The Institution of Electronics and Telecommunication Engineers

IETE Bengaluru Magazine

VOLUME 2, SEPT -NOV 2018

From the Chairman

Dear IETE Members,

It gives me great pleasure to present you the second issue of the IETE Bangalore Magazine. We wanted to create a platform to exhibit IETE Bangalore's achievements and also provide informative technical content. The enthusiastic response to the first issue has led to this second issue, which I hope, will also be received with similar excitement.

I am glad to inform you that IETE Bangalore has been very active in the last quarter organizing many technical activities, seminars and workshops for the benefit of the technical community. We have specially organized focussed technical events for the students with the help of IETE Student Forums at many Engineering Institutes. This has greatly benefitted the students.

IETE is organizing IETE International Conference India IICI-2018 from 13th to 15th Dec 2018. The theme of the Conference is Technological Advances & Applications in IOT, Big Data Analytics & 5G in Bangalore. This is going to be a very informative conference covering developments in many state-of-art technologies. I encourage all of you to participate in this and get enriched.

IETE Bangalore is always open to provide technical support to Industrial Organizations and Engineering Colleges in organizing workshops, seminars, special or customised courses. I invite all of you to take advantage of this.

It is our endeavour to create a vibrant technical ecosystem with the primary objective of knowledge dissemination. This Magazine is one of the segments of this larger objective. I am happy that it is taking the right shape and is on the way to meet its objective. We need your contributions and suggestions for its success.

Looking forward to your response and support.

With warm regards,
HS Bhatia
Chairman
IETE Bangalore

From the Hon. Secretary

This second issue of the Magazine is being issued as a companion volume of the Souvenir being released on the occasion of the first international conference being held by IETE Bangalore from 13th to 15th December 2018. The team that put together the first edition of the Magazine was charged with the responsibility of bringing out both the Souvenir and the Magazine. While the former commemorates a prestigious event and includes messages from persons distinguished in various fields, besides the proceedings of the conference, and therefore is special in its own way, the latter remains IETE Bangalore's pet house magazine. We have had to apportion our labour of love between the two but make sure that both the publications serve their respective readers fittingly.

While thanking the readers for their indulgence with the first issue, I look forward to your comments and criticism about the current issue of the magazine too.

C. Satyanandan
Hon. Secretary
IETE Bengaluru

CONTENTS

IETE BENGALURU

FROM THE EDITOR'S DESK

Welcome to to Second Issue of *iete Bengaluru Magazine!* We thank all of you for your kind and overwhelming appreciation and support for the inaugural issue. This has encouraged us to venture into the Second Issue. In this issue we are continuing with the same basic framework we have envisioned for this magazine – to record and inform the activities at the IETE Bangalore Centre, introduce the people behind these activities, inform about the proposed upcoming events and activities, include some technical articles and trace some technical trends. This time we have also added a technical crossword to tease your elementary technical knowledge.

IETE is organizing First IETE International Conference India – IICI-2018 – in Bangalore from 13th to 15th Dec 2018. The theme of the conference is Technological Advances and Applications in IOT, Data Analytics and 5G. Many experts in these domains will be participating and giving talks. We are sure this will be a very stimulating conference in the leading-edge technologies. We are glad this issue of IETEBM will be released during this Conference. We will be covering and reporting the IICI-2018 technical deliberations in the next issue.

We would like to thanks Mr M Anil Kumar, DDG Doordarshan and Prof A N Shivaram, ADTL for their technical 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.

Thanks for your support and encouragement. Please send your views, suggestions and also be part of the magazine by contributing articles, news clips etc.

As the next issue will be coming well into next year, on behalf of the entire editorial board of *iete Bengaluru Magazine,* let me wish all of you

A Very Happy and Technically Fulfilling New Year 2019!

Thank You

Dr M H Kori

On behalf of *iete Bengaluru Magazine* Editorial Board

IETE Bengaluru Executive Committee

1. PROF. H S BHATIA Chairman
2. SRI. G RAMESH Immediate Past Chairman
3. SRI.SATYANADAN C Hon. Secretary
4. SRI. JAGANNATHA RAO B N Hon. Treasurer
5. SRI. C P DWIVEDI Vice Chairman
6. SRI. G L GANGAPRASAD Vice Chairman
7. PROF. G K VENKATESH Exec. Committee Member
8. DR. K SHRISHAIL ANGADI Exec. Committee Member
9. SRI. DODDAMANI GOVIND RAO Exec. Committee Member
10. SRI. RANJEET KUMAR Exec. Committee Member
11. PROF. G S RAVEENDRA Exec. Committee Member
12. Dr. DC PANDEY Governing Council Member
13. SRI. VASU SEETHARAMAN Student Representative
14. SRI. ULLAS M Student Representative
15. PROF. C G RAGHAVENDRA Co-opted Member
16. SRI KS RAVI Co-opted Member
17. SRI. R PRAKASH Co-opted Member
18. DR. C V RAVISHANKAR Co-opted Member
19. SRI. M R KESHEOREY Co-opted Member
20. SRI. A B SRINIVASAN Special Invitee
21. SRI. VINOD S CHIPPALKATTI Special Invitee
22. SRI. P RADHAKRISHNA Special Invitee
23. DR. VENKATESWARA SHARMA Special Invitee
24. SRI. SUDARSHAN RAO P Special Invitee
25. SRI. M ANIL KUMAR Special Invitee

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 new 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 held highest position of IETE, PRESIDENT of IETE at IETE HQ New Delhi.

PAST IETE PRESIDENTS FROM BANGALORE IETE:

IETE Bangalore has produced seven IETE Presidents.

1. ***Prof K Srinivasan*** ***1956-1957***
2. ***Mr B V Baliga*** ***1957-1958***
3. ***Prof S V C Aiya*** ***1959-1960***
4. ***Col B K Rai*** ***1982-1984***
5. ***Mr K Thomas Kora*** ***1984-1986***
6. ***Prof B S Sonde*** ***1992-1994***
7. ***Dr Surendra Pal*** ***2012-2014***

We are proud of your achievements and contributions!

AN EVENTFUL QUARTER

Quarterly Activities Report for the Month of Oct, Nov and Dec 2018: IETE Bengaluru Centre

1. 14-10-2018: A One Day workshop on "DSP: Principles and Practice" was organized by the IETE Bengaluru Centre in association with Department of Electronics & Communication, Ramaiah Institute of Technology, Bengaluru and IMAPS India Chapter on 14th October 2018 at RIT Campus. The workshop inauguration ceremony was graced by Prof. Bhatia, Chairman, IETE Bengaluru Centre, Dr. M H Kori, Chairman, IMAPS India Chapter, Dr. S Sethu Selvi, HOD, Dept of EC, RIT, Bengaluru, Dr. Ashok Rao, Former Professor, IISc, Bengaluru, Sri C.P. Dwivedi, Vice-Chairman, IETE Bengaluru Centre and Prof. C G Raghavendra Executive Committee member, IETE Bengaluru Centre.

