***Assignment’s***

**Subject :**

**Wireless and Mobile Communication**

**Submitted By:**

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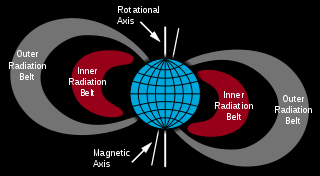
**Class No. 9**

**GDC Ekkaghund Mohmand Agency**

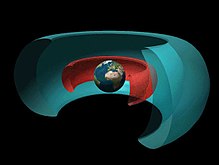
**BSCS (7th Semester)**

**What’s Van Allen Belt ?**

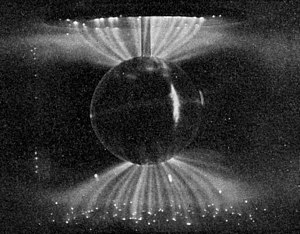
A Van Allen radiation belt is a zone of energetic charged particles, most of which originate from the solar wind, that are captured by and held around a planet by that planet's magnetic field. Earth has two such belts and sometimes others may be temporarily created. The discovery of the belts is credited to James Van Allen, and as a result, Earth's belts are known as the Van Allen belts. Earth's two main belts extend from an altitude of about 640 to 58,000 km above the surface in which region radiation levels vary. Most of the particles that form the belts are thought to come from solar wind and other particles by cosmic rays. By trapping the solar wind, the magnetic field deflects those energetic particles and protects the atmosphere from destruction.



The belts are located in the inner region of Earth's magnetosphere. The belts trap energetic electrons and protons. Other nuclei, such as alpha particles, are less prevalent. The belts endanger satellites, which must have their sensitive components protected with adequate shielding if they spend significant time near that zone. In 2013, NASA reported that the Van Allen Probes had discovered a transient, third radiation belt, which was observed for four weeks until it was destroyed by a powerful, interplanetary shock wave from the Sun.  
**Inner Van Allen Belt:**  
 The inner Van Allen Belt extends typically from an altitude of 0.2 to 2 Earth radii above the Earth. In certain cases when solar activity is stronger or in geographical areas such as the South Atlantic Anomaly, the inner boundary may decline to roughly 200 kilometers above the Earth's surface. The inner belt contains high concentrations of electrons in the range of hundreds of keV and energetic protons with energies exceeding 100 MeV, trapped by the strong (relative to the outer belts) magnetic fields in the region.



**Outer belt**:  
 The outer belt consists mainly of high energy (0.1–10 MeV) electrons trapped by the Earth's magnetosphere. It is more variable than the inner belt as it is more easily influenced by solar activity. It is almost toroidal in shape, beginning at an altitude of three and extending to ten Earth radii (RE) 13,000 to 60,000 kilometers above the Earth's surface. Its greatest intensity is usually around 4–5 RE. The outer electron radiation belt is mostly produced by the inward radial diffusion and local acceleration due to transfer of energy from whistler-mode plasma waves to radiation belt electrons. Radiation belt electrons are also constantly removed by collisions with Earth's atmosphere, losses to the magnetopause, and their outward radial diffusion.



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**GEO Usage:**

A geostationary orbit, often referred to as a geosynchronous equatorial orbit (GEO), is a circular geosynchronous orbit 35,786 km above Earth's equator and following the direction of Earth's rotation.

**Uses:**

🡪Most commercial communications satellites, broadcast satellites and SBAS satellites operate in geostationary orbits.  
**Communications:**  
 Geostationary communication satellites are useful because of their large coverage, extending 81°, and stationary position in the sky, eliminating the need for movable ground antennas.  
However, latency becomes significant — about 250ms for a trip from one ground-based transmitter to the satellite and back to another ground-based transmitter.  
 Geostationary satellites are directly overhead at the equator and appear lower in the sky to an observer nearer the poles. As the observer's latitude increases, communication becomes more difficult due to factors such as atmospheric refraction, Earth's thermal emission, line-of-sight obstructions, and signal reflections from the ground or nearby structures. At latitudes above about 81°, geostationary satellites are below the horizon and cannot be seen at all. Because of this, some Russian communication satellites have used elliptical Molniya and Tundra orbits, which have excellent visibility at high latitudes.  
**Meteorology:**  
 A worldwide network of operational geostationary meteorological satellites is used to provide visible and infrared images of Earth's surface and atmosphere for weather observation, oceanography, and atmospheric tracking. As of 2019 there are 19 satellites in either operation or stand-by. These satellite systems include:

* the United States' GOES series, operated by NOAA.
* the Meteosat series, launched by the European Space Agency and operated by the European Weather
* Satellite Organization, EUMETSAT.
* the Republic of Korea COMS-1 and GK-2A multi mission satellites.
* the Russian Elektro-L satellites.
* the Japanese Himawari series.
* Chinese Fengyun series.  
  🡪These satellites typically captures images in the visual and infrared spectrum with a spatial resolution between 0.5 and 4 square kilometers. The coverage is typically 70°,and in some cases less.

