A.V.C COLLEGE OF ENGINEERING, MANNAMPANDAL, MAYILADUTHURAI

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Department of Electronics and Communication Engineering

(Accredited by NBA)

"LEMON NEWSLETTER"

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Message from Head of the Department

I wish all the final year students to work hard and prepare well for the on campus and off campus interviews.

I look forward from the students to participate in paper presentation and national and international conferences will be conducted by various engineering colleges.

I expect from the faculties to focus towards the good univerty results of our department.

Dr. CHITRAVALAVAN

HOD/ECE

Personality

"A great personality makes everyone feel energized; just like a flower's fragrance that freshens ups the complete surrounding."

"You don't have to be someone else to achieve greatness in life. Celebrate your personality and uniqueness, because that's what makes a legend."

"Time has the power to mend appearance, wealth, and fame; but it always bends its knee in front of an amazing personality."

"No matter how much successful you are, your personality decides the life of your relationship with your keens."

Faculty Corner:

Cognitive Radio and its Significance

- ***Dr.C.Jayasri, AP/ECE***

Cognitive radio (CR) is a form of wireless communication in which a transceiver can intelligently detect which communication channels are in use and which ones are not. The transceiver then instantly moves into vacant channels, while avoiding occupied ones. These capabilities help optimize the use of the available radio frequency (RF) spectrum.

It also minimizes interference to other users. And, by avoiding occupied channels, it increases spectrum efficiency and improves the quality of service (QoS) for users.

The wireless RF spectrum is a limited resource, usually allocated through a licensing process. In the U.S., it is the joint responsibility of the Federal Communications Commission (FCC) and the National Telecommunications and Information Administration (NTIA). The FCC administers the spectrum for non-federal (e.g., commercial) use, while the NTIA does the same for federal (e.g., military, FBI) use.

The allocated (licensed) spectrum is not always used optimally. As a result, some bands are overcrowded (e.g., GSM cellular networks), while others are relatively unused (e.g., military). This spectrum inefficiency limits the amount of data that can be transmitted to users and lowers service quality.

As the number of connected devices in use continues to grow, this limited resource is fast becoming a *scarce* resource. Cognitive radio is an efficient way to use and share this resource intelligently, optimally and fairly.

Cognitive radio networks and capabilities

Joseph Mitola at the KTH Royal Institute of Technology in Stockholm, first proposed the idea of cognitive radio in 1998. It is a hybrid technology involving software-defined radio (SDR) as applied to spread spectrum communications.

A cognitive radio network (CRN) is split into two main networks, a *primary network* and a *secondary network*. The primary network owns the licensed band and consists of the primary radio base station and users. The secondary network shares the unused spectrum with the primary network. It consists of the cognitive radio base station and users.

The three key capabilities that differentiate cognitive radio from traditional radio are:

- Cognition: CR understands its geographical and operational environment.
- Reconfiguration: According to this cognitive knowledge, CR can decide to dynamically and autonomously adjust its parameters.
- Learning: CR can also learn from the experience, and experiment with new configurations in new situations.

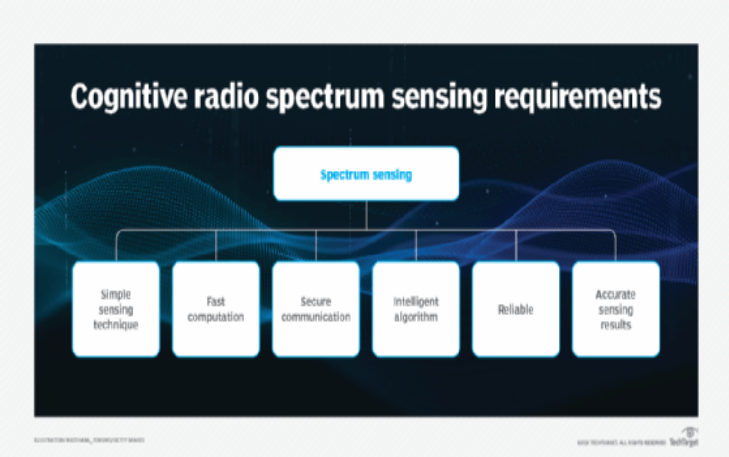
Cognitive radio facets

The two main facets used in CR are *spectrum sensing* and *spectrum database*.

Spectrum Sensing

CR devices track the spectrum bands in their neighborhoods to identify users licensed to operate in that band. They also look for unused portions of the RF spectrum known as white spaces or spectrum holes. These holes are created and removed dynamically and can be used without a license.

Spectrum sensing may be cooperative or non-cooperative. In the cooperative method, cognitive radio devices share spectrum information, while in the non-cooperative method, each CR device acts on its own.