The workshop was focused on training the students, faculty and industry expert working in the area of Signal Processing. The participants were students & faculty from different engineering colleges of Karnataka and Andhra Pradesh, and Industry also.

2. 22-10-2018 to 27-10-2018: A 6-day course on Modern Radars was conducted at Nalanda, BAE, for executives of Bharat Electronics Limited, Bengaluru. The faculty members were drawn from DRDO. Dr. D C Pande was the course director and Prof. H S Bhatia, Chairman, IETE Bengaluru Centre was the course coordinator.

3. 25-10-2018: IETE Students Forum (ISF) at Sri. Venkateswara College of Engineering (SVCE), Bengaluru in Computer Science and Information Science departments was inaugurated by Sri. C Satyanandan, Hon. Secretary, IETE Bengaluru Centre who was the Chief Guest. Prof. C Murali was Guest of Honor and he delivered a technical talk on 5G Systems. Dr. Shoba, Head of the Department, proposed the vote of thanks.

4. 28-10-2018: A One Day workshop on Internet of Things (IoT) and its Applications was organised at IETE Bengaluru Centre by Prof. G K Venaktesh, Executive Committee Member, IETE Bengaluru Centre in association with SJCIT, Chickaballapur and InductryConnect Technologies, Bengaluru.

Sri. C Satyanandan, Hon. Secretary, IETE Bengaluru Centre inaugurated the workshop. Prof. C Murali was the first speaker and he covered the baiscs of IoT and about WSN. Sri. M Sukumar, Principal Consultant, IndustryConnect Technology gave a brief talk about basics of Industrial Automation and IoT. Sri. Abhay Bharadwaj, Head – Operations & Training, Frugal Labs Tech Solutions Pvt. Ltd. delivered a highly industry evaluations and current technology like Introduction to IoT & Industrial IoT. Prof. H S Bhatia, Chairman, IETE Bengaluru Centre distributed the certificates for the participants.

5. 30-10-2018: Project exhibitions at Sir MVIT. Shri. C Satyanandan Hon. Secretary IETE Bangalore inaugurated the 'TELEPOSIUM'

6. 1-11-2018 to 17-11-2018: CA Exams were held at the Centre.

7..02-11-2018: IETE foundation day was celebrated on Friday 02nd Nov 2018 at IETE Bengaluru Centre

A Report on Celebration of Foundation Day at IETE Bengaluru Centre

IETE Foundation Day was celebrated at the Bengaluru Centre on 2nd November 2018. The program began with a Welcome Address by Shri. C Satyanandan Hon. Secretary. He also read out the Message from Dr. (Prof.) KTV Reddy President IETE and acknowledged the greetings from two of the senior Fellows Shri. YNK Murthy and Shri. DBN Murthy who had been invited for felicitation but could not attend.

Prof. HS Bhatia Chairman IETE Bengaluru requested Dr. DC Pandey Governing Council Member to preside over the function and conduct it. Dr. Pandey welcomed the Chief Guest and keynote speaker Dr. Subrata Rakshit, Associate Director (Technology) at Centre for Artificial Intelligence and Robotics (CAIR) Bengaluru Area, India and introduced him to the audience. He then requested Shri. H Ramakrishna to speak about Shri. DN Gadadhar in whose memory the theme lecture was being delivered. Shri. Ramakrishna gave an account of Shri. Gadadhar's contributions.

Dr. Pandey also welcomed Prof. C. Murali, Past Chairman IETE Bengaluru Centre and recipient of IETE - BR Batra Memorial Award 2018 and requested him to deliver his talk on "Green IoT for a Smart World".

Prof. HS Bhatia Chairman then addressed the gathering. He welcomed the Chief Guest Dr. Rakshit and Prof. Murali speakers of the evening.

Prof. Murali in his talk said Smart world is viewed as an era in which objects can automatically and intelligently serve people in a collaborative manner. IoT connects everything in the smart world. For a sustainable smart world, it is needed to look into the technologies and issues regarding green IoT, which further reduces the energy consumption of IoT.

He summarised the hot green information and communications technologies (green radio frequency identification, green wireless sensor network, green cloud computing, green machine to machine, and green data centre) enabling green IoT and general green ICT principles.

Prof. C Murali

Dr. Subrata Rakshit

Dr. Subrata Rakshit gave a presentation on Challenges in Development of Robotics Applications. He gave a brief overview of development at CAIR. He spoke about Intelligent Unmanned Systems, Evolution of Intelligent Robotics at CAIR and SLAM Algorithms.

He mentioned the Engineering challenges and explained the large set of ingredients of Robotics, Robotics and AI, Robotics in the third world industry and building indigenous Robots. Dr. Rakshit also explained the Non Engineering challenges of delivering Robotics in India, Robotics Ethics and Security, ownership and legality issues and social interaction.

Three senior Fellow members of IETE Bangalore who were chosen for being honoured were then felicitated. Chairman Prof. Bhatia and Immediate Past Chairman Shri. G Ramesh honoured the senior members Dr. K Soundararajan, Shri. AB Srinivasan and Wg. Cdr. Parthasarathy by presenting them shawl and bouquet.

The program concluded with Vote of Thanks proposed by Shri. CP Dwivedi, Vice Chairman.

Upcoming Events in The Next Quarter

13-12-18 to 15-12-18	IETE International Conference India- 18 (IICI-18)
15 -12-18 to 22-12-18	IETE Exams
13-12-18	Embedded Systems & Design
26-01-2019	Republic Day
28-02-2019	IETE Students' Day

Demystifying 5G! – Enabling Technologies

Dr M H Kori

In the previous article we had looked at what is 5G, why 5G was needed and what are its extended scope, apart from higher data rates. Just to recollect, there are three primary pillars on which 5G is based.

1. Enhanced Mobile Broadband (eMBB). eMBB is the most obvious extension of LTE capability, providing higher speeds for applications such as streaming, Web access, video conferencing, and virtual reality. Highest speeds will occur in small cells with limited movement speed of end users, such as with pedestrians.

• 10-20 Gbps peak • 100 Mbps whenever needed • 10000x more traffic • Macro and small cells • Support for high mobility (500 km/h) • Network energy saving by 100 times

2. Massive Machine-Type Communications (mMTC). Massive machine-type communications extends LTE Internet of Things capabilities—for example, NB-IoT—to support huge numbers of devices with lower costs, enhanced coverage, and long battery life. As shown in the ITU objectives, below, 5G will support ten times as many devices in an area as LTE.

