



IETE Bengaluru Magazine

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From the President IETE

I am very glad IETE Bengaluru Centre is bringing out the 4th edition of its quarterly magazine IETE Bengaluru Magazine. This continued effort to share information about the IETE Bengaluru activities and also to disseminate knowledge through topical and state-of-art technical articles is praiseworthy. IETE Bengaluru is one of the very active centres involved in organizing many programs and this magazine helps in showcasing its multifaceted activities.

IETE HQ has always supported and encouraged all initiatives by its Centres in the pursuit and sharing of knowledge. I wish the IETE Bengaluru Centre and this Magazine all the success.

Dr K. T. V. Reddy

President IETE
IETE HQ, New Delhi



From the Chairman

Dear IETE Members,

We are glad to present you the fourth issue of the IETE Bangalore Magazine.

IETE Bangalore organized many technical activities, conferences, seminars and workshops for the benefit of the technical community and has been very active in the last quarter. Details are given in this magazine. Some of the activities include: National Science Day, International Women's Day, SUSIEC and World Telecom & Information Day, several ISF Programs on varied technical areas at many associated Engineering Institutes. IETE Bangalore is keen to provide technical support to Institutions and Organizations in organizing courses, workshops, seminars. Please take advantage of this.

IETE Bengaluru Magazine is making effort to highlight to IETE Bangalore's achievements and also provide informative technical content. The positive and encouraging response to the first three issues has enthused us to bring this fourth issue.

We need your contributions and suggestions for the success of IETE Bengaluru Magazine. Looking forward to your response and support.

With warm regards,

HS Bhatia
Chairman, IETE Bangalore

CONTENTS

Messages from From the President From the Chairman &	1
From the Hon. Secretary From The Editor's Desk	2
Know Your Distinguished Persons From IETE Bangalore	3
An Eventful Quarter	4
A Report on National Science Day Celebration at IETE Bangalore	5
	6
LAURELS	7
We Miss Them	7
C-DAC IoT Research Lab Kit and its benefits	8
Weaponization and Militarization of Space	9
	10
Empowering the Student - English Language Proficiency	11
TECH TRENDS	13

IETE BENGALURU



From the Hon. Secretary

We brought out the last issue on the 28th February, the National Science Day 2019 and now we are before you with this, the 4th, edition of your Magazine, when we celebrate the World Telecommunication & Information Society Day. We have attempted to provide you a glimpse of the last quarter which was indeed eventful and hope you find the section interesting and informative. We carry a detailed report on the Science Day in this edition with excerpts from the presentations of the eminent guests of the day. The Summer School in Electronics & Computers was inaugurated on the 20th April and is under way, the Valedictory function being slated for 19th May. A full report will be published in the next issue. The endeavor of the Editorial Committee has been to make each edition decidedly better than the previous, and we hope you find this issue quite interesting and helpful.

On my part I would once again request you to go through the Magazine critically and provide us your valuable feedback which, I feel, is the only way in which we can evaluate the success of our effort. I also appeal to you to send us your own contributions and participate enthusiastically in all programs conducted by IETE Bangalore.

C. Satyanandan

Hon. Secretary
IETE Bengaluru

FROM THE EDITOR'S DESK



Welcome to Fourth Issue of *iете Bengaluru Magazine!*

We would like to thank all of you for the immense support and encouragement provided for the previous three issues. This issue covers all the activities organized at IETE Bangalore in 'Eventful Quarter' and also other regular features like 'Forthcoming Events', 'Technical Articles', 'Know Your Distinguished Persons from Bengaluru', 'Tech Trends' etc. IETE Bengaluru is one of the very active centres and is continuously organizing many technical activities which benefit our members. IETE Bengaluru is planning to establish an 'IOT Lab' in collaboration with C-DAC. We have included an article by C-DAC on 'C-DAC IoT Kit and benefits'

We would like to thank Dr S Pal & Shri Satyanandan for their articles. Our thanks are always due to Dr K T V Reddy, President IETE, Prof B S Sonde & Mr H Ramakrishna for their constant support & blessings.

Please send your views, suggestions and also be part of the magazine by contributing articles, news clips etc. Your contributions in any technical domain are always welcome. Thanks for your support and encouragement.

Thank You

Dr M H Kori

On behalf of *iete Bengaluru Magazine* Editorial Board

IETE Bengaluru Magazine Editorial Board: Shri. H Ramakrishna, Prof. HS Bhatia, Shri. C Satyanandan, Shri Jagannatha Rao, Prof. PN Sharada & Dr. M H Kori

KNOW YOUR DISTINGUISHED PERSONS FROM IETE BANGALORE

IETE Bangalore has produced a large number of very distinguished eminent persons who have held high responsible positions who have made significant contributions to industry, research, academics, administration & public policy and in many technical domains.

In this feature "**KNOW YOUR DISTINGUISHED PERSONS FROM IETE BANGALORE**", we are attempting to recognize all these eminent people.

In this issue we are listing all the Bangalore IETEians who have been elected as Distinguished Fellows.

IETE DISTINGUISHED FELLOWS FROM BANGALORE

Bangalore has twenty five IETE Distinguished Fellows:

1. Prof K Sreenivasan	1960-61	14. Shri Thomas Kora	1984-85
2. Prof S V C Aiya	1962-63	15. Shri K P P Nambiar	1985-86
3. Shri B V Baliga	1963-64	16. Dr K Kasturirangan	1994-95
4. Shri T V Ramamurti	1967-68	17. Prof Bharati Bhat	1996-97
5. Shri S S Ayier	1968-69	18. Dr R P Shenoy	1998-99
6. Shri N V Shenoi	1971-72	19. Dr S Pal	1999-00
7. Shri T V Srirangan	1977-78	20. Dr V K Aatre	2001-02
8. Shri T R Subramanyam	1978-79	21. Prof A Kumar	2003-04
9. Prof S Sampath	1978-79	22. Dr M G Chandrasekhar	2006-07
10. Prof P V Indiresan	1980-81	23. Shri A Bhaskaranarayana	2010-11
11. Shri B K Rai	1981-82	24. Prof M Basavaraj	2011-12
12. Prof B S Sonde	1983-84	25. Dr M H Kori	2017-18
13. Prof U R Rao	1984-85	We are proud of your achievements and contributions!	