Geostationary satellite imagery has been used for tracking volcanic ash, measuring cloud top temperature and water vapour, oceanography, facilitating cyclone path prediction and providing real time cloud coverage and other tracking data Some information has been incorporated into meteorological prediction models, but geostationary weather satellite images are primarily used for short-term and real-time forecasting.

**Navigation**:  
 Geostationary satellites can be used to augment GNSS systems by relaying clock, ephemeris and ionospheric error corrections and providing an additional reference signal.  
  
This improves position accuracy from ~5m to ~1m or less. Past and current navigation systems that use geostationary satellites include:

* The Wide Area Augmentation System(WAAS), operated by the United States Federal Aviation Administration (FAA).
* The European Geostationary Navigation Overlay Service (EGNOS), operated by the ESSP .
* The Multi-functional Satellite Augmentation System (MSAS), operated by Japan's Ministry of Land, Infrastructure and Transport Japan Civil Aviation Bureau(JCAB).
* The commercial StarFire navigation system, operated by John Deere and C-Nav Positioning Solutions (Oceaneering).
* The commercial Starfix DGPS System and OmniSTAR system, operated by Fugro.

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**Examples of LEO:**

**Cubesat:**  
 A CubeSat (U-class spacecraft) is a type of miniaturized satellite for space research that is made up of multiples of 10 cm × 10 cm × 11.35 cm cubic units. CubeSats have a mass of no more than 1.33 kilograms per unit, and often use commercial off-the-shelf (COTS) components for their electronics and structure. CubeSats are commonly put in orbit by deployers on the International Space Station, or launched as secondary payloads on a launch vehicle. Over 1000 CubeSats have been launched as of January 2019. Over 900 have been successfully deployed in orbit and over 80 have been destroyed in launch failures.  
 Uses typically involve experiments that can be miniaturized or serve purposes such as Earth observation or amateur radio. CubeSats are employed to demonstrate spacecraft technologies intended for small satellites or that present questionable feasibility and are unlikely to justify the cost of a larger satellite. Scientific experiments with unproven underlying theory may also find themselves aboard CubeSats because their low cost can justify higher risks.  
**Iridium**:  
The Iridium satellite constellation provides L-band voice and data coverage to satellite phones, pagers and integrated transceivers over the entire Earth surface. Iridium Communications owns and operates the constellation, additionally selling equipment and access to its services. It was originally conceived by Bary Bertiger, Raymond J. Leopold and Ken Peterson in late 1987 and then developed by Motorola on a fixed-price contract from July 29, 1993, to November 1, 1998, when the system became operational and commercially available.  
The constellation consists of 66 active satellites in orbit, required for global coverage, and additional spare satellites to serve in case of failure.

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**Private and Public IP addresses:**

Just as our network's **public IP address** is issued by our ISP(internet service provider), our router issues **private** (or internal) **IP addresses** to each network device inside our network. This provides unique identification for devices that are within our network, such as our computer, our video conferencing systems, and so on.

🡪Video conferencing can use both public and private IP addresses to send information (video/audio/data). When using a cloud video service, like Easy meeting, we typically will need to assign a public IP address to our video conferencing system in order for it to function optimally because private IP addresses never leave our network and cloud services require that we communicate over the internet outside of our network.

