Introduction to satellite:

"Newton's cannonball", presented as a "thought experiment" in A Treatise of the System of the World, by Isaac Newton was the first published mathematical study of the possibility of an artificial satellite. The first fictional depiction of a satellite being launched into orbit was a short story by Edward Everett Hale, The Brick Moon. The idea surfaced again in Jules Verne's The Begum's Fortune (1879).

In 1903, Konstantin Tsiolkovsky (1857–1935) published Exploring Space Using Jet Propulsion Devices, which is the first academic treatise on the use of rocketry to launch spacecraft. He calculated the orbital speed required for a minimal orbit, and that a multi-stage rocket fueled by liquid propellants could achieve this.

In 1928, Herman Potočnik (1892–1929) published his sole book, The Problem of Space Travel — The Rocket Motor . He described the use of orbiting spacecraft for observation of the ground and described how the special conditions of space could be useful for scientific experiments.

In a 1945 Wireless World article, the English science fiction writer Arthur C. Clarke (1917–2008) described in detail the possible use of communications satellites for mass communications. He suggested that three geostationary satellites would provide coverage over the entire planet.

The US military studied the idea of what was referred to as the "earth satellite vehicle" when Secretary of Defense James Forrestal made a public announcement on 29 December 1948, that his office was coordinating that project between the various services.

Sputnik 1: The first artificial satellite to orbit Earth , launched by the Soviet Union on 4 October 1957, and initiating the Soviet Sputnik program, with Sergei Korolev as chief designer. This in turn triggered the Space Race between the Soviet Union and the United States. Sputnik 1 helped to identify the density of high atmospheric layers through measurement of its orbital change and provided data on radio-signal distribution in the ionosphere. The unanticipated announcement of

Sputnik 1's success precipitated the Sputnik crisis in the United States and ignited the so-called Space Race within the Cold War.

Sputnik 2: was launched on 3 November 1957 and carried the first living passenger into orbit, a dog named Laika , who died a few hours after the launch. Sputnik 2 was a 4-meter (13 foot) high cone-shaped capsule with a base diameter of 2 meters (6.6 feet) that weighed around 500 kg, though it was not designed to separate from the rocket core that brought it to orbit, bringing the total mass in orbit to 7.79 tons. It contained several compartments for radio transmitters, a telemetry system, a programming unit, a regeneration and temperature-control system for the cabin, and scientific instruments. A separate sealed cabin contained the dog Laika.

In May, 1946, **Project RAND** had released the Preliminary Design of an Experimental World-Circling Spaceship, which stated, "A satellite vehicle with appropriate instrumentation can be expected to be one of the most potent scientific tools of the Twentieth Century." The United States had been considering launching orbital satellites since 1945 under the Bureau of Aeronautics of the United States Navy.

The United States Air Force's Project RAND eventually released the report, but considered the satellite to be a tool for science, politics, and propaganda, rather than a potential military weapon. In 1954, the Secretary of Defense stated, "I know of no American satellite program.". In February 1954 Project RAND released "Scientific Uses for a Satellite Vehicle," written by R.R. Carhart. This expanded on potential scientific uses for satellite vehicles and was followed in June 1955 with "The Scientific Use of an Artificial Satellite," by H.K. Kallmann and W.W. Kellogg.

In the context of activities planned for the International Geophysical Year (1957–58), the White House announced on 29 July 1955 that the U.S. intended to launch satellites by the spring of 1958. This became known as Project Vanguard. On 31 July, the Soviets announced that they intended to launch a satellite by the fall of 1957. Following pressure by the American Rocket Society, the National Science Foundation, and the International Geophysical Year, military interest picked up and in early 1955 the Army and Navy were working on Project Orbiter, two competing

programs: the army's which involved using a Jupiter C rocket, and the civilian/Navy Vanguard Rocket, to launch a satellite. At first, they failed: initial preference was given to the Vanguard program, whose first attempt at orbiting a satellite resulted in the explosion of the launch vehicle on national television. But finally, three months after Sputnik 2, the project succeeded; Explorer 1 became the United States' first artificial satellite on 31 January 1958.

In June 1961, three-and-a-half years after the launch of Sputnik 1, the Air Force used resources of the United States Space Surveillance Network to catalog 115 Earth-orbiting satellites.