AN EVENTFUL QUARTER

1. **28-02-2019:** National Science Day 2019 and Sir CV Raman Memorial Lecture. (Report in this issue)
2. **08-03-2019 International Women's Day** was celebrated by Sambhram College of Engineering in association with IETE Bangalore. Prof. HS Bhatia Chairman IETE and Shri. C Satyanandan Hon. Secretary participated.
3. **18-03-2019:** Prof. H S Bhatia, Chairman, IETE Bengaluru inaugurated ISF chapter at Bangalore Institute of Technology, Bangalore. Prof. C Murali was the guest of honor and he delivered a technical talk on "5G". Prof. Jalaja was the ISF coordinator.



4. **25-03-2019:** Computer Science Engineering department of SV College of Engineering, Bangalore conducted a seminar on "BigData and Hadoop" under the IETE Banner.
5. **26-03-2019:** Prof. Narayana S Ayier delivered a technical talk on "Control Systems" at SJCIT,

Chickballapur. Prof. H S Bhatia, Chairman, IETE Bengaluru was the chief guest and Prof. G K Venaktesh was the coordinator.

6. **31-03-2019:** IETE Bangalore Centre conducted one day workshop on "Signals & Systems with its Applications" for students. Sri. C Satyanandan, Hon. Secretary, IETE Bangalore inaugurated the workshop. Dr. D G Rao, Sc'E', LRDE, DRDO and Member of Executive Committee, IETE Bengaluru was the Chief Guest. Prof. G K Venkatesh was the Course Director.



7. **03-04-2019:** IETE Student Forum was inaugurated at Gopalan College of Engineering and Management Bangalore. Shri. C Satyanandan, Hon. Secretary IETE Bangalore was the Chief Guest at the programme of inauguration of ISF and Getocs V1.0 Tech Fest 2019 organized by the college. Prof. C Murali, former Vice President IETE and Guest of Honour was the keynote speaker. Dr. Gemson, Guest of Honour, Dr. Sengottaiyan, Principal, Dr. S Anantha Padmanabhan HoD, ECE and Brig. Jagadeesh Chandran, COO Gopalan Foundations participated.

8. **28-04-2019:** The inaugural programme of the "Summer School In Electronics & Computers (SUSIEC-2019)" was held on Sunday, 28th April 2018 at 1100 Hrs. at IETE Bengaluru Centre. It was inaugurated by Shri. P Radhakrishnan Outstanding Scientist & Associated Director, LRDE (DRDO) Bangalore, the Chief Guest. Shri. Rabindra Srikantan MD, ASM Technologies Ltd. was the Guest of Honour.

The welcome address was given by Shri. Satyanandan, Hon. Secretary. Dr. CV Ravishankar, Course Director, SUSIEC'19 introduced the Chief Guest who spoke on Electronics and its applications. The Guest of Honour Shri. Rabindra Srikantan distributed tool kits to the students. Prof. HS Bhatia, Chairman presided and Shri. Jagannatha Rao Hon. Treasurer proposed the Vote of Thanks. About 60 students registered for the programme. Students and their parents attended the inaugural function.



9.03-05-2019: Pratira-2019 "National Level Project Competition and Exhibition" was inaugurated at Sambhram Institute of Technology Bangalore by Dr. K Balaveera Reddy Former Vice Chancellor VTU, Chairmen-Governing Council NITK. Prof. Bhatia.H.S, Chairmen, IETE – Bengaluru was a Guest of Honour.

10. 03 & 04-05-2019: An International Conference on Recent Innovations in Science, Engineering, Humanities and Management and humanities (SEHM-2019) was held at Sambhram Institute of Technology Bangalore. Dr. K Balaveera Reddy Former Vice Chancellor VTU, Chairman-Governing Council NITK . Prof. Bhatia Chairman, IETE – Bengaluru was a Guest of Honour.



A Report on National Science Day Celebration at IETE Bangalore

The Institution of Electronics & Telecommunication Engineers Bangalore celebrated the National Science Day 2019 on the 28th February. Dr. VR Lalithambika Director, DHSP, ISRO HQ, Bangalore was the Chief Guest and delivered the 23rd Sir CV Raman Memorial Lecture on the topic 'Space Exploration'. Prof. BS Sonde, eminent scientist and Past President IETE who was the Guest of Honour delivered a speech on the contributions of Sir CV Raman.

The programme began with a Welcome Address by Shri. C Satyanandan, Hon. Secretary. Shri. CP Dwivedi, Vice Chairman read out an introduction of the speakers and Prof. HS Bhatia, Chairman presided.



Prof. BS Sonde in his address said that the discovery of Raman Effect by Sir CV Raman brought about a resurgence of scientific research in our country. National Science Day is celebrated in honour of this epoch making discovery, since 1988, his birth centenary year. Raman was awarded the Nobel Prize in Physics in 1930 two years after the discovery.

Prof. Sonde enlightened the audience about some little known facts about the genius of CV Raman. Raman was proficient in Telugu though born in a Tamil speaking family, as he had moved to Visakhapatnam, where he went to school and graduated at a very young age with an MA degree, in 1907. He became fluent in Kannada, as well, after he moved to Bangalore in 1932.

Prof. Sonde recalled that in 1905, or so, CV Raman was invited, while still working in a government department in Calcutta, by Sir Ashutosh Mukherji, Vice Chancellor of Calcutta University to take up the position of Professor of Physics. A teacher par excellence he was much sought after by students. He was willing to share research ideas. He became Fellow of Royal Society in 1924.