Cognitive radio devices track spectrum bands using a technique called spectrum sensing, which comes in two flavors (cooperative and non-cooperative) and has certain requirements.

Spectrum database

TV stations update their next week's use of the RF spectrum in a database that the FCC maintains. Cognitive radio devices can seek information about free spectrum from this database, so they don't have to rely on complex, time-consuming and expensive spectrum sensing techniques.

The drawback of this method is it's difficult for the database to update dynamic spectrum activity in real time. As a result, CR devices may miss out on opportunities to access unused spectrum.

To support the growing number of devices that use the RF spectrum, a combined approach is useful. It ensures that devices can quickly and accurately detect unused spectrum and so improve QoS.

Types of Cognitive Radio

The two main types of CR are *heterogeneous* and *spectrum-sharing*.

In heterogeneous CR, operators run several radio access networks (RANs) using the same or different radio access technology (RAT) protocols. Heterogeneous cognitive radio uses a network-centric approach, and the frequency bands allocated to the various RANs are fixed.

In spectrum-sharing CR, several RANs share the same frequency band. They also coordinate with each other to use unoccupied sub-bands intelligently and optimally.

In both CR types, radio resources are optimized, and the QoS is much better than it would be with traditional radio.

Another way of categorizing CR is as *full cognitive* or *spectrum sensing*. Full cognitive CR takes into account all parameters that a wireless node or network can be aware of. Spectrum-sensing CR detects channels in the RF spectrum.

Applications of Cognitive Radio

CR is a disruptive new technology with many potential applications. This is why it is also known as a next-generation communication network.

For example, CR can help address connectivity problems in rural areas. It can also optimize RF operations for smartphones and IoT devices, content delivery networks, also known as content distribution networks, and giant wireless hotspots.

Other potential applications include:

- City- and campus-wide network RF coverage
- Leased networks
- Disaster relief

- Emergency networks
- Cognitive mesh networks
- Medical applications
- Weather forecasting
- Traffic control

According to the IEEE, cognitive radio may even be used in space communications, particularly far outside of Earth's orbit.

Student Corner:

6G Mobile Communications Technology

- ***Kaviyarasi K, IV ECE***
-

Although the 5G mobile communications standard is still in the early days of its deployment, ideas are starting to come to the fore to consider what the next generation, i.e. 6G mobile communications might look like.

It is perfectly normal to start looking at what 6G technology might include because the technology for 6G will take some while to develop.

If 6G is to be able to meet the needs of the mobile communications when it is launched and for some while afterwards, then it will need to use up to the minute technology - technology which is not available at the moment.

However the has been talk that 5G will be the last mobile standard released as such: this will be updated to provide the required performance improvements and in this way it overcomes the huge investment required to launch a completely new system. If this idea catches hold then 6G will not be named as such, but instead it will be a major improvement in 5G performance to meet the needs of the ongoing mobile communications or wireless communications users.
the sixth-generation wireless communications system is the successor to 5G cellular technology. It is anticipated that 6G networks will be able to use higher frequencies than 5G networks and this will enable higher data rates to be achieved and for the 6G network to have a much greater overall capacity. A much lower latency levels will almost certainly be a requirement.

Overall it is expected that 6G mobile technology will be to support one micro-second or even sub-microsecond latency communications, making communications almost instantaneous.

Timescales for 6G

5G started its deployment in 2019, and it is anticipated that it will be the major mobile communications technology up until at least 2030. Initial 6G deployments might start to appear in the 2030 to 2035 timescales, although this is very much a rough estimate.

However these timescales for 6G roughly fall in line with those for previous generations: 1G was available in approximately the 1980s, 2G in the 90s, 3G started deployment around 2003, and 4G initial deployments started in 2008 and 2009, and finally 5G in 2019.
In order that 6G technology is available in time, initial ideas need to start coming together about now.

6G technology developments

There are already a number 6G technology research projects looking into what might be possible and also what might be needed.

The actual format for 6G will depend on how 5G develops and where its shortfalls appear to be. Currently there are many different use cases that have been put forwards and only time will tell what the uptake is and how 5G is used. It is expected that it will be used increasingly for the Internet of Things, IoT, as well as inter-vehicle communications for autonomous vehicles. The way all of this pans out remains to be seen.

If there are shortfalls in 5G, then these can be included in the 6G proposals.

In addition to this, one of the areas that is expected to be a key element of 6G is TeraHerz communications. Using these exceedingly high frequencies, huge bandwidths will become available, although the technology is not available to make this happen.

6G development projects

There are already a number of 6G technology projects that are under way at the moment, and some organisations are now starting early development.