Early satellites were constructed as "one-off" designs. With growth in geosynchronous (GEO) satellite communication, multiple satellites began to be built on single model platforms called satellite buses. The first standardized satellite bus design was the HS-333 GEO commsat, launched in 1972. Currently the largest artificial satellite ever is the International Space Station.

Space Surveillance Network:

The United States Space Surveillance Network (SSN), a division of the United States Strategic Command, has been tracking objects in Earth's orbit since 1957 when the Soviet Union opened the Space Age with the launch of Sputnik I. Since then, the SSN has tracked more than 26,000 objects. The SSN currently tracks more than 8,000 man-made orbiting objects.

The rest have re-entered Earth's atmosphere and disintegrated, or survived re-entry and impacted the Earth. The SSN tracks objects that are 10 centimeters in diameter or larger; those now orbiting Earth range from satellites weighing several tons to pieces of spent rocket bodies weighing only 10 pounds. About seven percent are operational satellites (i.e. ~560 satellites), the rest are space debris.

The United States Strategic Command is primarily interested in the active satellites, but also tracks space debris which upon reentry might otherwise be mistaken for incoming missiles.

Artificial Satellite Usages Classification:

1) Astronomical satellites: are satellites used for observation of distant planets, galaxies, and other outer space objects.

2) Biosatellites: are satellites designed to carry living organisms, generally for scientific experimentation. For example NASA launched three satellites named Biosatellite 1, 2 and 3 between 1966 and 1969.

NASA's Biosatellite program was a series of three satellites to assess the effects of spaceflight, especially radiation and weightlessness, on living organisms. Each was designed to reenter and be recovered at the end of its mission.

Its primary goal was that it intended to determine effects of space environment, particularly weightlessness, on life processes at three levels of organization: basic biochemistry of the cell; structure of growth of cells and tissues; and growth and form of entire plants and animals.

3) Communication satellites: are satellites stationed in space for the purpose of telecommunications. Modern communications satellites typically use geosynchronous orbits, Molniya orbits or Low Earth orbits.

4) Earth observation satellites: are satellites intended for non-military uses such as environmental monitoring, meteorology, map making etc.

5) Navigational satellites: are satellites which use radio time signals transmitted to enable mobile receivers on the ground to determine their exact location.

The relatively clear line of sight between the satellites and receivers on the ground, combined with ever-improving electronics, allows satellite navigation systems to measure location to accuracies on the order of a few meters in real time.

6) Crewed spacecraft (spaceships): are large satellites able to put humans into (and beyond) an orbit, and return them to Earth.

Spacecraft including spaceplanes of reusable systems have major propulsion or landing facilities. They can be used as transport to and from the orbital stations.

7) Miniaturized satellites: are satellites of unusually low masses and small sizes. New classifications are used to categorize these satellites: minisatellite (500–100 kg), microsatellite (below 100 kg), and nanosatellite (below 10 kg).

8) Reconnaissance satellites: are Earth observation satellite or communications satellite deployed for military or intelligence applications.

Very little is known about the full power of these satellites, as governments who operate them usually keep information pertaining to their reconnaissance satellites classified.

9) Tether satellites: are satellites which are connected to another satellite by a thin cable called a tether.

10) Weather satellites are primarily used to monitor Earth's weather and climate.

Satellite services Classification:

1) Satellite crop monitoring: is the technology which facilitates real-time crop vegetation index monitoring via spectral analysis of high resolution satellite images for different fields and crops which enables to track positive and negative dynamics of crop development. The difference in vegetation index informs about single-crop development disproportions that speaks for the necessity of additional agriculture works on particular field zones that is because satellite crop monitoring belongs to precision agriculture methods.

Satellite crop monitoring technology allows to perform online crop monitoring on different fields, located in different areas, regions, even countries and on different continents. The technology's significant advantage is a high automation level of sown area condition and its interpretation in an interactive map which can be read by different groups of users.

Satellite crop monitoring technology users are:

1) Agronomists and agriculture companies management (crop vegetation control, crop yield forecasting, management decisions optimization);

2) Business owners (business prospects estimates, making reasonable decisions on capital investments, providing information for management decisions);

3) Investors and investment analysts (investment potential estimation, making investment decisions, making sustainable forecasts);

4) Insurance brokers (data collection, clients claims verification, scale of rates and insurance premium amounts calculation);

5) Agriculture machinery producers (integration of crop monitoring solutions with agriculture machinery board computers operations, functional development);

6) State and sectoral organization's engaged in agriculture, food security and ecological problems.