• High density of devices (2x105 - 106 /km2) • Long range • Low data rate (1 - 100 kbps) • M2M ultra low cost • 10 years battery • Asynchronous access

3. Ultra-Reliable and Low-Latency Communications (URLLC). Of the three categories, URLLC enables wireless applications never before possible. Driven by high dependability and extremely short network traversal time, URLLC, also referred to as "mission-critical" communications, will enable industrial automation, drone control, new medical applications, and autonomous vehicles. This category is also referred to as critical machine-type communications (cMTC).

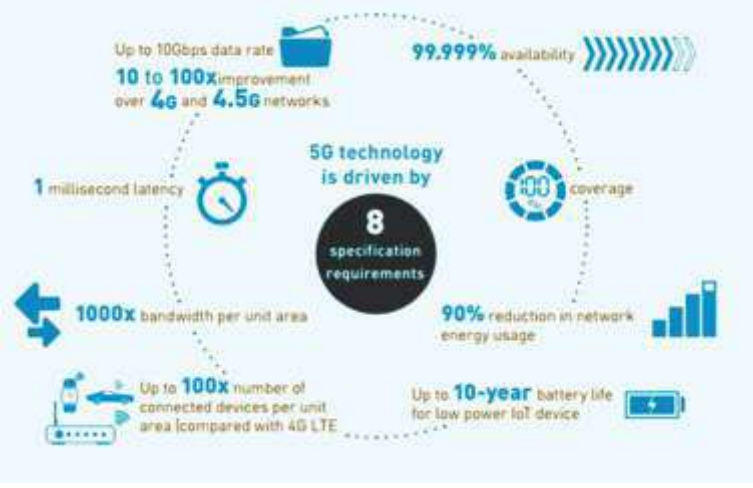
• Ultra responsive • <1 msec air interface latency • 5 ms E2E latency • Ultra reliable and available (99.9999%) • Low to medium data rates (50 kbps - 10 Mbps) • High speed mobility

Some fascinating technologies have facilitated meeting the above requirements. We will be covering some of these technologies in this issue.

Before delving into some of these technologies, let us recall the important 5G specifications:

5G technology is driven by 8 specification requirements

- Up to 10Gbps data rate - > 10 to 100x improvement over 4G and 4.5G networks
- 1-millisecond latency
- 1000x bandwidth per unit area
- Up to 100x number of connected devices per unit area (compared with 4G LTE)
- 99.999% availability
- 100% coverage
- 90% reduction in network energy usage
- Up to 10-year battery life for low power IoT devices



Now let us look at what are the technologies which drive some of these ambitious performance objectives of 5G.

1. 5G New Radio (NR)

5G New Radio (NR) is the global standard for a unified, more capable 5G wireless air interface. 5G NR is a new air interface being developed for 5G. An air interface is the radio frequency portion of the circuit between the mobile device and the active base station. It will deliver significantly faster and more responsive mobile broadband experiences and extend mobile technology to connect and redefine a multitude of new industries. In a nutshell, the 5G NR is being designed to significantly improve the performance, flexibility, scalability and efficiency of current mobile networks, and to get the most out of the available spectrum, be that licensed, shared or unlicensed, across a wide variety of spectrum bands.

The 5G NR must be able to: deliver a huge number of varied services provided across a diverse set of devices with different performance and latency requirements; support a wide range of deployment models from traditional macro to hotspot deployments; and allow

new ways for devices to interconnect, such as device-to-device and multi-hop mesh. And it must do all this at unprecedented levels of cost, power and deployment efficiencies.

There were many options for waveforms proposed at 3GPP. The main proposals were compatible with many essential technologies, including MIMO, Spectral efficiency, Low Peak to Average Power Ratio (PAPR), high time localization to support TDD systems and ultra-reliable low latency (URLLC) use cases, acceptable complexity and low out of band emissions. For 3GPP Release 15, it was agreed that an OFDM-based waveform with Cyclic Prefix (CP) will be supported for both 5G NR download and upload. DFT-S-OFDM based waveform will be also supported, complementary to CP-OFDM waveform and used for an enhanced mobile broadband (eMBB) uplink up to at least 40GHz.

The maximum channel bandwidth for 5G NR (Sub-6GHz) is 100MHz, while mmWave is a larger 400MHz. Compared to LTE, 5G NR is designed to have a higher bandwidth efficiency of up to 99%, versus up to 90% in LTE, where only 18 MHz in a 20 MHz channel was effectively used.

With an increasing number of use cases planned for 5G NR, a scalable and flexible physical layer design is required. The main idea of OFDM is to divide a wide channel into orthogonal, narrow subcarriers. A set of parameters defines the division, which in turn expresses sub-carrier spacing, symbol length, cyclic prefix (CP) and transmission time interval (TTI). For OFDM with cyclic prefix (CP), for both download and upload: QPSK, 16QAM, 64QAM, and 256QAM modulation methods are available. For the DFT-s-OFDM with cyclic prefix (CP), for upload only: $\pi/2$-BPSK, QPSK, 16QAM, 64QAM and 256QAM modulation methods are available. 3GPP discussions are ongoing regarding support of 1024QAM.

2. Massive MIMO & Beam Forming

Massive MIMO technology will almost certainly be a core component of the super-fast 5G networks of the future. Indeed, several mobile network operators around the world have already begun rolling it out ahead of 5G's arrival in 2020.

MIMO stands for Multiple-input multiple-output. While it involves multiple technologies, MIMO can essentially be boiled down to this single principle: a wireless network that allows the transmitting and receiving of more than one data signal simultaneously over the same radio channel, typically using a separate antenna for the transmitting and receiving of each data signal.

Standard MIMO networks tend to use two or four antennas to transmit data and the same number to receive it. Massive MIMO, on the other hand, is a MIMO system with an especially high number of antennas. There's no set figure for what constitutes a Massive MIMO set-up, but the description tends to be applied to systems with tens or even hundreds of antennas. For example, Huawei, ZTE, and Facebook have demonstrated Massive MIMO systems with as many as 96 to 128 antennas.

What are the advantages of Massive MIMO?

The advantage of a MIMO network over a regular one is that it can multiply the capacity of a wireless connection without requiring more spectrum. Reports point to considerable capacity improvements and could potentially yield as much as a 50-fold increase in future.

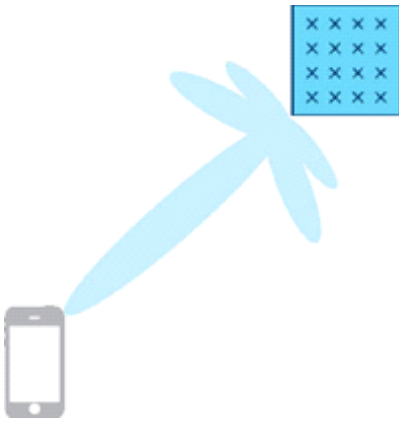
The more antennas the transmitter/receiver is equipped with, the more possible signal paths and the better the performance in terms of data rate and link reliability. The greater number of antennas in a Massive MIMO network will also make it far more resistant to interference and intentional jamming than current systems that only utilise a handful of antennas.

