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Department of Electronics & Communication

Chief Editor: Dr. Lakshmanan M (Prof. and Head, ECE Dept)

Faculty Editor: Mr. Hitesh Kumar (Asst. Professor)

Student Editor: Sristi Sharma
Utsav Verma

About ECE Department

The Department of ECE offers B.Tech and M.Tech courses in Electronics and Communication Engineering from Dr. A.P.J. Abdul Kalam Technical University, (formerly Uttar Pradesh Technical University / Gautam Buddha Technical University) Lucknow. Electronics & Communication Engineering deals with the electronic devices, circuits, communication equipment's like transmitter, receiver, integrated circuits (IC). microprocessors, satellite communication, microwave engineering, antenna and wave propagation. The department aims to impart high quality education in ECE and conduct top notch research in ECE related fields.

The department provides state-of-art infrastructure and computing facilities to students and faculty. The faculty members are actively involved in different domains of research with special focus in four thrust areas:

1. Wireless Communication and Networks
2. Microwave and Antennas,
3. VLSI Design
4. Communication Systems
5. Signal and Image Processing.

The department has a regular hardware and software labs as well as the state-of-art research labs in microwave and antennas, where faculty and students are working on funding projects and offering consultancy services. Some of the available softwares in ECE department are MATLAB, HFSS, ns-2, ns-3, Riverbed Academic edition, OrCAD PSPICE, eSim, SCILAB, OR-Tools, Expeyes, etc. The Department follows a well proven pedagogy of sharing knowledge with the young and vibrant minds of the college. As we are affiliated to AKTU University, Lucknow, the curriculum and subjects are prescribed by AKTU University. In addition to instruction in core ECE subjects, we also teach elective subjects in advanced topics such as Voice over Internet Protocol, Filter Design, Digital Image Processing, Digital System Design using VHDL, Speech Processing, Advance Digital Design using Verilog, Microcontroller for Embedded Systems, etc.

The department imparts world class training and research besides promoting active industry-institute collaboration by identifying current trends and taking part in sponsored research projects and consultancy services. The department also has a worldwide reach with its vibrant alumni network. Working shoulder with shoulder with the institution, it is constantly aiming towards reaching greater heights to serve the needs of the society and meet the aspirations of the student community.

Vision of Institute

To be a leading educational institution recognized for excellence in engineering education and research producing globally competent and socially responsible technocrats.

Mission of Institute

IM1: To provide state of the art infrastructural facilities that support achieving academic excellence.

IM2: To provide a work environment that is conducive for professional growth of faculty and staff.

IM3: To collaborate with industry for achieving excellence in research, consultancy and entrepreneurship development.

Vision of Department

To be recognized as a center of excellence in Electronics and Communication Engineering for the quality and global education, interdisciplinary research and innovation, to produce committed graduates who can apply knowledge and skills for the benefit of society.

Mission of Department

DM1: To provide quality education by providing state of the art facility and solutions for global challenges.

DM2: To provide a framework for promoting the industry-institution collaboration and empower the students in interdisciplinary research.

DM3: To transform students into socially responsible, ethical and technically proficient engineers with innovative skills and usage of modern tools.

DM4: To make the students corporate ready with spirit and necessary interpersonal skills.

Program Outcomes

PO1 **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6 **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11 **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12 **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes

By the completion of Electronics & Communication Engineering program the student will be able to:

PSO1: Design and develop models for analog & digital electronic circuits and systems.

PSO2: Design, develop and test electronic and communication systems for applications with real time constraints.

Program Educational Objectives

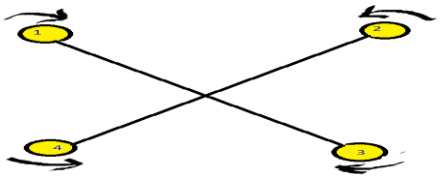
PEO 1	Graduates will excel in their career by acquiring knowledge in the field of Electronics and Communication Engineering with the usage of modern tools and emerging technologies.
PEO 2	Graduates will have the capability to analyze real life problems of the society and produce innovative solutions.
PEO 3	Graduates exhibit professionalism, ethical attitude, communication skills and team work in core engineering, academia and research organizations through professional development and life-long learning.