Raman became the Director of Indian Institute of Science Bangalore in 1933, the first Indian to occupy the post which he held until 1937. Raman set up the Dept. of Physics at IISc. for the first time. He established the Indian Academy of Sciences in 1934. After his term as Director he continued his research career as a Professor.

Raman was an Institution builder and a patient experimenter, said Prof. Sonde. He set up the Raman Research Institute and headed it until his death in 1970. Prof. Sonde joined the IETE community at Bangalore in paying homage to the great soul on the National Science Day 28th Feb. 2019.

then delivered the Sir CV Raman Memorial Lecture. She began her presentation by answering 'Why Space Exploration?' She said it is an extension of the human's natural urge to explore and that our natural curiosity has always stood us in good stead. We have a desire to better ourselves and better our lives. We also want to know how life has come about, whether life is confined only to earth and such matters. Scientific and philosophical questions are sought to be answered.



Dr. VR Lalithambika Chief Guest

Dr. Lalithambika made a parallel with early terrestrial explorations such as exploration of one's country and then that of other parts of the world and even colonization. Explorers have been pushing the boundary and wanting to do what none has done before. Infrastructure began to be built in parallel and developments took place in transportation. These are true of space exploration as well. She mentioned the unmanned flights of the 1950's, sending voices across solar system, orbiting of humans around earth and moon landing.

Dr. Lalithambika described the technical challenges in space exploration. Comparing rockets with commercial aircraft, she said there are huge differences in payload and fuel requirement. She also dwelt on hazards like debris floating around earth, both natural and man-made. An interesting observation was that there are 4000 dead satellites as part of this garbage in space. Of course, methods are being explored to minimize or dispose of them. She further explained such technical activities as mission planning, trajectories and spacecraft design.

The space scientist predicted that interstellar travel can become a reality in about half a century. Communication with the spacecraft and autonomy of equipment on board are among the many technical challenges. Also, effects of time on human body while in Space and psychological effects have to be studied in depth before sending humans into space, she said.



At the end of the CV Raman Memorial Lecture, the third edition of 'IETE Bengaluru Magazine' was released by the distinguished guests. Dr. MH Kori, Chairman of the Editorial Committee spoke about the current and previous editions of the Magazine and the forthcoming issues.

Prof. HS Bhatia, Chairman gave a brief Presidential speech. Shri. G Ramesh, Immediate Past Chairman spoke on IETE Bangalore's interaction with other institutions in the city.

The function concluded with a Vote of Thanks by Shri. KS Ravi Member, Executive Committee, IETE Bangalore.

LAURELS

Two IETE Bangalore Executive Committee Members were awarded PhD recently for their meritorious work.

Dr D G RAO, Senior Scientist in DRDO Bangalore, carried out research work at National Institute of Technology, Warangal on "Design and Realization of Novel Adaptive Digital Beamformer Architecture for Phased Array Radars" under the guidance of Prof T Kishore Kumar and Dr Vengadarajan. Based on the work carried out in this area by him, NIT Warangal has awarded PhD to Sri D G Rao.



Dr D G RAO



Dr G K VENKATESH

Dr G K VENKATESH completed his PhD in Electronics Engineering from Jain University Bangalore during the year 2019 in the field of Wireless Mobile Communications on the topic "Performance Analysis - A Novel Method for Fast Handovers in TDD and FDD for LTE".

Congratulations and best wishes to both DR D G Rao and Dr D G Venkatesh.

We Miss Them

We are very sad to inform that we have lost the following three very senior IETE Fellows from Bangalore:



AVM A S Murthy



Prof A Kumar



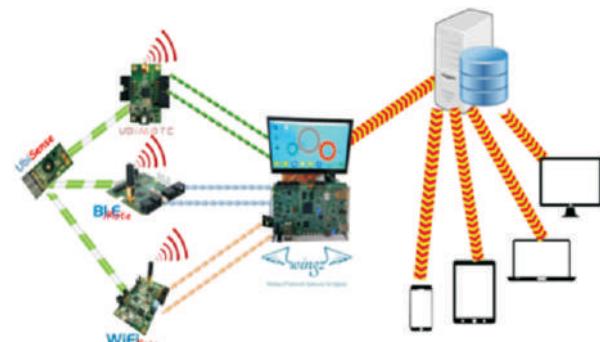
Brig K Balasubramaniam

Their contributions to IETE in general and IETE Bangalore Centre in particular have been immense. We will always remember them for their valuable suggestions and guidance.

C-DAC IoT Research Lab Kit and its benefits

The Internet of Things (IoT) is an interconnection of sensors and physical devices of all kinds into the world's information systems, in essence of creating a collection of machine-to-machine communication devices used to gather and distribute information. Ministry of Electronics and Information Technology (MeITY), Government of India has come out with a draft IoT Policy document which aim to create an IoT industry in India of USD 15 billion by 2020. It has been assumed that India would have a share of 5-6% of global IoT industry. It is important to impart

awareness on the state of the art technology 'Internet of Things' to a wider community. CDAC's IoT lab kit comprises of the following: ☺



- ❖ WSN Nodes: Ubimote, Wi-Fi Mote, BLE Mote
- ❖ Sensor Module: UbiSense
- ❖ WSN Gateway: WINGZ

Ubimote

Ubimote is a high performance wireless communication module complaint to IEEE 802.15.4 with rechargeable lithium battery, generic sensor interface enabled with Contiki, Zigbee and 6LowPAN stacks. It contains all building blocks required for effective implementation of secure communication.

Wi-Fi Mote

Wi-Fi mote is complaint to IEEE 802.11 b/g/n with hardcoded TCP/IP stack and different security protocols. This module also has a generic sensor interface header with multiple powering options like solar and DC- adapter supply.

BLE Mote

BLE mote is a Bluetooth 4.0 complaint communication module with generic sensor interface which can also work as a BLE beacon. It also comes with a rechargeable battery provision. It has an efficient crypto engine for security management.

UbiSense

Ubi-Sense is the generic sensor board to sense different physical parameters like temperature and relative humidity, light intensity, barometric pressure and proximity sensing.