Massive MIMO networks will utilise beamforming technology, enabling the targeted use of spectrum. Current mobile networks are rather dumb in the way they apportion a single pool of spectrum between all users in the vicinity, which results in a performance bottleneck in densely populated areas. With Massive MIMO and beamforming such a process is handled far more smartly and efficiently, so data speeds and latency will be far more uniform across the network.

Beamforming vs. Massive MIMO

Beamforming is a word that means different things to different people. According to its basic definition, it is the ability to adapt the radiation pattern of the antenna array to a particular scenario. In the cellular communications space, many people think of beamforming as steering a lobe of power in a particular direction toward a user (Fig. 1). Relative amplitude and phase shifts are applied to

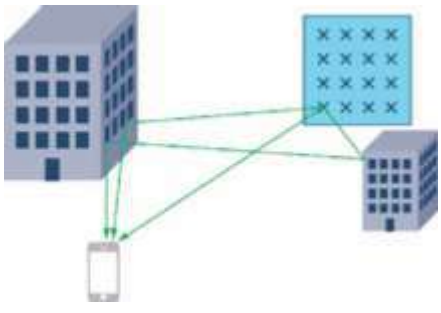
each antenna element to allow for the output signals from the antenna array to coherently add together for a particular transmit/receive angle and destructively cancel each other out for other signals. The spatial environment that the array and user are in is not generally considered. This is indeed beamforming, but is just one specific implementation of it.



Traditional beamforming.

Massive MIMO can be considered as a form of beamforming in the more general sense of the term, but is quite removed from the traditional form. "Massive" simply refers to the large number of antennas in the base-station antenna array. "MIMO" refers to the fact that multiple spatially separated users are catered for by the antenna array in the same time and frequency resource.

Massive MIMO also acknowledges that in real-world systems, data transmitted between an antenna and a user terminal—and vice versa—undergoes filtering from the surrounding environment. The signal may be reflected off buildings and other obstacles, and these reflections will have an associated delay, attenuation, and direction of arrival (Fig. 2). There may not even be a direct line-of-sight between the antenna and the user terminal. It turns out that these non-direct transmission paths can be harnessed as a power for good.

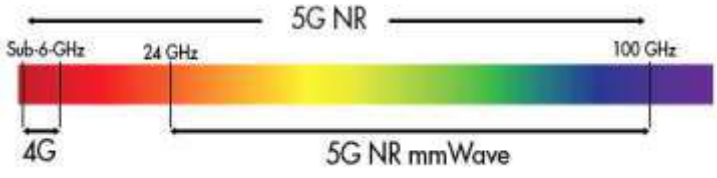


Multipath environment between the antenna array and user

Iin order to take advantage of the multiple paths, the spatial channel between antenna elements and user terminals needs to be characterized. In the literature, this response is generally referred to as channel state information (CSI). This CSI is effectively a collection of the spatial transfer functions between each antenna and each user terminal. Such spatial information is gathered in a matrix. Massive MIMO spatial multiplexing has the potential to become a game-changing technology in the cellular communications space, allowing for increased cellular capacity and efficiency in high-traffic urban areas. The diversity that multipath propagation introduces is exploited to allow for data transfer between a base station and multiple users in the same time and frequency resource.

3. mm Wave for 5G

Even with the advances of 4G LTE, the network is running out of bandwidth. The solution, as seen by 5G wireless network developers, is to add more bandwidth by using frequency spectrum in the millimeter-wave frequency range (Fig. 1). With hundreds of megahertz of wireless transmission bandwidth available at center frequencies such as 24, 28, and 38 GHz, 5G wireless networks will be capable of almost zero-latency phone calls and extremely high data speeds. Although mmWave frequencies, according to their wavelengths, range from 30 to 300 GHz, 5G innovators such as Qualcomm and other members of the 3GPP working on 5G network solutions typically refer to the mmWave frequency range as starting at about 24 GHz.



1. The amount of bandwidth available at mmWave frequencies is enormous compared to the amount of frequency spectrum used by 4G and previous wireless network technologies.

Autonomous vehicles will need that 1-ms latency of 5G networks to safely steer through traffic and maintain awareness of the traffic around them by means of vehicle-to-everything (V2X) communications. In addition, potentially billions of Internet of Things (IoT) sensors may be adding their data contributions to 5G networks within the next decade, giving people instant access to information about different things and environments around them. Due to this projected massive bandwidth consumption, developers see mmWave frequencies providing the bandwidth to make 5G possible.

However, Electromagnetic (EM) energy at those higher frequencies suffers a great deal of path loss through the air (especially through air with high humidity) compared to lower-frequency signals with longer wavelengths.

Signals at 24 GHz and above can be absorbed by any objects in their propagating path, such as buildings, trees, even the hand of someone holding the smartphone that's sending the mmWave signals to a cell site to connect with a listener. But mmWave frequencies also have benefits, in addition to the generous bandwidths they offer, such as their use of much smaller antennas compared to lower frequencies. The small size of these antennas makes it possible to pack many of them together into small form factors to benefit from antenna arrays.

5G network infrastructure must be erected with many more, smaller cell sites or base stations than lower-frequency wireless networks. In addition, within those smaller cells, many antennas will be used to produce three-dimensional (3D) antenna beams, also known as beamforming.

Millimeter waves tend to be susceptible to interference and generally need to maintain line-of-sight for transmission to work. At the most basic level, mmwave transmissions usually go in a straight line between point A and point B. But something as simple as a person walking in between the receiver and transmitter can block the signal altogether. One has to figure out how to make sure the signal gets from base stations to mobile devices. In 5G NR, part of the solution, are two processes called beamforming and beam tracking.

We will be exploring them and a few more exciting 5G technologies in the next issue!

Ref:

1. LTE to 5G - 5G Americas / Rysavy Research White Paper

2. 5G Era – GSMA

3. 3GPP Reports

4. Engadget

5. Microwave & RF

6. 5g.co.uk

7. Mediatek

BRIDGING THE DIGITAL DIVIDE - IN DIGITAL BROADCASTING WAY

- Anil Kumar Mangalgi, DDG(E), Doordarshan Bangalore

Doordarshan, India's public service broadcaster, a division of Prasar Bharati, is one of the largest broadcasting organisations in the world in terms of the number of studios and transmitters. As per the current legal and regulatory framework in India, VHF and UHF bands are reserved for TV broadcasting, and terrestrial TV transmission is limited to Doordarshan. It covers 88% of population with an analogue terrestrial network of 1412 transmitters. The terrestrial TV network has been using analogue technology and provides only Free to Air (FTA) channels. Doordarshan has started replacing its analogue transmitters by digital transmitters, which will allow more than 10 channels of TV and radio to be carried over a single transmitter.