ARTICLE: 1 THE FLYING EAGLE

This article is based on our four-wing drone named as flying eagle. It has many applications in our day-to-day life and can prove to be a wonderful instrument during crisis time especially during disasters is very easy to assemble the parts but the main function is to adjust its settings which is bit difficult but can be set by just knowing the fundamental principles.

FLYING EAGLE

- Four 1000 KV brushless DC shunt motors
- Plastic frame (preferable because of less weight and cheap cost)
- 4 ESC's (Electronic Speed Control) of 30A (SIMON is preferred)
- Two pairs of Propellers (8 inch or 10 inch)
- 1 LIPO Battery (LIPO: LITHIUM POLMER BATTERY) of approx. 2200mAH.
- Transmitter and Receiver (preferable of FLYSKY)
- 1 Flight controller (You can take KK MINI 2.0 for your practice purpose and can later on replace by another good flight controller.)
- Jumper Wires (Female-Female)

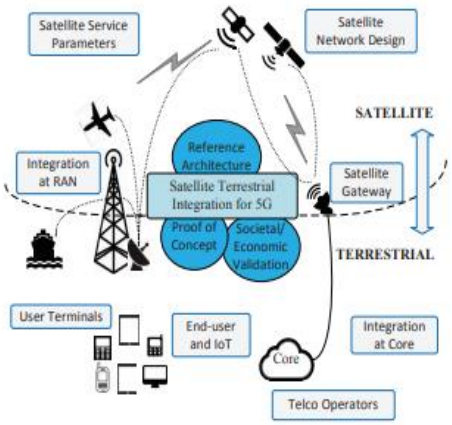


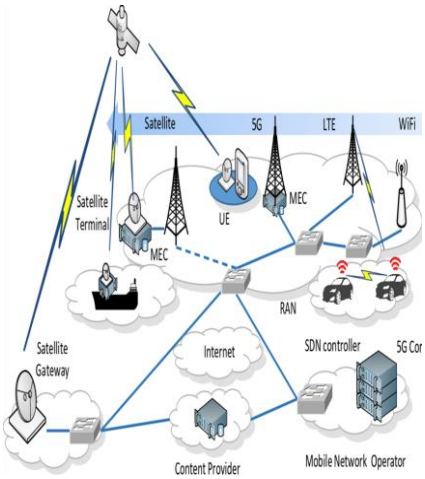
When we have these parts in our hand, we just assemble the parts and connect the transmitter and receiver. Always note that whenever you are testing it, the propellers should be removed from the quadcopter else you may have chances of getting injured. Assemble the motors according to the directions shown in the image. Place your battery exactly in the middle of the frame else it will cause disbalancing. We have to first do the **ESC calibration** to move all the ESC's at the same time. It is just done by holding the first and the last buttons on the flight controller and then connecting the battery. A beep sound will come, wait for it and when another beep comes with some options on the screen then it means your ESC's are calibrated. After that set your **PI** values from the PI editor option present in flight controller. It consists of **roll, pitch, yaw, rudder**. Adjust it according to your setup of hardware. These PI values are for controlling your quadcopter through your transmitter and receiver**.** Go to layout option in the flight controller and select the **X layout** option. Then put it on a plane even surface and go to the option of **ACC calibration** and calibrate your accelerometer to give all the motors a same level to initiate the rotation of motors at the same time. If accelerometer is not done in a proper manner then it can tilt to one side and may not able to fly properly. Adjust the channels on the transmitter using setting options on its menu page. Adjust other settings accordingly. After all these settings adjust your propellers and give your quad a final flight.

