will empower patients by giving them more information about their health." The Apple Watch also includes fall detection sensors, and if the person remains prone and unresponsive for a set period of time, an emergency SOS call can be made to a designated family member or friend. While company's like Apple are investing heavily in wearables, a growing number of innovative start-ups are also entering the wearable space. "One, notable for its pulse wave analysis (PWA) technology is CardieX, which has been conducting US trials into obtaining cardiovascular blood pressure (BP) data, using a Bulimia radar frequency sensor and Cardiac PWA technology in a wearable device,". CardieX has significant expertise in the market, with a central arterial pressure waveform analysis product that has seen 4,000 deployed worldwide in major medical institutions. "Experience is a benefit in this market," suggested Keenan. "Former wearable market casualty Jawbone has resurfaced as Jawbone Health, a medical subscription service that aims to help users catch health problems early. While the company plans to offer subscribers a wearable device, it also intends to partner with device manufacturers (including Apple) to acquire data from a customer's existing wearable sensors," explained Keenan. Accurate sensing While early fitness trackers often relied heavily on step counting, the wider availability of accurate sensors is helping to transform the market. In particular, more flexible and usable pressure sensors are having a major impact on devices that offer running coaching, as they open up the possibility of delivering kinetic gait analysis, which factors in measurements of force, such as power, torque, and pressure, giving far more accurate results than visual analysis of gait alone. Companies such as US-based IoT wearable company Boogio has developed pressure-sensitive in-shoe sensors that are thin enough to easily slip under the insole of your favorite trainers. "The sensors have sixty-five thousand layers of pressure sensitivity across toe, heel and arch areas of the foot, theoretically providing highly accurate data on foot strike, position and cadence,". While the market for fitness and health wearables is forecast to grow in the coming years another sub-sector within this space, and one that extends the concept of well-being beyond that of simply better long-term health decisions or better monitoring an ageing population, is the use of personal safety devices. Leaf Wearables, an India-based company, has developed the 'Safer Pro' device which comes in a Smartphone form factor – but can also be embedded into other devices, such as jewellery. A panic button is able to transmit an alert using Bluetooth Low Energy wireless connectivity to the user's smartphone, which then sends messages, or alerts, to selected and trusted contacts. The device is trackable via GSM or GPS, helping to pin-point the location of the user or to provide navigation to a local hospital or police station. In the US, wearable protection is available in the form of the Automatic Injury Detection (AID) device which, via a panel fitted with a thin film sensor within body armor, can send emergency alerts to a paired device should the user be harmed in any way. The device was developed by Data soft and is currently being deployed in 'man down' vests for the US military and law enforcement agencies. The wearables market is only just beginning to find its feet and explore novel uses. The growth in artificial intelligence and improved sensor technology are both becoming key driving forces in this fast growing space. In addition, on-going trends including an aging population in the west, coupled with rising healthcare costs are certainly combining to strengthen demand over the coming years.

Choosing a Connectivity Standard

Ms. K. Swapna
Asst. Professor, Dept of ECE

The IIoT covers many industries with very different use cases. The connectivity technologies and standards that target these applications are themselves diverse. In fact, the IIoT space is so big that the technology options barely overlap. The architecture challenge in the IIoT space is not one of choosing among overlapping standards that may each be able to reasonably solve a problem but rather understanding the technologies, comparing the intended use to the application, and choosing the one that best addresses the particular challenge. Stretching a technology out of proportion can make anything work. But, that will result in a lot of extra work and an awkward design.



Before the Industrial Internet Connectivity Framework (IICF), people assumed that competing standards met overlapping requirements in the IIoT connectivity space. It turns out, however, that those connectivity standards do not overlap. Most applications will not be a perfect it and so must adapt. After all, while connectivity technologies all move data they are nonetheless very different. Since the connectivity options are so different, in most use cases, there tends to be no choice in the connectivity technology, but this lack of overlap in the IIoT space actually helps to makes an architect's task much simpler. It's possible, however, to ask a few very simple questions for each technology option and quickly narrow the choices.

Data Distribution Service (DDS)

Here are five questions to answer and determine if you need DDS:

1. Is it a big problem if your system goes down for a short time?
2. Are milliseconds important in your communications?
3. Do you have more than 10 software engineers?
4. Are you sending data to many places, as opposed to just one?
5. Are you implementing a new IIoT architecture?