India has a highly commercialized Cable & Satellite TV ecosystem. As of January 2017, besides the 26 channels of DD, there are 899 licensed private satellite TV channels beaming their content in the country. Of the total C&S Households nearly 87% are being served by the private sector and the remaining by the public broadcaster DD. Thus, a basic pack has an average price of around Rs 150 and gives access to more than 150 channels. Lack of choices on terrestrial transmission and the high penetration of cable and satellite TVs are providing intense competition to terrestrial service, which is in turn causing reduction in the terrestrial viewers day by day. To revive the terrestrial network by offering new value added services which other delivery platforms are not able to offer in a cost effective way , Terrestrial broadcaster could explore the possibility of using latest Wi-FAR and universally popular WiFi technology to extend digital terrestrial television (DTT) and broadband connectivity to people in the remote areas.

Wi-FAR Standard

Today, frequency spectrum is a scarce and expensive resource, and making the best use of any unused frequency is a must. The IEEE 802.22 Wireless Regional Area Networks Working Group has developed a point-to-multipoint wireless broadband standard optimized for operation in the VHF and UHF TV bands- in the frequency range between 54 MHz and 862 MHz. The standard is especially useful for serving rural areas where most of the empty TV spectrum in VHF & UHF can be found. In these areas population also remains mostly unserved or underserved by Internet broadband access service providers.

ISO Approved the Award-Winning IEEE 802.22™-2011 Standard in 2015 to Provide Broadband Connectivity to Rural and Underserved Global Communities. IEEE 802.22-2011 on Wireless Regional Area Networks (WRAN) takes advantage of the favourable propagation characteristics in the VHF and low UHF TV bands to provide broadband wireless access under Line of Sight (LoS) and Non Line of Sight (NLoS) conditions over a

large area (10 kilometers to 30 kilometers). This is possible while operating on a strict non-interference basis along with the basic TV transmissions. This unused spectrum (other than those channels used for TV transmission) is also known as the Television Band White Space (TVWS). Wi-FAR is a recently trademarked name from the non-profit WhiteSpace Alliance (WSA) that refers to the 802.22 wireless standards first approved by the IEEE (Institute of Electrical and Electronics Engineers) in 2011. For an impoverished or sparsely populated region where people, businesses and schoolchildren have little Internet access, Wi-FAR could be a god sent gift, when used to link base stations (typically found at the ground level) in a distributed network. Each Wi-FAR cell can provide aggregate throughput of 22 - 29Mbps per TV channel while typical distance covered ranges from 10 Kms to 30 Kms.

Wi-FAR and WiFi in Terrestrial Network

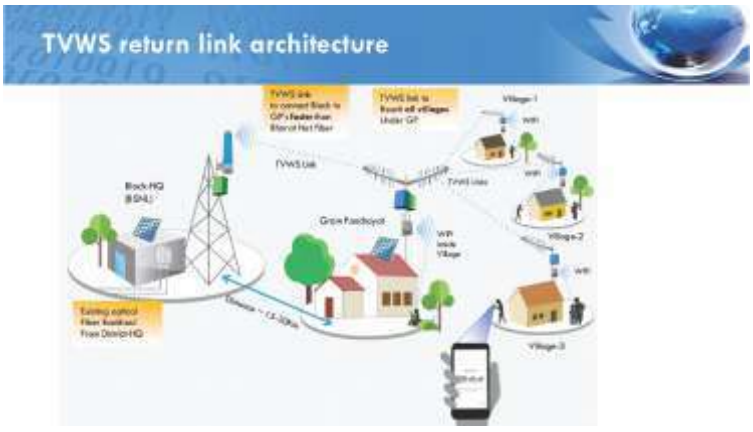
Terrestrial TV broadcaster can make use of the above standards for simultaneous extension of Digital TV services and broadband connectivity to remote un-served or underserved villages to realize nations socio economics initiatives and government's "Digital India" program.

To expedite the possibility of using these standards in deployment of both Digital TV and Wi-FAR(TVWS) systems in DD network, Doordarshan Kendra, Bengaluru interacted and coordinated with M/s Saankhya Labs Bengaluru ,an industry expert, chipset designer, manufacturer and developer of Wi-FAR systems to successfully carryout the Live demonstration of DTT and WI-FAR service both in the Lab and in the field in a limited way (Point to point) .

A possible deployment plan

- Deployment assumes that the NFON (Bharatnet backbone) which is terminated in the Gram Panchayat/Hobli would carry TV programs on IP along with broadband and where there is no NFON network, satellite connectivity could be used.
- Minimum two UHF channels will be used at each Place. One to carry Digital TV programs and second would be used for broadband extension using Wi-FAR link
- Trans-end can be installed in LPTV or Gram Panchayat/Hobli premises
- Minimum two receives in each village (Village office and PHC) within the radius of 15 to 25 Kms would be needed. Each receive system would consist of TVWS CPE modem + digital TV Receiver and electronics to convert Broadband and digital TV in to WiFi for direct reception on a ordinary mobile or tab with simple WiFi receive facility. This would cover entire village.
- Any simple WiFi device can facilitate access through an App to all Govt portals and apps like Digital India, BHIM, SEHAT(Telemedicine), Krishi Bazar, Soil Health Card, Start up India, Make in India, PMKVY etc and in addition to Digital TV and radio channels for entertainment. Access to nongovernmental sites can be disabled if needed.
- Digital TV and Radio channels can also be directly received in each of the households by using simple set top box and outdoor/ indoor antenna
- Once implemented it would help in a big way in
- Providing internet connectivity in remote and isolated parts without the help of mobile operators
- Digital payments using BHIM and other Apps
- Tele medicine
- Promoting of pro poor and pro farmer policies
- E-Kissan applications
- E- education , Adult education and literacy mission programmes
- Video on Demand(VOD) for education, health and farming
- Self learning Skills development videos
- Digital India, stand-up India and Make in India
- FREE quality Digital TV and radio entertainment

Simple demo showing the features and connectivity was successfully carried out in the Lab environment and practically in the field condition by deploying one Trans and one receive setup between DDK Bangalore and Saankhyaa Lab office (Aerial distance 5Kms) using 250 mw power and Omni Directional Antenna at Trans end and simple directional Yagi receive Antenna at the receive end. Both the features of Digital TV and Broadband extension over WiFi and in addition direct reception of Digital TV on Sony TV with built in DVB-T/DVB-T2 chipset were successfully tested and demonstrated. Diagram showing the deployment and technical details is given below for quick reference.