Ankur Pal
Garvita Singh
Student/ECE/GCET

ARTICLE: 2 SATELLITE 5 G INTEGRATION

Mobile satellites today provide services to air, sea and remote land areas via GEO operators (e.g. Inmarsat, Thuraya) and non GEO operators (e.g. Iridium, Global star, O3b). These operate in L, S and recently Ka bands, to both handheld and vehicle mounted, as well as some fixed terminals. Air interfaces and network functions have tended to be proprietary although some integration with MSS and 3GPP network interfaces exists. Fixed satellites today provide backhaul services to cellular in Ku and Ka bands. Satellite has been an overlay rather than integrated system except in S band where an integrated satellite and terrestrial MSS standard has been adopted principally for broadcast services to mobile.





Backhaul to ships, aircraft and fast trains using FSS satellites provide a full range of mobile and broadcast services to passenger vehicles. A growing area of interest is in the transport sector where safety services and V2V are seen as ideal for satellite delivery. Satellite is also used extensively for low-rate SCADA applications to/from pipelines, oil and gas remote installations etc

Coverage: Satellites can provide the wide coverage to complement and to extend the dense terrestrial cells, which is in line with the ubiquitous coverage targeted by 5G networks.

IoT: The inclusion of billions of sensors in the IoT all transmitting low date rate M2M and being scattered over wide areas makes it well suited to satellite collection and distribution.

Spectrum: The lack of spectrum was seen as one of the key drivers to the 5G network architecture. The demands on the design of the network could be relaxed if more spectrums could be made available. Frequency sharing on a dynamic basis between mobile and satellite systems can deliver major increases in the spectrum provided both sectors accept the sharing principles.

Ms. Rekha Rani

Asst. Prof./ECE/GCET

ARTICLE: 3 NANO MACHINE ENABLED COMMUNICATION TECHNOLOGY

Nano Machine Enabled Communication Technology

In 1959, Nobel laureate physicist Richard Feynman announced "There is Plenty of Rooms at the Bottom". His foresight was about fully functional nano machines. In 2015, Prof. Akyildiz announced, "Nanoscale communications will be a reality in the near term". Scientist around the world are working on this new frontier of communication i.e. Nano Communication (NC) to help humanity in almost every field of life, ranges from security to medical, information communication to bioinformatics and body machine interface to consumer industry. Further, NC have been divided into two classes; NC based on Electromagnetic (EM) wave known as Electromagnetic Nano Communication (EMNC) and NC based on Molecular Nano machine known as Molecular Nano Communication (MNC).

The importance of NC in humanity can be predicted the enlisted applications as follows; Applications: In Military: Nuclear, Biological and Chemical (NBC) Weapons. In Environment: Environment Monitoring (Involves: Amplification, Identification, Guidance and Regeneration) and Biosensor & Actuator Network. In Biological Engineering: Regeneration of Tissues and Organ, Lab on Chip (LOC) and Brain-Machine Interface (BMI). In Medical and Healthcare: Target drug delivery, Nano medicine, Regenerative Medicine, Intracellular Therapy and Molecular Imaging. In ICT: Biochip Integrated Mobile Phones (BIMP), Novel Computation, and Internet of Nano Things (IoNT). In Industry: Smart Material, Smart Agriculture and Smart Manufacturing. of it.

Various groups are working to make above theory a reality. Few of them are list as follows.

Nanophotonic Brain-Machine Interfaces, Nanophotonic Devices for Stem Cell Regulation, Coordinating European Research on Molecular Communications, Graphene-enabled Wireless Communications, Bacterial Nanonetworks, Neuronal Networks, Calcium Signaling. So, NC can be a predominant future not for only research scholar but for academician as well.