WINGZ (Multi-protocol Gateway)

Wireless IP Network Gateway for Zigbee (WINGZ) with on board sensors, provides interface to connect personal area networks (Zigbee, 6LowPAN, Bluetooth) to IP networks (Wi-Fi, Ethernet, 3G) for the back end connectivity. On the whole it is a single board computer with display and audio functionalities.

Research Scope

IoT Lab kit can be used to do research and development in various sectors. The IoT Lab kit is designed with a gateway and several nodes which supports different protocols. It also has dedicated lab manuals to restructure the process of learning on different communication technologies. Its low power design and medium range communication link make it suitable for application design in the areas of agriculture, traffic control, natural disaster relief , health

monitoring and control, environment and habitat monitoring, home automation, consumer and industrial applications, product quality monitoring, seismic sensing etc.

Keeping that in mind, C-DAC Bangalore has developed some real time solutions using IoT Lab kit. Body area Network (BANs) is one of the examples where various categories of sensors such as ECG (Electrocardiogram), EEG (Electroencephalogram), body temperature etc. are placed at particular places on human body and the collected data is transmitted to a centralized gateway using BLE. The gateway, i.e., WINGZ will transmit the data to respective doctors over Wi-Fi. C-DAC Bangalore has also developed an Early Fire Detection System and a Safe Exit Guidance Algorithm. This is also an application of IoT lab kit where sensor data has been sent to centralized server via Wi-Fi. As expertise in this multi-disciplinary domain is increasing day by day C-DAC Bangalore is working to fulfill the requirements of Smart Cities by using the communication and networking technologies. In agricultural sector C-DAC's IoT Lab kit has been deployed to measure micro climatic information from groundnut fields. Around 100 nodes were deployed in 500-acre land to measure the parameters. After collecting the sensor data, it has been sent to a centralized server via gateway. Similarly, C-DAC Bangalore has also developed a water distribution system using IoT Lab kit.

To develop an end to end network C-DAC Bangalore has come up with SCADA lab kit, Sumegha Cloud lab kit by which extracted sensor data can be sent to cloud and run data analytics also. Figure 2 shows the entire network using IoT Lab kit, SCADA Lab kit and Cloud Lab kit.

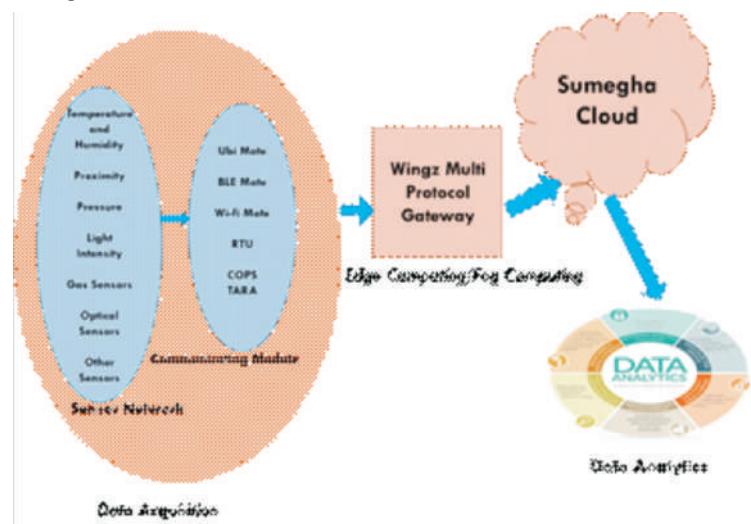


Figure 2: End to End Network using CDAC's IoT lab kit, SCADA lab kit and Sumegha cloud

Weaponization and Militarization of Space

Dr. S. Pal



The subject becomes more relevant with our recent ASAT experiment and CHINA going ahead in a big way for both weaponization as well as militarization of space besides the big powers: US & Russia. Even France has allocated large funds for the same. EU is thinking of having an independent space defence system. Needless to add that preparation for offence are always under the grab of defence.

The last place one would expect to fight a war is in outer space. It is no longer an empty and vast space. There are almost 1800 to 2000 active satellites crowding the nest of orbits, providing communication, navigation, weather, remote sensing, ISR, planetary surveillance. **All Militaries rely heavily on these satellites for modern warfare.**

In the highly "informatized" and technologically advanced battles that will characterize the 21st century, the outer space is playing and will continue to play a dominant role. Space assets largely helps military operations, for making crucial battlefield decisions. In this regard, attempts to weaponize space and command this sphere, are to be expected from US, Russia & China. US & Russia (including erstwhile USSR) started weaponizing space in 1950's & 1960 respectively. China is now following the suit.

'Weaponization' of Space:

The weaponization of space includes placing weapons in outer space or on heavenly bodies as well as creating weapons that will transit outer space or simply travel from earth to attack or destroy targets in space. It could be by placing of orbital or sub orbital satellites with the intention of attacking enemy satellites, using lasers to

incapacitate enemy satellites, plasma attacks, orbital ballistic missiles, ASAT from ground, jamming of enemy satellite signals, and satellite attack on earth targets. This could be further classified as:

- a) Direct energy and b) Kinetic energy weapons
- The weaponization of space is different from the militarization of space, which includes using space based assets from C4ISR (Command, Control, Communication, Computers, Intelligence, Surveillance and Reconnaissance)

MILITARIZATION OF SPACE

The militarization of space assists armies on the conventional battlefield, where as via the weaponization of space, outers space itself emerges as the battleground, sometimes referred to as the "fourth frontier of war".

Today's space faring nations use their Ballistic Missile Defence (BMD) systems, which includes ICBM as an auxiliary systems capable of destroying space-based assets. The difference between BMD and ASAT lies mainly in the S/W and control algorithms used to detect back and home on the satellite as compared to the warhead.

CHINA is working to target US Intelligence, Surveillance and Reconnaissance (ISR) satellites. Practically the difference between a midcourse BMD and hit to kill ASAT system is minimal.