Looking at its excellent features cited above and its utility in achieving the Government's mission of Digital India, it will be very much desirable for the public service broadcaster to try out a pilot deployment of the whole technology at any one selected location with connectivity extended to 10 villages. This would not only help to showcase and prove the technology beyond any doubt, but also help quicken pan India deployment to achieve the nation's vision of Digital India. Once implemented it would be a classic example of 'Make In India, By A Startup India, For Digital India' and the entire solution implemented by the Indian Public Service

Development of a Cavity Backed Patch Antenna for a Tactical Control Radar

- Prof A N Shivaram, ADTL

Alpha Design Technologies, a premier private company has been pursuing the development of a Tactical Control Radar (TCR), similar to the model, EL/M-21NG of ELTA Company. TCR refers to a class of medium rang radar systems, normally portable which can be quickly deployed for operation. It is a solid state, fully coherent pulse Doppler radar implementing state-of-the-art technologies such as Digital Signal Processing (DSP), MTI, etc.

Development of the antenna subsystem for TCR is detailed in this write-up. The specifications of the antenna are given in Table 1.

Table 1: Specifications of Antenna.

Frequency	L Band (1.2 to 1.4 GHz)
Centre Frequency	1.3 GHz (λ=23 cm)
Bandwidth	10%
Azimuth Beam-width	8 Degrees
Elevation Beam-width	16 Degrees
Polarization	Linear
SLL	-25.0 Db
Cross Polar Level	-20.0 Db
VSWR	< 2.0
Power Handling	800 W
Antenna Size (m)	2.0 X 1.0 meter
Antenna Type	Planar Array of micro strip radiating elements.

Micro-strip patch was chosen as the radiating element since it has the advantage of being low profile, lightweight and is easy and economical to manufacture the antenna unit can be divided into sub arrays for easy packaging and deployment. However, the micro-strip patch antenna is inherently a narrow band device due to its high Q, resulting in a bandwidth of 2 to 3 %. There are methods to increase the bandwidth greater than 3% and in this endeavour, we have chosen a probe feed to excite the patch antenna element which is backed by a cavity as shown in figure 1 and 2.

Figure 1: Top view of the cavity backed patch antenna

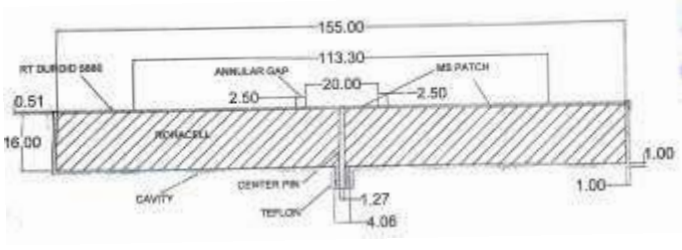


Figure 2: side view of the cavity backed patch antenna.

After the preliminary first cut design, HFSS simulation tool was used to arrive at the final configuration. The radiating element assembly

as shown in figure consists of a metal cavity with a hole at the bottom to pass the central pin of the SMA connector RT duroid (□r=2.2 and thickness=0.79 mm) is used as substrate due to its low loss and large peel strength characteristics. The radiating element is printed over the substrate and bottom metal is fully etched. The patch is direct fed through extended pin probe type connector. The feed point in the patch is having a concentric slot ring to compensate the inductive effect of the feed due to its increased height. The cavity is filled with Rohacell (□r=1.07) that has low dielectric constant to support the micro-strip patch antenna PCB placed over the cavity. The below figure 3 shows the fabricated single patch antenna element.

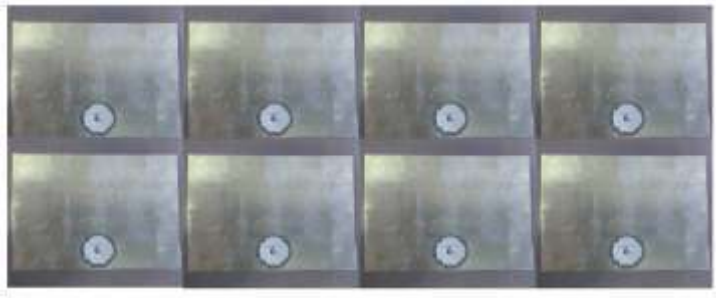


Figure 3: Single patch antenna

Subsequently, eight such antenna elements have been fabricated and tested. Figure 4 shows eight patch antenna elements configured as 4x2 element array. Test results are encouraging and indicate good bandwidth of 10% for a -18dB return loss.

TECH TRENDS

Electronic Stickers for the 'Internet of Things'

As society moves toward connecting all objects to the internet -- even furniture and office supplies -- the technology that enables these objects to communicate and sense each other will need to scale up. Researchers at Purdue University and the University of Virginia have developed a new fabrication method -Transfer Printing - that makes tiny, thin-film electronic circuits peelable from a surface. The technique not only eliminates several manufacturing steps and the associated costs, but also allows any object to sense its environment or be controlled through the application of a high-tech sticker.
Most of today's electronic circuits are individually built on their own silicon "wafer," a flat and rigid substrate. The silicon wafer can then withstand the high temperatures and chemical etching that are used to remove the circuits from the wafer. But high temperatures and etching damage the silicon wafer, forcing the manufacturing process to accommodate an entirely new wafer each time.

With ***transfer printing***, it cuts down manufacturing costs by using a single wafer to build a nearly infinite number of thin films holding electronic circuits. Instead of high temperatures and chemicals, the film can peel off at room temperature with the energy-saving help of simply water. Shown below is an illustration of the key steps for physically liberating a thin-film nanoelectronics from its fabrication SiO2/Si wafer in water. These thin-film electronics can then be trimmed and pasted onto any surface, granting that object electronic features. Putting one of the stickers on a flower pot, for example, made that flower pot capable of sensing temperature changes that could affect the plant's growth.

SpaceX Gets FCC Approval to Launch 7,000 New Internet Satellites

One step closer to creating a satellite "constellation" orbiting Earth.

Elon Musk's SpaceX, the aerospace company, won approval from the Federal Communications Commission to launch 7,000 new internet satellites into low-Earth orbit, markedly increasing the number of satellites currently deployed. SpaceX, which has long held ambitions to expand global broadband internet access by way of a satellite constellation called Starlink, hopes will include 12,000 satellites by the mid-2020s. FCC's approval gives SpaceX the lead in a competitive field.

As Per Bloomberg, there's only 2,000 satellites currently floating in low-Earth orbit. The deal means SpaceX is primed to build on its already formidable interstellar real estate, and make tangible headway in its pursuit of a space-based internet. In March, the company gained approval to launch 4,000 internet-beaming satellites.
With space poised to host an influx of devices, the FCC

also approved a few measures to curb the inevitable buildup of space junk. With a variety of companies like Rocket Lab, Iridium Next, LeoSat and Open Cosmos vying alongside SpaceX to make satellite launches cheaper and more efficient, the issue of crowding has become a cause for concern.