Dr. S. P. SINGH

Assoc. Prof./ECE/GCET

ARTICLE: 4 GRAPHENE

GRAPHENE: If you've ever drawn with a pencil, you've probably made graphene. The world's thinnest material is set to revolutionize almost every part of everyday life. Fascination with this material stems from its remarkable physical properties and the potential applications these properties offer for the future. Although scientists knew one atom thick, two-dimensional crystal graphene existed, no-one had worked out how to extract it from graphite. That was until it was isolated in 2004 by two researchers at The University of Manchester, Prof Andre Geim and Prof Kostya NovoLog. This is the story of how that stunning scientific feat came about and why Andre and Kostya won the Nobel Prize in Physics for their pioneering work. Graphene is 200 times stronger than steel. Graphene is 1 million times thinner than human hair. It is word's most conductive element.

What can graphene do?

Graphene's properties

Prof Robert Young discusses the uses of graphene composite materials and their many promising commercial applications

Graphene: the world's first 2D material. Since graphene's isolation in 2004 it has captured the attention of scientists, researchers and industry worldwide.

- It is ultra-light yet immensely tough.
- It is 200 times stronger than steel, but it is incredibly flexible.
- It is the thinnest material possible as well as being transparent.
- It is a superb conductor and can act as a perfect barrier - not even helium can pass through it.

Current applications

At The University of Manchester, graphene research is focused on the following applications: Energy; Membranes; Composites and Coatings; Biomedical; Sensors; Electronics. This is only the start. These are only the first steps. The potential of graphene is limited only by imagination.

Future technology

So where will graphene take us? How will it change our world? What benefits will it bring to mankind? What applications will we see in the near future and decades to come?

Clean drinking water for millions. Graphene membranes could see huge progress in water purification technology in developing countries and provide more efficient desalination plants.

Electronics and energy storage could also be revolutionized by graphene. Flexible, durable, semi-transparent mobile phones. Wearable technology, clothing that communicates. Electric sports cars. Lightweight planes. These are the future technologies which are becoming realistic in our present.

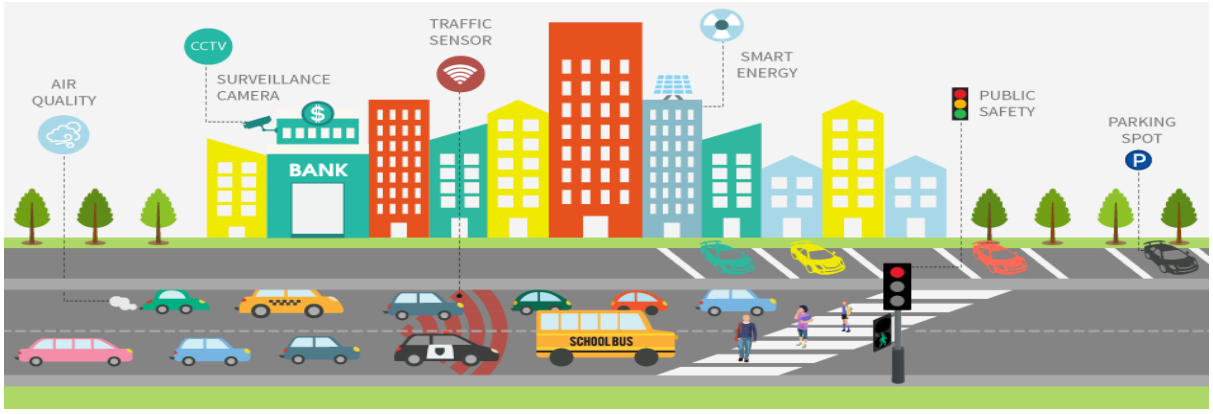
Mr. Amit Gupta

Asst. Prof./ECE/GCET

ARTICLE: 5 IOT Application for Smart Cities

Approximately 70 percent of the world's population is expected to live in cities by 2050 according to Gartner. This rapid urban growth is already placing a considerable strain on the existing infrastructure, and with more people making the move to urban living, it's only going to get worse in the coming years.