CHINA has spacecraft equipped with Robotic Arm, to have dual use as ASAT weapon. Anolong-1 is believed to be one such first S/C in the series, which has been tasked to collect man-made space debris. However, such satellites can change the orbit of a satellite, snap off antennas & incapacitate a satellite.

The long simmering tensions are now approaching a boiling point due to several events, including recent and ongoing tests and anti-satellite weapons by CHINA, RUSSIA, US & now India.

Interestingly, US studies predicted in 2015 itself that India will enter into this club.

There are many ways to disable or destroy satellites beyond provactively, blowing them up with missiles. Rogue S/C can approach another one, create a high EM Field, spray paint on sensors, manually snap off its antennas, destabilize the orbit or jam RF.

US & USSR (Now Russia) during the cold war era developed space mines. In eighties President Reagan's "STRATEGIC DEFENCE INITIATIVE", where multi-billion dollar budget was earmarked to develop orbital countermeasures against soviet ICBM, the whole effort later on was dubbed as STARWARS.

In space the GEO & MEO satellites are like sitting ducks while LEO's do need some efforts.

Space junk & debris are the biggest threats for every one. More space weaponization, more satellites would result in to more space debris.

US has its programme of Geo synchronous Space Situational Awareness Program (GSSAP) a planned set of 4-S/C capable of monitoring the Earth's high orbits and even rendezvousing with other satellites to inspect them up-close. **In space particularly at GSO one need not hit a S/C even sliding up to the adversaries, strategic satellite, is considered as a risk.**

Russians have developed Commercial Launcher where the last stage after accomplishing the mission, launches small s/c, which could be used for refueling S/C or as space mines.

There is a tendency to develop offensive rather than defensive capabilities. **OFFENSIVE COUNTER MEASURES** widens the routes by which space soon becomes weaponized.

Most of the military space activities of an administration (particularly US) is behind a veil of secrecy, because the average countryman feels that there is no role of military in space. **Space is for NASA in US & ISRO in India.**

Most of the big administrations, feel there should be "SPACE POWER" like air, naval or ground.

There is an amalgamation of militarization and Nationalism across almost all nations in the world. The mutual distrust will give rise to space warfare.

INDIA & A-SAT

A-SAT operation on 28th March was a first major step towards building up a futuristic defence in India against attacks by space-borne systems and space docking activities. Such activity requires multi-agency coordination, including the Tracking and Command network of the Indian Space Research Organisation, the radar network of the Defence Research and Development Organisation and the excellent and 100 percent reliable communications link between the various ground

stations, radars and computational infrastructure.

The mission was accomplished with the help of good computational capability, a precise triangulation algorithm, automated launch and control of missile, accurate, orbital and position estimation of the satellite and various other systems. The scientists and all other personnel of both ISRO and DRDO deserve the entire nation's hearty congratulations!

While reports talk about China's earlier space test in 2007, the destruction of the satellite was a slightly easier task as it was at a higher orbit and therefore the velocity of the satellite was slightly less.

The physical cross-section of the LEO (Low Earth Orbit) satellite could be between, say two square meters to a maximum of six square meters. The radar's section will depend on the aspect angle with respect to radar. Hence, to precisely determine the position of the satellite, a multi-pronged approach is used where a network of radars, the satellite ground tracking network, if possible optical tracking, etc, are put in to service, and then the position or more precisely the arc of the orbit of the satellite over Indian territory or may be over international waters is determined and selected with extremely high levels of accuracy.

After launch of A-SAT, and say within a 100-200 meter vicinity of the satellite, the missile seeker guided the missile (Seekers could be infrared (IR), radio frequency (RF) active or passive, laser/optical seekers). India's A-SAT employed an IR seeker. The whole process was like seeking a coin and targeting it in a heap of hay under dynamic conditions, in a very limited period of time. In such operations, the role of the seeker is very critical as it helps to home on the target and hits it without delay of even a nano second.

Therefore, it was a major achievement and needed a lot of appreciation by the entire country.

When a satellite is orbiting in LEO (300 km from earth), it will travel at speeds of 7-8 km per second, but the speed of the missile will be 3 km per second, so even a millisecond difference will mean that the missile will miss the target by several meters. Therefore, the accuracy of the timing, and finding the orbital position of the satellite will be very critical in order to hit the bull's eye over Indian territory during such a mission.

In future, India could be well advised to emulate the United States and Russia, which have positioned satellites in space to control and track the launch of missiles and also photograph and trace the target with much higher

accuracy. This would help in hitting the targets even over international waters rather than over our own territory.

There was a subdued reactions to the 28th March A-SAT test by various countries, given the present geopolitical situation. However, in future, if an international treaty on such activities is signed, India will be treated at par with the United States, Russia and China. This activity was conducted only to demonstrate the capability and preparedness of the country for any kind of warfare in space. It is not a routine activity, and no administration would like to load its infrastructure for such tests.

Gen Hyten of US Airforce told that if the US is 'threatened in space' we have right of self defence". US

will execute that right because they are military and not NASA. They do not want to lose the war. So this becomes a tipping point of war.

I feel we are in the process of messing up space. Most of the person do not realize it, because they do not see it. Hence there is great need of some treaty with teeth.

However, under the present Geo political scenario we should have National Security and Space Strategy in place for India.

(The article is based on some talks delivered and an article in Deccan Chronicles ,Written by the Author)

Empowering the Student - English Language Proficiency

C. Satyanandan

It is estimated that about 64 lakh students pass out of colleges in India after an undergraduate degree every year. According to the All India Survey on Higher Education (AISHE) 2017-18 of the Ministry of Human Resources Development, Engineering & Technology alone accounts for 8.7 lakh.