- ***South Korea Electronics and Telecommunications Research Institute:*** As might be expected, South Korea is well ahead and this institute is conducting research on Terahertz band technology for 6G. They are hoping to make 6G 100 times faster than 4G LTE and 5 times faster than 5G networks.
- ***The Ministry of Industry and Information Technology, MIIT, China:*** With China investing large amounts into technology, they are keen to gain a lead in 6G. Accordingly MIIT is directly investing and monitoring the research and development process.
- ***The University of Oulu, Finland:*** This university has started a 6G research initiative known as 6Genesis. The project is expected to run for at least eight years and it will develop ideas that will be suitable for 6G technology almost to 2040.
- ***USA initiatives:*** The USA is planning to open up 6G frequency spectrum at frequencies at frequencies between

95 GHz and 3 THz for early research and development, although this will require approval from the Federal Communications Commission FCC for frequencies over 95 gigahertz GHz to 3 THz

Technologies for 6G

6G mobile communications technology will build on that already established for 5G. Some of the existing new technologies will be further developed for 6G

- ***Millimetre-Wave technologies:*** Using frequencies much higher in the frequency spectrum opens up more spectrum and also provides the possibility of having much wide channel bandwidth. With huge data speeds and bandwidths required for 6G, the millimetre wave technologies will be further developed, possibly extending into the TeraHertz region of the spectrum.
- ***Massive MIMO:*** Although MIMO is being used in many applications from LTE to Wi-Fi, etc, the numbers of antennas is fairly limited -. Using microwave frequencies opens up the possibility of using many tens of antennas on a single equipment becomes a real possibility because of the antenna sizes and spacings in terms of a wavelength.
- ***Dense networks*** Reducing the size of cells provides a much more overall effective use of the available spectrum. Techniques to ensure that small cells in the macro-network and deployed as femtocells can operate satisfactorily are required.

Many new technologies will also be introduced. Some candidates that are being talked about could include the following.

- ***Future PHY / MAC:*** The new physical layer and MAC presents many new interesting possibilities in a number of areas:
- ***Waveforms:*** One key area of interest is that of the new waveforms that could be used for wireless communications. OFDM has been used very successfully in 4G and 5G mobile communications as well as a number of other high data rate wireless communications systems, but it does have some limitations in some circumstances. Other waveforms could include: GFDM, Generalised Frequency Division Multiplexing, as well as FBMC, Filter Bank Multi-Carrier, UFMC, Universal Filtered MultiCarrier. Each has its own advantages and limitations and it is possible that adaptive schemes may be employed, utilising different waveforms adaptively for the 6G mobile communications systems as the requirements dictate. This provides considerably more flexibility for 6G mobile communications.
- ***Multiple Access Schemes:*** Again a variety of new access schemes are being investigated for 6G techno
- ***Modulation:*** Whilst PSK and QAM have provided excellent performance in terms of spectral efficiency, resilience and capacity, the major drawback is that of a high peak to average power ratio. Modulation schemes like APSK could provide advantages in some circumstances. APSK has a much lower peak to average power ratio, PAPR, it lends itself better for mobile communications systems better as the final amplifier can operate more efficiently the lower the PAPR
- ***Duplex methods:*** There are several candidate forms of duplex that could be considered for the new 6G wireless communications system. Currently systems use either frequency division duplex, FDD or time division duplex, TDD. New possibilities are opening up for 6G including flexible duplex, where the time or frequencies allocated are variable according to the load in either direction or a new scheme called division free duplex or single channel full

duplex. This scheme for 6G would enable simultaneous transmission and reception on the same channel.

Although 6G mobile communications is a very long way off, research and development as well as some thought of what 6G might look like is already starting, and the pace will only continue to increase.

Gate Questions –Digital Signal Processing

- Sangeetha M, IV ECE

1. Which of the following relation is true if the signal x(n) is real?
   a) $X^*(\omega)=X(\omega)$
   b) $X^*(\omega)=X(-\omega)$
   c) $X^*(\omega)=-X(\omega)$
   d) None of the mentioned
2. For a signal x(n) to exhibit even symmetry, it should satisfy the condition $|X(-\omega)|=|X(\omega)|$.
   a) True
   b) False
3. What is the energy density spectrum Sxx(ω) of the signal $x(n)=a^n u(n)$, $|a|<1$?
   a) $1/(1+2a\cos\omega+a^2)$
   b) $1/(1+2a\sin\omega+a^2)$
   c) $1/(1-2a\sin\omega+a^2)$
   d) $1/(1-2a\cos\omega+a^2)$
4. Which of the following condition is to be satisfied for the Fourier transform of a sequence to be equal as the Z-transform of the same sequence?
   a) $|z|=1$
   b) $|z|<1$
   c) $|z|>1$
   d) Can never be equal
5. The sequence $x(n)=\sin\omega_c n/\pi n$ does not have both z-transform and Fourier transform.
   a) True
   b) False
6. If x(n) is a stable sequence so that X(z) converges on to a unit circle, then the complex cepstrum signal is defined as _____
   a) X(ln X(z))
   b) ln X(z)
   c) X^{-1}(ln X(z))
   d) None of the mentioned
7. If a power signal has its power density spectrum concentrated about zero frequency, the signal is known as _____
   a) Low frequency signal
   b) Middle frequency signal
   c) High frequency signal
   d) None of the mentioned
8. What are the main characteristics of Anti aliasing filter?
   a) Ensures that bandwidth of signal to be sampled is limited to frequency range
   b) To limit the additive noise spectrum and other interference, which corrupts the signal
   c) All of the mentioned
   d) None of the mentioned
9. In general, a digital system designer has better control of tolerances in a digital signal processing system than an analog system designer who is designing an equivalent analog system.
   a) True
   b) False