To accommodate this new demand on cities, municipalities around the globe are turning to the Internet of Things innovation to enhance their services, reduce costs, and improve communication and interaction. Though the potential is there for IoT to improve nearly every aspect of urban living, there are three IoT applications for smart cities.



An innovative solution to traffic congestion: As more and more people move to cities, traffic congestion – which is already a massive problem – is only going to get worse. Fortunately, the Internet of Things is well positioned to make improvements in this area that can benefit residents immediately. For example, smart traffic signals can adjust their timing to accommodate commutes and holiday traffic and keep cars moving.

More reliable public transportation: Public transportation is disrupted whenever there are road closures, bad weather, or equipment breakdowns. IoT can give transit authorities the real-time insights they need to implement contingency plans, ensuring that residents always have access to safe, reliable, and efficient public transportation. This might be done using insights from cameras or connected devices at bus shelters or other public areas.

Energy-efficient buildings: IoT technology is making it easier for buildings with legacy infrastructure to save energy and improve their sustainability. Smart building energy management systems, for instance, use IoT devices to connect disparate, nonstandard heating, cooling, lighting, and fire-safety systems to a central management application. The energy management application then highlights areas of high use and energy drifts so staff can correct them. Research shows that commercial buildings waste up to 30 percent of the energy they use, so savings with a smart building energy management system can be significant. As smarter city buildings use energy management systems, the city will become more sustainable as a whole.

How Can Your City Use IoT Technology? : For governments to successfully increase efficiency, enhance their services, and improve the quality of life for their residents, they need a platform that can power IoT applications for smart cities. The right one will aggregate, process, and interpret the data that smart devices generate, ensuring that the infrastructure is in place to take these cities into the new era of connectivity.

Mr. Amanpreet Singh

Asst. Prof./ECE/GCET

ARTICLE: 6 NEXT-GENERATION OPTICAL FIBER RESEARCH FOR THE ULTRAHIGH SPEED HIGH CAPACITY

Internet traffic is increasing exponentially with the accelerating spread of services such as social networking and video content services. The bandwidth of optical fiber communications systems that form the backbone for this communication is also being increased yearly. However, there are limits to the increase in bandwidth and speed that can be achieved with the single-mode optical fiber currently in use, and it is estimated that these limits will be reached in ten years. Therefore, a new transmission medium that overcomes these limitations will need to be created. We are focusing on ways to spatially extend the transmission area of optical fiber, which is one way to overcome these limitations (Fig. 4).

Current optical fibers transmit optical signals using a single mode, through a single core (transmission path) within a strand of quartz glass. However, optical fiber design and production technology is advancing because of the employment of complex cross sections such as hole structures, and digital transmission processing technology. Fiber with multiple cores in a single strand of quartz glass, and multi-mode fiber capable of transmitting stable signals with multiple modes in a single core are presenting new possibilities for novel fiber structures with higher spatial multiplexing. We have continued to demonstrate the possibilities of multicore fiber with, for example, a successful 1-Pbit/s transmission over a single 12-core optical fiber of 52 km, which is a world record (ECOC (European Conference on Optical Communication) International Exhibition, Sept. 2012, and NTT News Release).