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**Sensors in Mobile’s:**

**1) Accelerometer:**  
                  Determine whether our phone is in portrait or landscape orientation.  
**2) Gyroscope :**  
                  Provides orientation details and direction like up/down and left/right but with greater precision like how much the device is tilted.  
**3) Magnetometer:**  
                    Our smartphones are equipped with magnetometer which we commonly recognize as a compass. It can detect magnetic fields, so the compass app in phones uses this smartphone sensor to point at the planet’s north pole.  
**4) Global Positioning System (GPS):**  
                   Communicate with the satellites to determine our precise location on Earth.  
**5) Proximity Sensor:**  
                     Makes use of an infrared LED and IR light detector to find out how close the phone is to an outside object. It used while making calls and when the phone is held to the face to make or receive a call, the sensor detects it and disables the touchscreen display to avoid unintended input through the skin.  
**6) Ambient Light Sensor**:  
                   It is used in Automatic Brightness Adjuster to decrease or increase the brightness of the smartphone screen based on the availability of light.  
**7) Microphone:**  
                   The microphone is basically a sound sensor that detects and measures the loudness of sound. Apart from making and receiving calls, it is used for voice search and voice commands for digital assistant apps like Google Assistant, Siri, Cortana, etc.  
**8) Touchscreen Sensors**:  
                 The smartphone sensors in a touchscreen have an electrical current passing through them at all times and touching the screen causes a change in the signals. This change acts as input for the device.   
**9) Fingerprint Sensor**:  
                    Fingerprint sensor enables biometric verification to secure many smartphones today. It is a capacitive scanner that records our fingerprint electrically.  
**10) Pedometer:**  
                    The pedometer is used for counting steps, and fitness tracker makes use of this sensor to count the number of steps we take. Pedometers generally use the values generated by the accelerometer to monitor our movements like running or walking.  
**11) Barcode/QR Code sensors:**  
                     Most of the smartphones have barcode sensors that can read a barcode by detecting the reflected light from the code. It generates an analog signal with varying voltage that represents the barcode. This analog signal is then converted to a digital one and finally decoded to reveal the information in it. Barcode sensors are useful in scanning the barcodes products or QR codes.  
**12) Barometer**:  
                     The barometer measures the air pressure, so it is quite useful in detecting weather changes and in calculating the altitude we’re at.  
**13) Heart Rate Sensor:**  
                      Next up is the heart rate sensor that measures heartbeat with the help of LED and optical sensors. The LED emits light towards the skin, and this smartphone sensor looks for the light waves reflected by it.  
**14) Thermometer:**  
                    Every smartphone comes with an inbuilt thermometer for monitoring the temperature inside the device and battery. In case a component starts overheating, the system shuts down itself to prevent any damage.  
**15) Air Humidity Sensor:**  
                  It could measure the humidity in the air, and the data collected by it would tell the user whether the given air temperature and humidity are optimum or not.   
**16) Geiger Counter**:  
                  There is only one phone that supports it – the Sharp Pantone 5. This handset has been released in Japan only. The Geiger Counter in it can measure the current radiation level in the area.

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**Frequency Modulation (FM):**

Frequency modulation (FM) is a technique used to encode data on an alternating digital or analog signal. The method includes varying the frequency of the carrier wave on which useful information is imposed or impressed upon. The signal on which data is imposed is known as the carrier signal and the resulting signal with variable frequency is called a frequency modulated signal.  
 Frequency modulation is widely used for radio transmission due to the fact that the signal-to-noise ratio (SNR) is large in this method of modulation and hence radio frequency interference is minimized. FM signals are used in technology such as radars, telemeters, EEG, radio broadcasting, satellite communication and magnetic tape recording systems. The frequencies vary by up to 5 kHz in the case of wireless two-way communication and they vary up to several MHz in the case of wireless broadcasting.

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**Telemetry:**

Telemetry is the collection of measurements or other data at remote or inaccessible points and their automatic transmission to receiving equipment for monitoring. The word is derived from Greek the roots *tele*, "remote", and *metron*, "measure". Systems that need external instructions and data to operate require the counterpart of telemetry, telecommand.

A telemeter is a device used to remotely measure any quantity. It consists of a sensor, a transmission path, and a display, recording, or control device. Telemeters are the physical devices used in telemetry. Electronic devices are widely used in telemetry and can be wireless or hard-wired, analog or digital. Other technologies are also possible, such as mechanical, hydraulic and optical.

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**Phase of Wave:**

Phase is a particular point on the cycle of a waveform, measured as an angle in degrees. A complete cycle is 3600.  The waves are in phase if the waves are either 0 or 3600 apart. The resulting amplitude is twice the original. They are out of phase if the resulting amplitude is between 0 and twice the original. They are completely out of phase if the waves are 1800 apart.

In phase

Out of phase

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**What is Baud ?**

In telecommunication and electronics, baud is a common measure of symbol rate, one of the components that determine the speed of communication over a data channel.  
It is the unit for symbol rate or modulation rate in symbols per second or pulses per second. It is the number of distinct symbol changes (signaling events) made to the transmission medium per second in a digitally modulated signal or a bd rate line code.

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**Multiplexing:**

Multiplexing is a technique in which different nodes or devices signals combine(multiplex) into a single shared(multiplexed) medium.

Multiplexing

Synchronous

Asynchronous

Frequency Division Multiplexing

Time Division Multiplexing

**Synchronous TDM:**

The multiplexer allocates exactly the same time slot to each device at all times, whether or not a device has anything to transmit.

* For example, Time slot 1 is assigned to device 1 alone and cannot be used by any other device .

MUX

**Frames:** In synchronous TDM, a frame consist of one complete cycle of time slots. Thus the number of slots in frame is equal to the number of inputs.

**Asynchronous TDM:**

In asynchronous TDM, each slot in a frame is not dedicated to the fix device. Each slot contains an index of the device to be sent to and a message. Thus , the number of slots in a frame is not necessary to be equal to the number of input devices.

More than one slot in a frame can be allocated for an input device. Asynchronous TDM allows maximization the link. It allows a number of lower speed input lines to be multiplexed to a single higher speed line.

MUX