If you answered three out of the five questions "yes," you probably should use DDS. DDS is a series of standards managed by the Object Management Group (OMG) that define a databus, which is data-centric information low control. It's a similar concept to a database, which is data-centric information storage. The key difference: a database searches old information by relating properties of stored data. A databus finds future information by filtering properties of the incoming data. Both understand the data contents and let applications act directly on and through the data rather than with each other. Applications using a database or a databus do not have a direct relationship with peer applications. It can, for instance, resolve redundancy to support multiple sources, sinks and networks. The databus can control Quality of Service (QoS) like update rates, reliability and guaranteed notification of data liveliness. It can look at the data inside the updates and optimize how to send them or decide not to send them at all. It also can discover and secure data lows dynamically. All of these things define interaction between software modules. The data-centric paradigm thus enables software integration.

Meeting the needs of Employers

Dr B. Prasad Rao
Director-Training and Placement

The T-Level is a new, 2-year, technical Level 3 qualification, which will replace the current suite of vocational qualifications. Due to be rolled out between 2020-22, we can expect to see the end of Government funding for BTECs, OCR Nationals, EAL, and City & Guilds qualifications. Instead, each of those awarding organizations will tender to be the sole provider of T-Levels. T-Levels are intended to provide a simpler system of qualifications for students aged 16-18, offering a technical alternative to A-Levels and a more college-based alternative to apprenticeships, although including a 45-day mandatory work placement. They are based upon a map of 15 occupational pathways, including engineering, in a bid to help employers. The Further Education (FE) system in INDIA is a complicated one, with numerous post-16 qualifications available in engineering alone and that, coupled with the lack of apprentice placements on offer, has resulted in the Government looking to reform and simplify the technical qualification system. Extensive consultation with educational experts and industry resulted in the T-Level, an idea born out of the Lord Sainsbury 'Post-16 Skills' Review in 2016 of vocational education and is, according to Damian Hinds, Secretary of State for Education, central to the "greatest shake-up of technical education for 70 years". The Department for Education has committed to funding of £500million per year to support the introduction of T-Levels, covering additional classroom hours, as well as the 45-day work placement. Doubts have surfaced however; with universities and educationists worried that T-Levels will only add to the confusion that already exists in what is already a reform-heavy UK education system. For example, the Apprenticeship Levy, recently introduced, still has employers confused over the paperwork, and questioning whether it will help to improve the quantity and quality of apprentices. In fact, since it was introduced, the number of apprenticeships has tumbled to just 261,200 apprenticeship starts for the 2017/18 academic year, compared to 362,400 in 2016/17. "T-Levels are a good idea, but so many things are going on at the same time," said Professor Ewart Keep of the Department of Education at Oxford University. "The system has undergone a lot of change in recent years and left many people baffled." Imperial College London and University College London are said to be skeptical about T-Levels, and have said that they will not recognize the qualification. A spokesperson for Imperial said: "We do not believe that T-Levels provide suitable preparation for students." Many others remain undecided on the reform, Oxford University has said that it will be "watching with interest" and will base its judgment, as the T-Levels are rolled out, on how they're implemented. A lack of information about the T-Level, with almost half of education providers rating their understanding of T-Levels as either "middling or poor", according to research from City & Guilds and AELP, is another concern. "I think most colleges are keen that T-Levels are a success," Prof Keep said, "but they're concerned about the work placement element. They're also nervous about staff retraining costs and whether or not they'll be enough young people to make T-Level pathways viable." Businesses have also expressed concerns, with the City & Guilds and AELP's research revealing that just 17% believe themselves to have a good understanding of the qualification, while only 8% say they currently offer placements that match requirements. "The Government will need to spend a lot of time, energy, and money trying to get the message across to employers that the T-Levels are coming and getting employers engaged in the process and ready to offer placements," . The DoE is putting "real money" into both building relationships between industry and educators, and is working to create flexible work placements that suit the employer, rather than being delivered in a continuous block. It's essential that the work placement is piloted. The problem is, running a pilot in a few colleges is very different from trying to get enough work placements to support the full programme. for future talent. I've listened to the feedback from some of those pilots, What even surprised is the appetite from employers to

offer placements. There's quite a lot of intellectual snobbery around T-Levels. For some, the only route into a decent job is via higher education. However, many employers believe graduates don't have the skills they require. It can take years, before graduates are productive. "The knowledge they've gained from university doesn't necessarily make them fit for the workplace," T-Levels are designed by employers. T-Levels won't change the negative attitudes attached to vocational courses. We've turned the system on its head," . "Rather than Government driving course content, employers have to say what they need." The Institute for Apprenticeships is responsible for designing the Standards, bringing together trailblazer groups (employers) to create the content. "This will pull in different employers with expertise in different areas for each of the T-Levels. The industry wants and adds that it is unclear to him what mechanism will be available to amend content deemed unsuitable. Ensure that the qualifications are right not only for today's jobs, but also future occupations."If successful, the qualifications will have much stronger market value and confer much greater social and economic mobility on students who do not want, or are not suited, to a university education. We need to ensure our young people have a good start in life and provide them with the knowledge and skills they need. At the same time we need ensure that we are giving employers the employees they need.