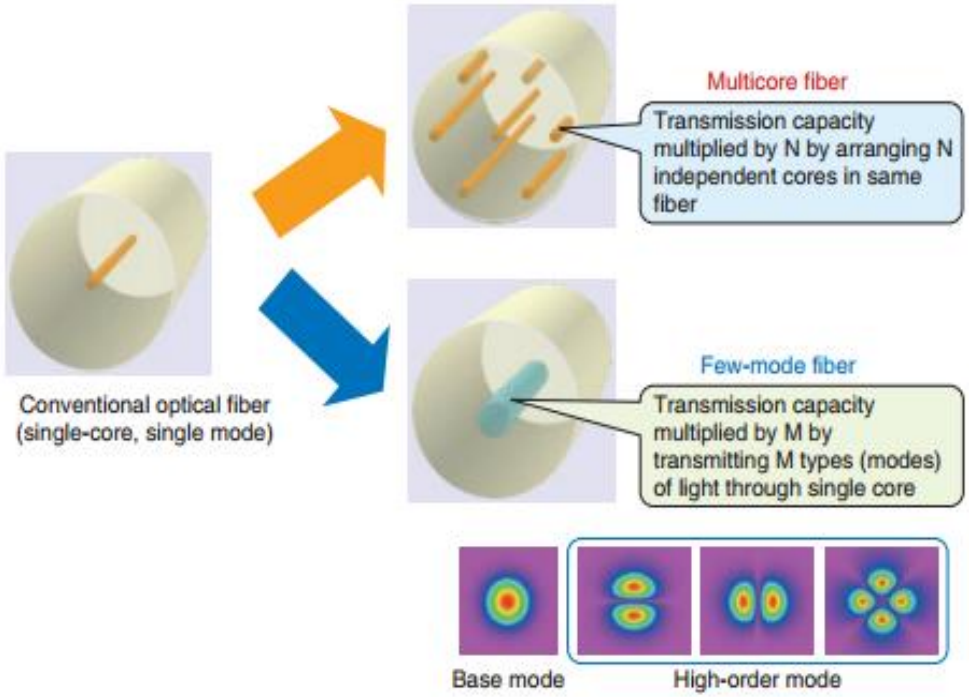


Fig. 4. Next-generation fiber for space-division multiplexing.

Ms. Ruchi Agrawal

Asst. Prof./ECE/GCET

ARTICLE: 7 WEARABLE TECHNOLOGY HAS POTENTIAL IN MEDICAL APPLICATIONS AND HEALTHCARE

Ultra-thin skin patches allows back motion to be measured with high accuracy

The medical and healthcare sector, primarily characterized as 'digital health', represents the single largest opportunity for the wearable technology industry. Patients want it, some physicians are embracing it, insurance companies are starting to fund some of it, regulators are approving some of it and companies - big and small - all want to be involved. Back health applications, including issues related to posture, pain and growth, are a particular area where wearables may have an impact. From developing and maintaining posture as a preventative measure against back pain, to training exercises in the form of therapy, to spinal motion characterization, many solutions are already, or will soon be, available. This is one of several prominent areas to broadly adopt many different wearable technology solutions.These examples illustrate three differing product strategies that address the same sector. While the sensors (inertial motion units and stretch sensors) remain very similar in each product, the time to market, required investment, margins, regulatory process and target markets differ for each.Consumer products have lead times of three to six months, whereas medical devices can take up to 10 years to go from idea to product. Solutions for the broad healthcare space span that whole range, so product developers need to understand the lead times and investment models in order to achieve sustainable success, will soon be spun out under new holding company Alphabet. Qualcomm launched its Tricorder XPrize, which has seen entries from more than 39 countries and will conclude in March 2016.Novartis is working with companies developing new sensors and digital health platforms, investing heavily in companies including Proteus Digital Health. GSK is assessing potential opportunities, with its UK based Innovation Platform Technology and Science (iPTS) division working to use wearable technology to support clinical trials. Even manufacturing giants like Flextronics and Jabil have weighed in, via acquisitions and active development programmes. the sector is large enough for there to be multiple winners. Healthcare expenditure currently represents 10% of global GDP and this figure is only likely to rise as the population grows and ages. The global healthcare system requires constant and significant investment to stay ahead and wearable technology is a crucial part of the solution.