10. The term 'bandwidth' represents the quantitative measure of a signal.
a) True
b) False

Answers:

1. b) $X^*(\omega)=X(-\omega)$
2. a) True
3. d) $1/(1-2a\cos\omega+a^2)$
4. a) $|z|=1$
5. b) False
6. c) $X^{-1}(\ln X(z))$
7. a) Low frequency signal
8. c) All of the mentioned
9. a) True
10. a) True

PUZZLES

- Sudharshan. M , IV ECE

Logic Puzzle 1: *Susan and Lisa decided to play tennis against each other. They bet $1 on each game they played. Susan won three bets and Lisa won $5. How many games did they play?*

Answer: Eleven. Because Lisa lost three games to Susan, she had lost $3 ($1 per game). So, she had to win back that $3 with three more games, then win another five games to win $5.

Logic Puzzle 2: *If five cats can catch five mice in five minutes, how long will it take one cat to catch one mouse?*

Answer: Five minutes. Using the information we know, it would take one cat 25 minutes to catch all five mice (5x5=25). Then working backward and dividing 25 by five, we get five minutes for one cat to catch each mouse.

Logic Puzzle 3: *There is a barrel with no lid and some wine in it. "This barrel of wine is more than half full," says the woman. "No, it's not," says the man. "It's less than half full." Without any measuring implements and without removing any wine from the barrel, how can they easily determine who is correct?*

Answer: Tilt the barrel until the wine barely touches the lip of the barrel. If the bottom of the barrel is visible then it is less than half full. If the barrel bottom is still completely covered by the wine, then it is more than half full.

Logic Puzzle 4: *There are three bags, each containing two marbles. Bag A contains two white marbles, Bag B contains two black marbles, and Bag C contains one white marble and one black marble. You pick a random bag and take out one marble, which is white. What is the probability that the remaining marble from the same bag is also white?*

Answer: 2 out of 3. You know you don't have Bag B. But because Bag A has two white marbles, you could have picked either marble; if you think of it as four marbles in total from Bags A and C, three white and one black, you'll have a greater chance of picking another white marble.

Editors Desk

Ten Hot Water Benefits

- Introduces Tea and Coffee into Diets.
- Helps With Circulation.
- Encourages Bowel Movements.
- Promote Weight Loss.
- Help With Congestion and Cold.
- Helps With Detoxification.
- Soothing Menstrual Cramps.
- Promote Hair Health.
- Keeps Skin Healthy.
- Improves Dental Health.

Send your suggestions to:

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4. S.Ashika, III ECE

Department Vision

To create globally competent engineers in Electronics and Communication Engineering to meet the industrial progress for betterment of the society

Department Mission

1. To create an academic ambience for quality education in the field of Electronics and Communication Engineering
2. To make the best use of modern tools and software for teaching and research activities
3. To promote industry-institution interaction for skill-based learning of students from rural society
4. To inculcate moral and ethical values with a sense of professionalism.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO's):

1. To provide the students with a strong foundation in the required sciences in order to pursue studies in Electronics and Communication Engineering.
2. To gain adequate knowledge to become good professional in electronic and communication engineering associated industries, higher education and research.
3. To develop attitude in lifelong learning, applying and adapting new ideas and technologies as their field evolve
4. To prepare students to critically analyze existing literature in an area of specialization and ethically develop innovative and research oriented methodologies to solve the problems identified.
5. To inculcate in the students a professional and ethical attitude and an ability to visualize the engineering issues in a broader social context.

PROGRAMME OUTCOMES:

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **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.
3. **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.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **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.
6. **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.
7. **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.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **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.
11. **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.
12. **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.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

- PSO1: Design, develop and analyze electronic systems through application of relevant electronics, mathematics and engineering principles
- PSO2: Design, develop and analyze communication systems through application of fundamentals from communication principles, signal processing, and RF System Design & Electromagnetics.
- PSO3: Adapt to emerging electronics and communication technologies and develop innovative solutions for existing and newer problems