The Two Fastest Supercomputers in The World Now Belong to The United States

The pendulum swings back to the U.S. in the supercomputer arms race.

Since 2013, the U.S. and governments in Europe and Asia have been locked in a constant battle to equip supercomputers with more processing power to claim the ever-shifting title of world's fastest mega-machine. The U.S. ***relinquished its place*** at the top of the pile last June, but ***reclaimed it a year later*** when the Oak Ridge National Laboratory managed to get its Summit supercomputer online.

Now the two fastest supercomputers in the world currently reside within U.S. borders, according to the newest ***SuperComputer TOP500*** List. Summit is now joined by Sierra, a machine housed at California's Lawrence Livermore National Library meant for nuclear arms research.

The TOP500 list uses a test called the LINPACK to assess how quickly a machine can do computations in units of work called "flops" for floating-point operations per second. Supercomputers, powerful as they are, usually rank in petaflops, or quadrillions of floating-point operations per second. This year, Summit improved its previous showing with a score of 143.5 petaflops per second. Sierra, on the other hand, ousted a Chinese machine for the number two spot by posting a score of 122.3 petaflops per second.

Just last year, it seemed something of a long shot for both Summit Sierra to scale the rankings and supersede China's Tianhe-2 and Sunway TaihuLight computers, which previously topped the list as the fastest and second fastest machines. Both Summit and Sierra are IBM products, powered by the company's Power9 CPUs and NVIDIA V100 GPUs and equipped with 2.4 and 1.6 million processor cores, respectively.

Samsung's Folding Smartphone

The future of smartphones is more screens.

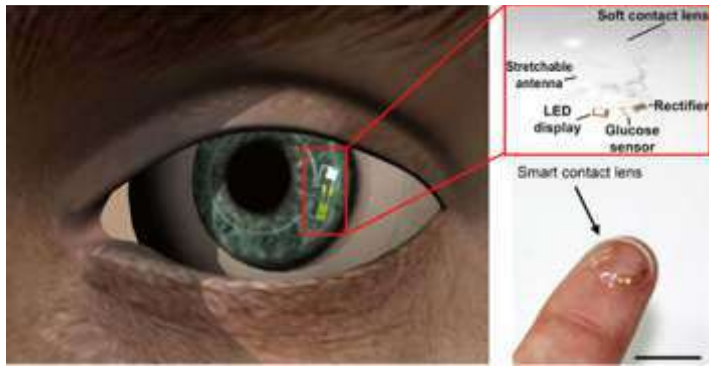
Samsung just showed off a prototype of its first folding smartphone. Featuring what Samsung dubbed the Infinity Flex Display, the phone unfolds into a tablet-sized device with a full screen, and folds back into a phone with a cover screen about half the size. Apparently, two screens are better than one.

The company previewed the folding smartphone-slash-tablet on stage at the Samsung Developer Conference Wednesday, noting it will be ready for mass production in a "matter of months." Samsung also made it purposefully difficult to see the device, because the final product isn't ready to be displayed.

From what one can see here, the phone does not look nearly as sleek as single-screen smartphones on the market now, although Samsung claimed the device was hidden in that clunky case so as to not reveal too much at the keynote. Still, even with a streamlined design, it will likely be thicker and heavier than any current model. As for dimensions, the tablet display measures 7.3 inches and the front cover display measures 4.58 inches.

There are other flexible phones on the market, like this chunky monster that look like a hardcover-bound book. The folding smartphone is expected to go on sale in 2019.

No Needles: Contact Lens Could Monitor Glucose for People with Diabetes



An illustration shows a contact lens with a glucose monitor, stretchable antenna and LED display.

Many people with ***diabetes*** need to prick their finger for a drop of blood up to eight times a day to monitor their glucose levels, an uncomfortable and cumbersome task. It can all add up to tens of thousands of finger pricks over a person's lifetime.

Now, South Korean researchers may have a means of measuring blood sugar without a finger prick in sight: The scientists developed a ***glucose monitor embedded***

in a soft contact lens that measures glucose levels in tears and transmits that information wirelessly to a handheld device… and you don't even need to cry.

The device has been tested so far only on live rabbits, with no signs of discomfort. But the researchers who created the device predict that this sugar-sensing contact lens may be available commercially for people in less than five years. The device would be placed in one eye and not be used to correct vision, like traditional contact lenses.

Previous attempts to embed glucose monitors into a contact lens had been fraught with difficulties. The electronics were too brittle and the lenses were too rigid, leading to a fragile device that was both uncomfortable and prone to breaking, said lead study author Jang-Ung Park, a professor of engineering at Ulsan National Institute of Science & Technology in South Korea. Elements in these earlier devices blocked vision, too, and would potentially damage the eye, according to the paper.

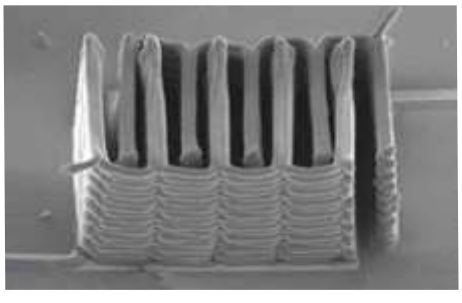
But advances in ***materials science*** and nano technology in recent years have enabled Park's team to design flexible, or stretchable, structures and circuits, including an LED display embedded in the lens.

The resulting product measures glucose levels in real time in ***natural tear secretions*** and relays this data through LED display that can emit a non-intrusive light if glucose levels get too high. Or, with the inclusion of a miniature antenna in the lens, information can be transmitted wirelessly.

"The key difference is the soft lens with stretchable electronics and displays," Park told Live Science. "This soft contact lens is stretchable and can be turned over. So, the ***LED light*** can be emitted into the [eye of the] wearer or into the opposite direction, dependent on the wearer's choice."

The researchers hope that their technique of embedding sensors on ***soft contact lenses*** also can be applied to other areas, such as smart devices for drug delivery, augmented reality and even biomarker monitoring via a smartphone

Tiny 3-D Printed Batteries



Researchers at Harvard University and the University of Illinois at Urbana-Champaign announced last year that they ***have figured out how to 3-D print miniature batteries*** about 1 mm across.

The researchers, led by Jennifer A. Lewis, PhD, Harvard School of Engineering and Applied Sciences, created and tested materials, or "inks," able to function as electrochemically active materials. The materials also had to harden into layers in just the right way so they could be stacked up in layers during the 3-D printing--creating working anodes and cathodes.

The recipe includes ink for the anode with nanoparticles of one lithium metal oxide compound, and an ink for the cathode from "nanoparticles of another." The printer lays the ink onto the teeth of two gold combs to create a tightly interlaced stack of anodes and cathodes. The whole setup gets packaged into a tiny container and filled it with an electrolyte solution to complete the battery.