Ms. Ranjana Kumari

Asst. Prof./ECE/GCET

ARTICLE: 8 COGNITIVE RADIO: BRAIN -EMPOWERED WIRELESS COMMUNICATIONS

Cognitive Radio: Brain-Empowered Wireless Communications

Cognitive radio (CR) is one of the new long term developments taking place and radio receiver and radio communications technology. After the Software Defined Radio (SDR) which is slowly becoming more of a reality, cognitive radio (CR) and cognitive radio technology will be the next major step forward enabling more effective radio communications systems to be developed. The idea for cognitive radio has come out of the need to utilize the radio spectrum more efficiently, and to be able to maintain the most efficient form of communication for the prevailing conditions. By using the levels of processing that are available today, it is possible to develop a radio that is able to look at the spectrum, detect which frequencies are clear, and then implement the best form of communication for the required conditions. In this way cognitive radio technology is able to select the frequency band, the type of modulation, and power levels most suited to the requirements, prevailing conditions and the geographic regulatory requirements.

A cognitive radio may be defined as a radio that is aware of its environment, and the internal state and with a knowledge of these elements and any stored pre-defined objectives can make and implement decisions about its behavior general the cognitive radio may be expected to look at parameters such as channel occupancy, free channels, the type of data to be transmitted and the modulation types that may be used. It must also look at the regulatory requirements. In some instances, it may be necessary to use a software defined radio, so that it can reconfigure itself to meet the optimal transmission technology for a given set of parameters.

Cognitive radio spectrum sensing methodologies: There are a number of attributes that must be incorporated into any cognitive radio spectrum sensing scheme.

Spectrum sensing bandwidth: There are a number of issues associated with the spectrum sensing bandwidth. The first is effectively the number of channels on which the system will sense whether they are occupied.

Transmission type sensing: The system must be capable of identifying the transmission of the primary user for the channel. It must also identify transmissions of other units in the same system as itself

Spectrum sensing accuracy: The cognitive radio spectrum sensing mechanism must be able to detect any other signal levels accurately so that the number of false alarms is minimized.

Spectrum sensing timing windows: It is necessary that the cognitive radio spectrum sensing methodology allows time slots when it does not transmit to enable the system to detect other signals. These must be accommodated within the frame format for the overall system.

Ms. Ruchi Tripathi

Asst. Prof./ECE/GCET

ARTICLE: 9 Lora Technology- THE GAME CHANGER

LoRa technology was developed by a company called Semtech and it is a new wireless protocol designed specifically for long-range, low-power communications. LoRa stands for Long Range Radio and is mainly targeted for M2M and IoT networks. This technology will enable public or multi-tenant networks to connect a number of applications running on the same network.

LoRa Alliance was formed to standardize LPWAN (Low Power Wide Area Networks) for IoT and is a non-profit association which features membership from a number of key market shareholders such as CISCO, actility, MicroChip, IBM, STMicro, SEMTECH, Orange mobile and many more. This alliance is key to providing interoperability among multiple nationwide networks. LoRa also features an adaptive data rate algorithm to help maximize the nodes battery life and network capacity. The LoRa protocol includes a number of different layers including encryption at the network, application and device level for secure communications.

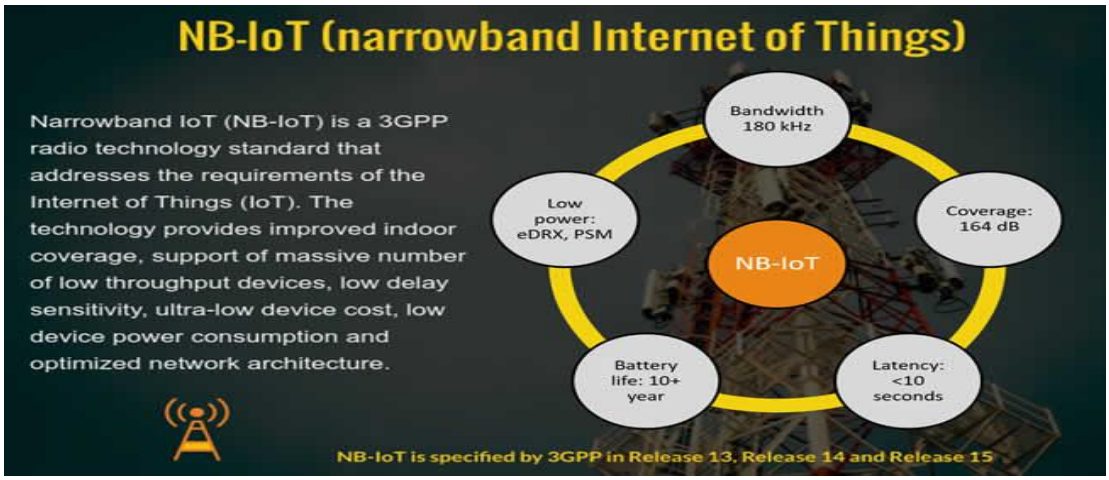
Features: The following table showcases some of the key features of the LoRa protocol such as range, modulation and capacity.