Making 5G a Reality

Dr Kalyan Kasturi
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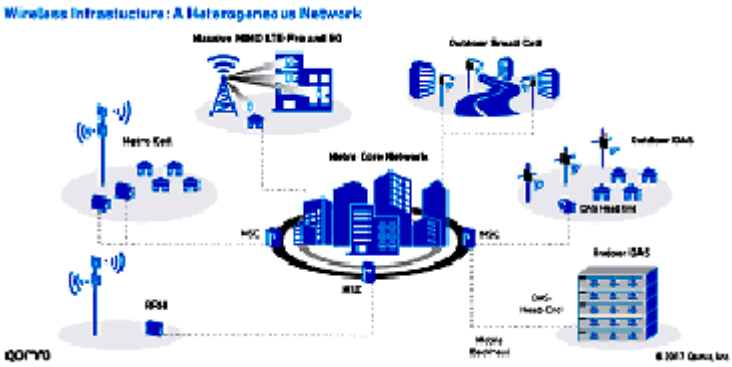
Last month saw over 2500 people from over 70 countries gather at a 4G/5G Summit organized in Hong Kong by Qualcomm. It was a chance for carriers, equipment providers, OEMs and software providers to come together to discuss how the industry was working to make 5G a reality and, despite accusations of hype, it appears that they are nearer to realizing 5G than was previously the case – even just a few months ago. Before the summer doubts had been expressed about the viability of rolling out 5G, but now the talk is of the commercial deployment of handsets next year. So, is 2019 going to be the year when we'll see the first 5G handsets? Some would argue that it's a very aggressive time frame but for Qualcomm's President, Christiano Amon, that's certainly not the case. He expects, "every Qualcomm Android partner with flagship Android phones to have 5G NR phones in 2019." Qualcomm's business model is very much driven by delivering 5G so, perhaps, there is a need to be a little wary when it comes to their announcements, but there's no denying that it is a key player when it comes to driving the roll-out of 5G. Qualcomm partners with every leading Android handset manufacturer in the world, as well as working closely with leading carrier equipment manufacturers including: Ericsson, Huawei Technologies, Nokia and Samsung among many others.

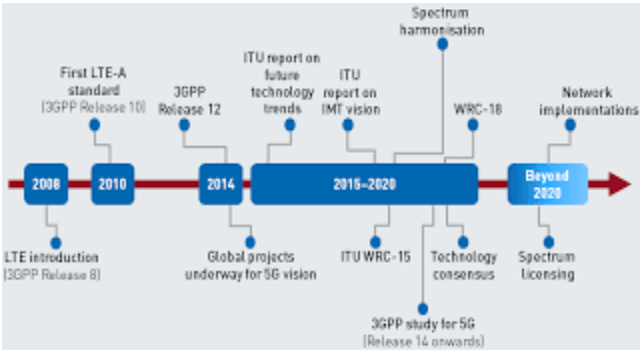


Speaking at the Summit, Thomas Noren, VP, Head of 5G Commercialization at Ericsson said, "A year ago the situation regarding 5G was very different. Then people were asking whether they needed it, what it was and when it would be deployed. The acceleration we've seen over the past twelve months has been a fantastic achievement for the industry – the market is certainly gaining momentum." Critics suggest that there's still much to do and 5G certainly isn't a 'done deal', but there has certainly been a tremendous amount of work undertaken with regards to 5G and there are a growing number of trials taking place globally. "5G is critical because without superior connectivity the promise of artificial intelligence of VR just wont be realized," Noren suggested. While Release 15 is beginning to deploy, as with the other 'G's, there will have to be a lot of continuous work when it comes to the development of standards. Beyond Release 15, Releases 16 and 17 will enable 5G NR for massive IoT, mission-critical services, and car to car communications (C-V2X) but while these standards evolve, companies will face further investment in time, people and resources.