The Indian student today looks beyond her country's borders for continuing education and lucrative employment. India is considered as only second to China in terms of international student enrollment in schools across the globe. Some of the reasons for the increasing number looking to study abroad are:

1. Desire for quality education - Seats in our top ranking institutions are limited and admission is highly competitive. (For example, lakhs of students compete every year for about 10000 seats in IIT's.) Undergraduate admission at a highly-ranked foreign school is, on the other hand, perceived to be comparatively easier.
2. More Options of Study - There is a rich variety of courses available to international students in countries like the US, UK, and Canada. Schools in these countries offer courses in contemporary and unconventional fields.
3. Perceived ease of getting a well-paid job – Apart from the glamour attached to a foreign degree, often the courses offered are job-oriented and the investment made is adequately compensated.

4. Opportunities to work while studying, and availability of scholarships.

Apart from the USA, the UK, Australia and Canada which have traditionally been the favoured destinations for both education and employment, new destinations such as Germany, Italy, New Zealand and China are emerging too.

Although Indians' preference for working abroad has somewhat taken a fall according to a recent sample survey of working professionals, still a substantial 60% according to it want to work temporarily or permanently in a foreign country. Reasons vary from better career opportunity to higher salary to acquiring global experience.

One mandatory requirement to obtain a visa to these countries for either education or for immigration, as far as Indians are concerned, is a valid proof of proficiency in English. Briefly the requirements of some of the countries are as under:

1. The USA: While the USA does not insist on knowledge of English for a Visa, most universities and colleges insist on scores in one of the recognized tests. TOEFL scores are the most common language requirements, while most North American universities will accept either TOEFL or IELTS as proof of your English language ability.
2. The UK: Universities will state their minimum English

language entrance requirement in a variety of different tests – IELTS, TOEFL, PTE Academic etc. IELTS is approved by the UK Government for UK Visas and Immigration (UKVI) application

3. Canada: IELTS exam scores are the most common language requirements for Canadian universities.

4. Australia & New Zealand: IELTS (General), PTE Academic and TOEFL are strong choices for immigration, while for University admissions IELTS (Academic), TOEFL & PTE Academic are among the accepted tests.

5. Germany: IELTS (Academic) is the preferred test for admission to English medium courses in Germany.

I intend to throw some light on the features of the three main tests mentioned to help the student to choose one that he may find best suited to his ability and need.

All three, IELTS, TOEFL and PTE Academic, test ability in Reading, Listening, Speaking and Writing. While TOEFL, managed by ETS, is the oldest with a history dating back to 1964, PTE is the latest entrant, and IELTS is perhaps the most widely accepted test.

IELTS (International English Language Testing System): IELTS is jointly owned by the British Council, IDP: IELTS Australia and Cambridge English Language Assessment. IELTS has two versions - Academic and General Training.

Certain unique features of IELTS are:

- i. It is a paper n pencil test in India. (Very recently a computer delivered version has also been inducted.)
- ii. The Speaking test in IELTS is a conversation with a certified IELTS Examiner.
- iii. The Speaking test is conducted on a date different from that of other modules.
- iv. IELTS evaluates the test takers using scores from 1 to 9 (in steps of 0.5).
- v. Score reports for IELTS are received within 13 calendar days.

TOEFL (Test of English as a Foreign Language):

- i. It is an internet based test in India (iBT).
- ii. In Speaking Test candidates speak into a microphone and the computer captures the audio

iii. TOEFL Speaking section is evaluated by a human rater.

iv. TOEFL scores the candidates on a range of 0 to 120.

v. Score reports for TOEFL are received within two weeks.

PTE (Pearson Test of English) Academic:

- i. PTE is computer based.
- ii. In Speaking Test candidates speak into a microphone and speaking is evaluated by a computer programme.
- iii. PTE includes a lot of innovative question formats.
- iv. PTE has an automated speech and writing scoring and students are graded on a scale of 10 to 90.
- v. PTE results are available online in five days.

While the above tests are mandatory for non-native English speakers seeking admission to university courses as detailed above, these are not the only requirements. The aspiring student should carefully study the stipulations of individual institutions where they seek admission. English at higher levels is also part of many other tests. Some of the important tests whose scores are considered for admission are mentioned below:

GRE: GRE, administered by ETS, is an admissions requirement for most graduate schools in the United States. It aims to measure verbal reasoning, quantitative reasoning and analytical writing.

GMAT: GMAT is a computer adaptive test intended to assess certain analytical, writing, quantitative, verbal, and reading skills in written English for use in admission to a graduate management program, such as an MBA in the USA and many other countries including India.

SAT: SAT is a standardized test widely used for undergraduate admissions in the United States. The current SAT comprises mathematics, and critical reading & writing plus an optional essay.

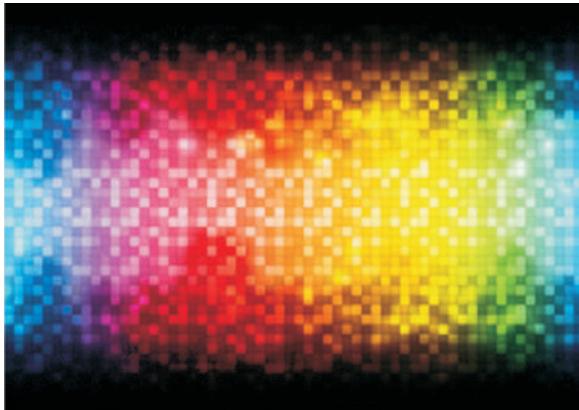
Scores of the above three tests are valid for 5 years.

A detailed description of the above tests is beyond the scope of this article and they are mentioned here only in connection with the need for English Language Proficiency.

Some decry the Indian's 'craze' for English. Maybe, this article offers one explanation for it.

TECH TRENDS

Smallest pixels ever created could light up color-changing buildings



The smallest pixels yet created -- a million times smaller than those in smartphones, made by trapping particles of light under tiny rocks of gold -- could be used for new types of large-scale flexible displays, big enough to cover entire buildings.

The colour pixels, developed by a team of scientists led by the University of Cambridge, are compatible with roll-to-roll fabrication on flexible plastic films, dramatically reducing their production cost. The results are reported in the journal *Science Advances*.