Specification	LoRa Feature	Modulation	Spread spectrum modulation type based on FM pulses which vary.
Range	2-5Km Urban (1.24-3.1 mi), 15Km suburban (9.3 mi)	Capacity	One LoRa gateway takes thousands of nodes
Frequency	ISM 868/915 MHz	Battery	Long battery life
Standard	IEEE 802.15.4g	LoRa Physical layer	Frequency, power, modulation and signalling between nodes and gateways

Mr. Bishnu Deo kumar
Asst. Prof./ECE/GCET

ARTICLE: 10NB -IOT

Narrowband IoT or NB-IoT is a wireless communication standard for the Internet of Things (IoT). NB-IoT belongs to the category of low-power wide-area networks (LPWAN), enabling to connect devices that need small amounts of data, low bandwidth, and long battery life.



NB-IoT (Narrowband-IoT) is a narrowband radio technology for M2M and Internet of Things (IoT) devices and applications requiring wireless transmission over a more extended range at a relatively low cost and using little power for long battery lives. NB-IoT operates in the licensed spectrum, and like LTE, uses Frequency Division Multiple Access (FDMA) in the uplink, Orthogonal FDMA (OFDMA) in the downlink, and Quadrature Phase Shift Keying (QPSK) modulation

IoT applications that require more frequent communications will be better served by NB-IoT, which has no duty cycle limitations operating on the licensed spectrum. NB-IoT can be deployed 'in-band', utilizing resource blocks within a normal LTE carrier, or in the unused resource blocks within a LTE carrier's guard-band, or 'standalone' for deployments in dedicated spectrum. The advantages of the NB-IoT technology include low energy consumption and high reliability in areas with coverage challenges.

NB-IoT is also more focused on low energy usage and thus low power than LTE-M which is also related to the fact that LTE-M is the more powerful option. One NB-IoT base station cell is estimated to have the capacity to support thousands of devices using an NB-IoT connection. Since NB-IoT uses narrowband (or a narrower bandwidth and a single narrow band of 200KHz or 180KHz to be precise), it allows for an increased density of transmission power and that, along with other coverage enhancement capabilities, is what makes indoor penetration and reach overall better.

On 19 July 2019, T-Mobile first launched the Narrowband Internet of Things (NB-IoT) in the USA. T-Mobile is the first to launch NB-IoT in the guard bands in the USA as well as first in the world for optimizing efficiency. NB-IoT was initially deployed in Europe and Asia. Just as is the case for many wireless IoT protocols, not only of the LPWAN kind, the leading market for NB-IoT by far today is China, however. By 2026, NB-IoT and LTE-M will capture over 60% of the 3.6 billion LPWA network connections

Ms. Shristi Priya

Asst. Prof./ECE/GCET

Eminent Recruiters:

Idea	Cummins	Cognizant	appin
Ericsson	wipro	Infosys	Aon Hewitt
Samsung	Tech Mahindra	IBM	intec
vivo	Nokia Connecting People	headstrong a GENPACT company	Relcom Group