Tiny batteries could be game-changing for the medical device industry, finding use in applications such as biomedical sensors and skin-based monitoring devices. In addition, they could be embedded into plastic housing of devices such as hearing aids.

Two-photon polymerization uses lasers shining two different-wavelength beams on a sensitive material. Where the beams intersect, the material is polymerized. Then residual material can be washed out. Narayan continues, "I think that more biocompatible materials for 3-D printing, particularly for processes like stereolithography, micro-stereolithography, and two-photon polymerization, will facilitate wider use of these technologies for commercial production of medical devices."

AI: Researchers use machine learning to find source of viruses

Scientists have developed a machine learning algorithm that may help find the original hosts of viruses. It is hoped that the new tool could help inform preventive measures against deadly diseases. The new research, led by the University of Glasgow, uses a new algorithm designed to use viral genome sequences to predict the likely natural host for a broad spectrum of RNA viruses – the viral group that most often jumps from animals to humans.

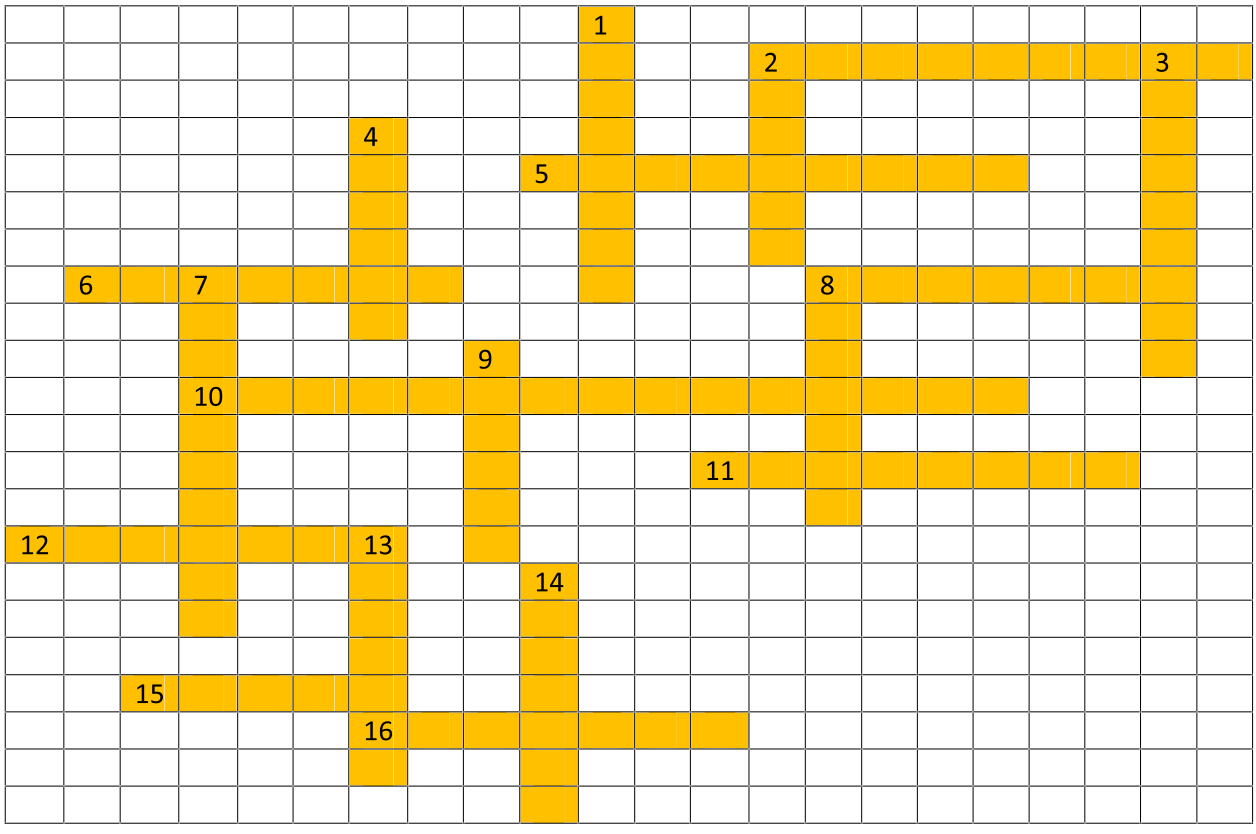
Finding the source of viruses from genome sequences can take years of intensive field research and laboratory work. These delays can make it difficult to implement preventive measures such as vaccinating the animal sources of disease or preventing dangerous contact between species. Researchers studied the genomes of over 500 viruses to train machine learning algorithms to match patterns embedded in the viral genomes to their animal origins. These models were able to accurately predict which animal reservoir host each virus came from, whether the virus required the bite of a blood-feeding vector and, if so, whether the vector is a tick, mosquito, midge, or sandfly.

The research found that two of the four species of Ebola

which were presumed to have a bat reservoir had equal or stronger support as primate viruses, which could point to a non-human primate, rather than a bat, source of some Ebola outbreaks.
The prospect of quickly identifying a virus source could play a key part in quickly combating the rapid spread of viruses by better understanding their origins.

The vast quantities of data associated for DNA and RNA make them candidates for AI training and analysis. We expect to see further advancements into the use of AI in DNA research soon, and with it the ethical questions that greater insight into DNA will undoubtedly raise.

TECH CROSSWORD



Across: 2. Symbolic diagram of electrical / electronic circuits 5. Subatomic particle with a charge of negative electricity 6. A voltage source that converts chemical energy to electrical energy 8. A flow of electric charge

10. Capable of being charged repeatedly 11. A material that is composed of a mixture of elements 12. An electromotive force 15. A short circuit will have a _____ current flow 16. A subatomic particle without an electric charge

Down: 1. A voltmeter is used in _____ with the circuit 2. A device that opens or completes an electrical path 3. A material that opposes the movement of free electrons 4. A unit of electric current equal to a flow of one coulomb per second 7. A resistive component that is designed to be temperature sensitive 8. A unit of electric charge, equal to the quantity of electricity conveyed in one second by a current of one ampere 9. A subatomic particle with a positive electric charge 13. A substance that cannot be broken down by chemical means 14. It is used to measure current

CROSSWORD SOLUTION:

Across: 2. SCHEMATIC 5. ELECTRONS 6. BATTERY 8. CURRENT 10. RECHARGABILITY 11. COMPOUND 12. VOLTAGE 15. LARGE 16. NEUTRON

Down: 1. PARALLEL 2. SWITCH 3. INSULATOR 4. AMPERE 7. THERMISTOR 8. COULOMB 9. PROTON 13. ELEMENT 14. AMMETER