It has been a long-held dream to mimic the colour-changing skin of octopus or squid, allowing people or objects to disappear into the natural background, but making large-area flexible display screens is still prohibitively expensive because they are constructed from highly precise multiple layers.

At the centre of the pixels developed by the Cambridge scientists is a tiny particle of gold a few billionths of a metre across. The grain sits on top of a reflective surface, trapping light in the gap in between. Surrounding each grain is a thin sticky coating which changes chemically when electrically switched, causing the pixel to change colour across the spectrum.

The team of scientists, from different disciplines including physics, chemistry and manufacturing, made the pixels by coating vats of golden grains with an active polymer called polyaniline and then spraying them onto flexible mirror-coated plastic, to dramatically drive down production cost.

The pixels are the smallest yet created, a million times

smaller than typical smartphone pixels. They can be seen in bright sunlight and because they do not need constant power to keep their set colour, have an energy performance that make large areas feasible and sustainable. "We started by washing them over aluminized food packets, but then found aerosol spraying is faster," said co-lead author Hyeon-Ho Jeong from Cambridge's Cavendish Laboratory.

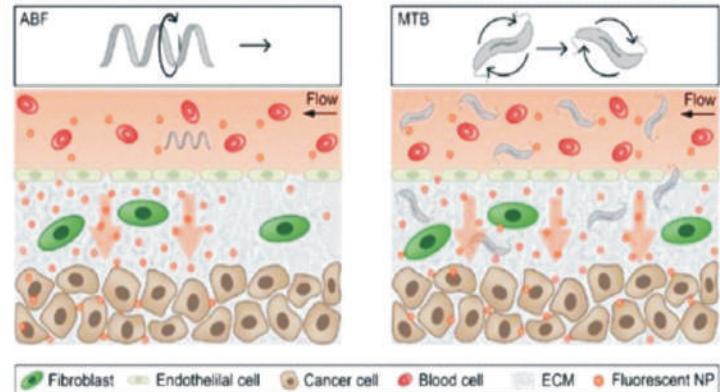
"These are not the normal tools of nanotechnology, but this sort of radical approach is needed to make sustainable technologies feasible," said Professor Jeremy J Baumberg of the NanoPhotonics Centre at Cambridge's Cavendish Laboratory, who led the research. "The strange physics of light on the nanoscale allows it to be switched, even if less than a tenth of the film is coated with our active pixels. That's because the apparent size of each pixel for light is many times larger than their physical area when using these resonant gold architectures."

The pixels could enable a host of new application possibilities such as building-sized display screens, architecture which can switch off solar heat load, active camouflage clothing and coatings, as well as tiny indicators for coming internet-of-things devices.

The team are currently working at improving the colour range and are looking for partners to develop the technology further.

Nanoparticles take a fantastic, magnetic voyage

Tiny robots powered by magnetic fields could help drug-delivery nanoparticles reach their targets



Engineers have designed tiny robots that can help drug-delivery nanoparticles push their way out of the bloodstream and into a tumor or another disease site. The magnetic microrobots could help to overcome one of the biggest obstacles to delivering drugs with nanoparticles: getting them to exit blood vessels and accumulate in the right place.

MIT engineers have designed tiny robots that can help drug-delivery nanoparticles push their way out of the bloodstream and into a tumor or another disease site. Like crafts in "Fantastic Voyage" -- a 1960s science fiction film in which a submarine crew shrinks in size and roams a body to repair damaged cells -- the robots swim through the bloodstream, creating a current that drags nanoparticles along with them.

The magnetic microrobots, inspired by bacterial propulsion, could help to overcome one of the biggest obstacles to delivering drugs with nanoparticles: getting the particles to exit blood vessels and accumulate in the right place.

"When you put nanomaterials in the bloodstream and target them to diseased tissue, the biggest barrier to that kind of payload getting into the tissue is the lining of the blood vessel," says Sangeeta Bhatia, the John and Dorothy Wilson Professor of Health Sciences and Technology and Electrical Engineering and Computer Science, a member of MIT's Koch Institute for Integrative Cancer Research and its Institute for Medical Engineering and Science, and the senior author of the study.

"Our idea was to see if you can use magnetism to create fluid forces that push nanoparticles into the tissue," adds Simone Schuerle, a former MIT postdoc and lead author of the paper, which appears in the April 26 issue of *Science Advances*.

In the same study, the researchers also showed that they could achieve a similar effect using swarms of living bacteria that are naturally magnetic. Each of these approaches could be suited for different types of drug delivery, the researchers say.

Novel thermoelectric nanoantenna design for use in solar energy harvesting

Researchers have demonstrated an innovative nanodevice for harvesting solar energy. The article reports that evolutive dipole nanoantennas (EDNs) generate a thermoelectric voltage three times larger than the classic dipole nanoantenna (CDN).

Capturing visible and infrared radiation using nanodevices is an essential aspect of collecting solar energy: solar cells and solar panels are common devices that utilize nanoantennas, which link electromagnetic radiation to specific optical fields. The EDN antenna can be useful in many areas where high thermoelectric

efficiency is needed from energy harvesting to applications across the aerospace industry.

"The paper reports on a novel design and demonstration of a nanoantenna for efficient thermoelectric energy harvesting," says Professor Ibrahim Abdulhalim, JNP Associate Editor, SPIE Fellow and a professor in the Electrooptics and Photonics Engineering Department at Ben-Gurion University of the Negev. "They demonstrated thermoelectric voltage three times larger than a classical antenna. This type of antenna can be useful in many fields from harvesting of energy from waste heat, in sensing and solar thermal energy harvesting."

The nanoantennas are bimetallic, using nickel and platinum, and were fabricated using e-beam lithography. The nanoantenna design was optimized using simulations to determine the distance between the elements. In comparing their thermoelectric voltage to the classic dipole nanoantenna, the EDNs were 1.3 times more efficient. The characterization was done using a solar simulator analyzing the I-V curves. The results indicate that EDN nanoantenna arrays would be good candidates for the harvesting of waste heat energy.