2)Satellite Internet access: provided through communications satellites. Modern consumer grade satellite Internet service is typically provided to individual users through geostationary satellites that can offer relatively high data speeds, with newer satellites using K_a band (is a portion of the microwave part of the electromagnetic spectrum defined as frequencies in the range 26.5–40 gigahertz (GHz)) to achieve downstream data speeds up to 506 Mbps.

3)Satellite navigation: or Satnav system is a system that uses satellites to provide autonomous geo-spatial positioning. It allows small electronic receivers to determine their location (longitude, latitude, and altitude/elevation) to high precision (within a few meters) using signals transmitted along a line of sight by radio from satellites. The system can be used for providing position, navigation or for tracking the position of something fitted with a receiver (satellite tracking). The signals also allow the electronic receiver to calculate the current local time to high precision, which allows time synchronization. Satnav systems operate independently of any telephonic or internet reception, though these technologies can enhance the usefulness of the positioning information generated.

A satellite navigation system with global coverage may be termed a global navigation satellite system (GNSS). As of October 2018, the United States' Global Positioning System (GPS) and Russia's GLONASS are fully operational GNSSs, with China's BeiDou Navigation Satellite System (BDS) and the European Union's Galileo scheduled to be fully operational by 2020. India, France and Japan are in the process of developing regional navigation and augmentation systems as well.

Global coverage for each system is generally achieved by a satellite constellation of 18–30 Medium Earth Orbit (MEO) satellites spread between several orbital planes. The actual systems vary, but use orbital inclinations of >50° and orbital periods of roughly twelve hours (at an altitude of about 20,000 kilometers or 12,000 miles).

4)Satellite phone: or Satphone is a type of mobile phone that connects to orbiting satellites instead of terrestrial cell sites. They provide similar functionality to terrestrial mobile telephones; voice, SMS and low-bandwidth Internet access are supported through most systems.

Depending on the architecture of a particular system, coverage may include the entire Earth or only specific regions. The mobile equipment, also known as a terminal, varies widely. Early satellite phone handsets had a size and weight comparable to that of a late-1980s or early-1990s mobile phone, but usually with a large retractable antenna. More recent satellite phones are similar in size to a regular mobile phone while some prototype satellite phones have no distinguishable difference from an ordinary smartphone. Satphones are popular on expeditions into remote areas where terrestrial cellular service is unavailable.

5)Satellite radio: is defined by the International Telecommunication Union (ITU)'S ITU Radio Regulations (RR) as a broadcasting-satellite service. The satellite's signals are broadcast nationwide, across a much wider geographical area than terrestrial radio stations, and the service is primarily intended for the occupants of motor vehicles. It is available by subscription, mostly commercial free, and offers subscribers more stations and a wider variety of programming options than terrestrial radio.

Satellite radio uses the 2.3 GHz S band in North America for nationwide digital radio broadcasting. MobaHO! Operated at 2.6 GHz. In other parts of the world, satellite radio uses part of the 1.4 GHz L band allocated for DAB.

Satellite radio subscribers purchase a receiver and pay a monthly subscription fee to listen to programming. They can listen through built-in or portable receivers in automobiles; in the home and office with a portable or tabletop receiver equipped to connect the receiver to a stereo system; or on the Internet.

6)Satellite television: Satellite television is a service that delivers television programming to viewers by relaying it from a communications satellite orbiting the Earth directly to the viewer's location. The signals are received via an outdoor parabolic antenna commonly referred to as a satellite dish and a low-noise block downconverter.

A satellite receiver then decodes the desired television program for viewing on a television set. Receivers can be external set-top boxes, or a built-in television tuner. Satellite television provides a wide range of channels and services. It is usually the only television available in many remote geographic areas without terrestrial television or cable television service.

Modern systems signals are relayed from a communications satellite on the **Ku** band frequencies (12–18 GHz) requiring only a small dish less than a meter in diameter. The first satellite TV systems were an obsolete type now known as television receive-only. These systems received weaker analog signals transmitted in the **C**-band (4–8 GHz) from FSS type satellites, requiring the use of large 2–3-meter dishes. Consequently, these systems were nicknamed "big dish" systems, and were more expensive and less popular.