5G development

Qualcomm has a critically important role in the development of 5G – looking around the 4G/5G Summit it as obvious how important a role it plays, and will play, in the development and deployment of 5G, as it hosted or organized hundreds of meetings. But beyond that it has been responsible for a number of 'firsts'. It has developed a mobile 5G NR commercial platform, including the first commercial modem, transceiver, and mobile reference design RF front end for initial 5G launches. These "firsts" have enabled the eco-system that has built up around 5G to move more quickly.

The speed at which 5G and the technology being developed to support it is evolving, was demonstrated at the Summit where Qualcomm announced that it had extended its QTM052 mm Wave antenna module family of fully- integrated 5G NR millimetre wave (mm Wave) modules for smart phones and other mobile devices. Compared with the first set of modules, which were only announced back in July, these new mm Wave antenna modules are 25 percent smaller and engineered to enable mobile device manufacturers to address stringent mobile handset size requirements for 5G NR smartphones and mobile devices, which are expected to launch next year. According to Qualcomm, the modules will provide OEMs with more options when it comes to the placement of antennas, offering more freedom and flexibility in their 5G mm Wave designs. Pairing the QTM052 mmWave antenna modules with Qualcomm's Snapdragon X50 5G modem, they feature a phased antenna array design, integrating up to four modules in a smartphone form factor. The modules are able to support advanced beam forming, beam steering, and beam tracking technologies, all of which help to improve the range and reliability of mmWave signals. The modules also include an integrated 5G NR radio transceiver, a power management IC, RF front-end components and a phased antenna array, and support up to 800 MHz of bandwidth in the 26.5-29.5 GHz (n257), 27.5-28.35 (n261), and 37-40 GHz (n260) mmWave bands. The amount of work involved in the development and roll-out of 5G was highlighted by the announcement that Qualcomm was working with Samsung to develop 5G small cells, which it's hoped will open the door for massive 5G network speed, increased capacity, extended coverage and ultra-low latency. Small cells are seen as a foundational building block for 5G and are intended to support delivery of uniform 5G experiences, especially indoors where most data tends to be consumed. In order to address cost and form factor requirements for a wide range of 5G NR deployment scenarios, service providers, enterprises, factories and other stakeholders are expected to become increasingly dependent on 5G NR small cell solutions, and the suppliers that deliver them. Mobile operators across the world including those in the United States, Japan and Korea are all expected to deploy small cells as a catalyst to support 5G-class experiences. Small cells are expected to provide multi-gigabit throughputs and millisecond level latencies to improve the wireless experience, and support a variety of new and emerging applications, such as augmented and virtual reality. In addition, 5G networks have the potential to create new opportunities, such as industrial automation and Automated Guided Vehicles (AGV), which rely on secure and high-speed wireless links. By harnessing the 5G spectrum networks will be able to deliver multi- gigabit wireless



speeds, making it ideal for fixed wireless access (FWA) applications, delivering "last-mile" broadband connectivity for homes, apartments and other venues in regions which have proved difficult to serve using traditional fibre or copper infrastructure. Qualcomm's FSM 100xx 10nm 5G Solution is said to be capable of enabling the Samsung 5G Small Cell solution to utilize both the sub-6GHz and mmWave spectrum, providing a next-generation wireless experience. According to Qualcomm, the FSM100xx is expected to deliver MIMO baseband functionality that it claims will be unrivalled in the industry. Coupled with Samsung's leading position in the development of 4G/5G infrastructure, Qualcomm said that it expected Samsung's 5G small cell solution would provide mobile network operators with a much improved tool that would be capable of supporting both outdoor and indoor deployment scenarios. As Amon said in his speech to the conference, "People may talk about the 'hype' that's perceived to

surround 5G but, as you can see from the ecosystem that it has thrown up, a lot of hard work is being undertaken to deliver 5G. By my reckoning over 560 companies are contributing to this technology and there have been over 100,000 technical contributions to the specifications that were completed at the end of 2017. “What we are seeing is the development of foundational technologies that will provide the scaling-up and flexibility that’s necessary to support use cases that will go way beyond mobile phones
– there’s certainly a lot more to 5G than simply mobiles.”

According to Amon,“As new networks are deployed, so industries will be transformed. We’ve been through a number of significant milestones with this technology and the industry is moving very quickly towards 5G. “A growing number of partners, working with Qualcomm, have announced deployments of 5G already and the commercial roll-out of 5G handsets is going to happen in 2019.” So, if Amon is to be believed, it really is going to all happen next year. Reality or hype, the next twelve months could prove crucial to the future success of 5G.