Digitized Spaces

New high-resolution geolocation technologies based on wireless radios in mobile devices, plus data mining software, are creating opportunities to understand how people and things move through physical spaces. Companies that adopt these technologies will get access to information about the users of their buildings that will open up new possibilities for business extensions and improvements.

Any business with customers at its sites (retail, education, medical, hospitality) will be able to see not just which spaces are used, but when and by what type of customer. For example, a retailer might be able to tell precisely when recipients of a coupon visit a store. A hotelier could tell if loyalty card members are using the health club. Educators would be able to track patterns in teaching spaces.

Additionally, digitized spaces will help network managers. They'll be able to identify areas where wireless service is weak, allowing highly precise deployment of new access points. And in security, it will be easier for analytics engines to notice unusual patterns of movement among wireless devices that could indicate physical break-ins.

Wi-Fi 6

Wi-Fi 6, also called 802.11ax, is an upgrade on the current highest-speed Wi-Fi protocol in wide use, 802.11ac. Wi-Fi 6 brings a dramatic improvement in efficiency across all existing Wi-Fi bands, including older 2.4GHz frequencies. Wi-Fi 6 will also likely get new spectrum in the 6GHz band in 2019 or 2020, further improving its speed.

The biggest improvement that comes with Wi-Fi 6 is that it increases the density of devices that can co-exist in a single space, further increasing the speed of all devices when there is more than one.

The new standard also improves performance by supporting deterministic (that is, not random) packet scheduling, which, as well as increasing the efficiency of the use of any given band, also makes for dramatic improvements in power utilization by mobile devices.

Wi-Fi 6 will eventually improve the experience for almost all wireless users, from office workers, who will find that their devices communicate more reliably and quickly in crowded offices, to people supporting constellations of IoT devices, who will find that they can pack more low-power devices into a space with fewer access points. The reliably deterministic nature of Wi-Fi 6, combined with its speed, means it should be usable for life-safety applications, including things like remote surgery devices.

Wi-Fi 6 products will begin rolling out in 2019.

Software Defined Wide-Area Networking (SD-WAN)

Traditionally, corporate networks have been based around centralized control, routing, and security. Nearly all network traffic in a large business would be back-hauled to a main data center, where the interconnects to other branches and systems were, and where the security applications like firewalls did their work.

That model still exists – businesses don't change network architectures rapidly – but it is breaking down. Designing networks primarily around branch-to-data-center connections doesn't make sense when so many business applications are now run out of the cloud, and so many end users rely on the open Internet for connection when they're not in a company office.

For these and other reasons, business are moving to software-defined wide-area networking. SD-WAN. SD-WAN allows networks to route traffic based on centrally-managed roles and rules, no matter what the entry and exit points of the traffic is – and with full security. For example, if a user in a branch office is working on Office365, SD-WAN can route their traffic directly to the closest cloud data center for that app, improving network responsiveness for the user and lowering bandwidth costs for the business.

SD-WAN networks can be run by leaner teams of networking engineers, and it is easy for these teams to modify the rules as business needs change. Ultimately, SD-WAN will make it easier for machine intelligence to take a hand in network management, further lowering bandwidth expenses and improving security.

SD-WAN has been a promised technology for years, but in 2019 it will be a major driver in how networks are built and re-built. In the coming year, SD-WAN network traffic will grow by 500%, and our research shows that more than half of business customers who don't currently use SD-WAN are going to make plans for its adoption.

What is a quantum computer?

How it works, why it's so powerful, and where it's likely to be most useful first

A quantum computer harnesses some of the almost-mystical phenomena of quantum mechanics to deliver huge leaps forward in processing power. Quantum machines promise to outstrip even the most capable of today's—and tomorrow's—supercomputers.



They won't wipe out conventional computers, though. Using a classical machine will still be the easiest and most economical solution for tackling most problems. But quantum computers promise to power exciting advances in various fields, from materials science to pharmaceuticals research. Companies are already experimenting with them to develop things like lighter and more powerful batteries for electric cars, and to help create novel drugs.

The secret to a quantum computer's power lies in its ability to generate and manipulate quantum bits, or qubits.

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What is a qubit?

Today's computers use bits—a stream of electrical or optical pulses representing 1s or 0s. Everything from your tweets and e-mails to your iTunes songs and YouTube videos are essentially long strings of these binary digits.

Quantum computers, on the other hand, use qubits, which are typically subatomic particles such as electrons or photons. Generating and managing qubits is a scientific and engineering challenge. Some companies, such as IBM, Google, and Rigetti

Computing, use superconducting circuits cooled to temperatures colder than deep space. Others, like IonQ, trap individual atoms in electromagnetic fields on a silicon chip in ultra-high-vacuum chambers. In both cases, the goal is to isolate the qubits in a controlled quantum state.

Qubits have some quirky quantum properties that mean a connected group of them can provide way more processing power than the same number of binary bits. One of those properties is known as superposition and another is called entanglement. Where is a quantum computer likely to be most useful first?

One of the most promising applications of quantum computers is for simulating the behavior of matter down to the molecular level. Auto manufacturers like Volkswagen and Daimler are using quantum computers to simulate the chemical composition of electrical-vehicle batteries to help find new ways to improve their performance. And pharmaceutical companies are leveraging them to analyze and compare compounds that could lead to the creation of new drugs.

The machines are also great for optimization problems because they can crunch through vast numbers of potential solutions extremely fast. Airbus, for instance, is using them to help calculate the most fuel-efficient ascent and descent paths for aircraft. And Volkswagen has unveiled a service that calculates the optimal routes for buses and taxis in cities in order to minimize congestion. Some researchers also think the machines could be used to accelerate artificial intelligence.

It could take quite a few years for quantum computers to achieve their full potential. Universities and businesses working on them are facing a shortage of skilled researchers in the field—and a lack of suppliers of some key components. But if these exotic new computing machines live up to their promise, they could transform entire industries and turbocharge global innovation.