SATELITE COMMUNICATION

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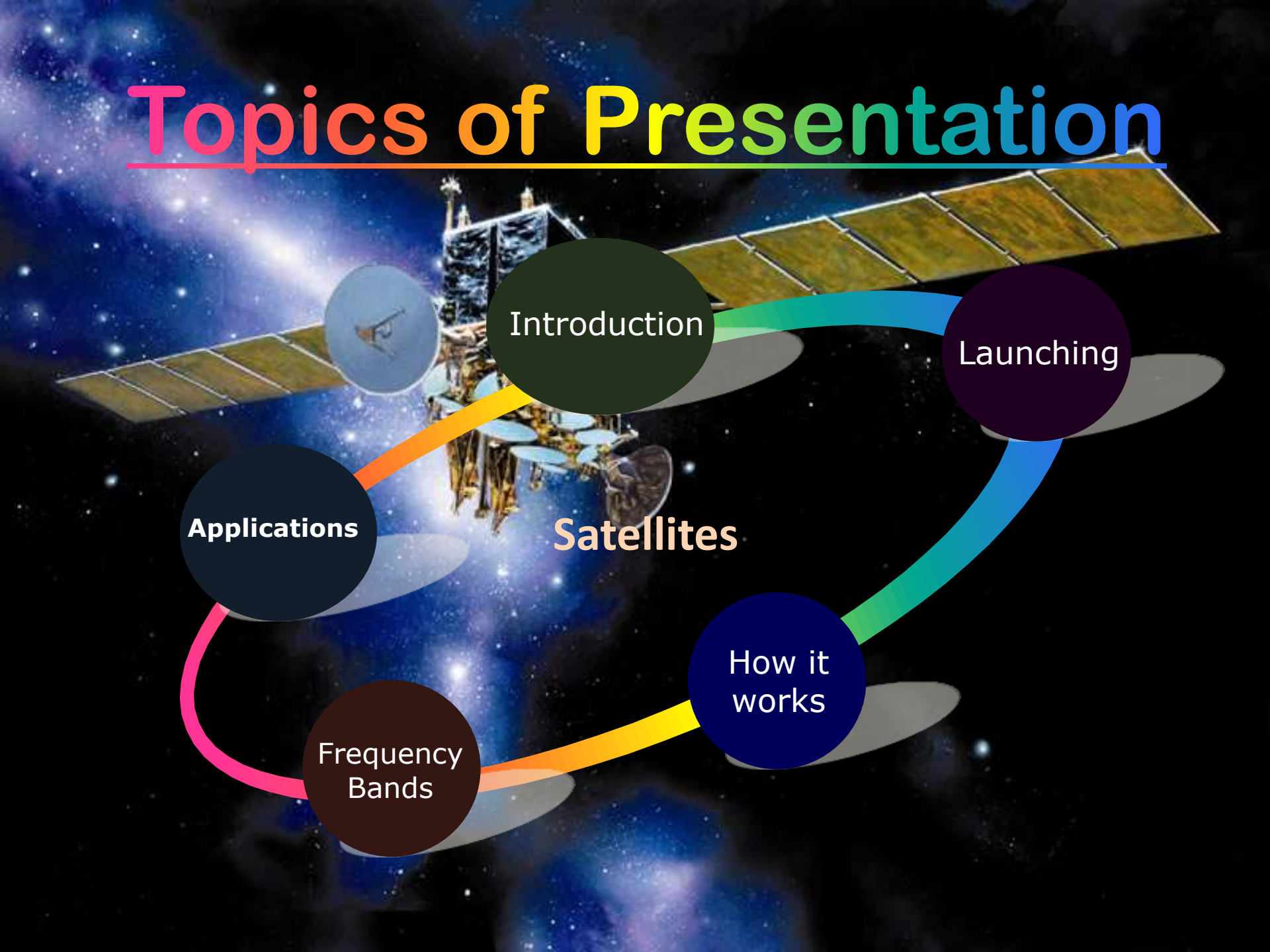
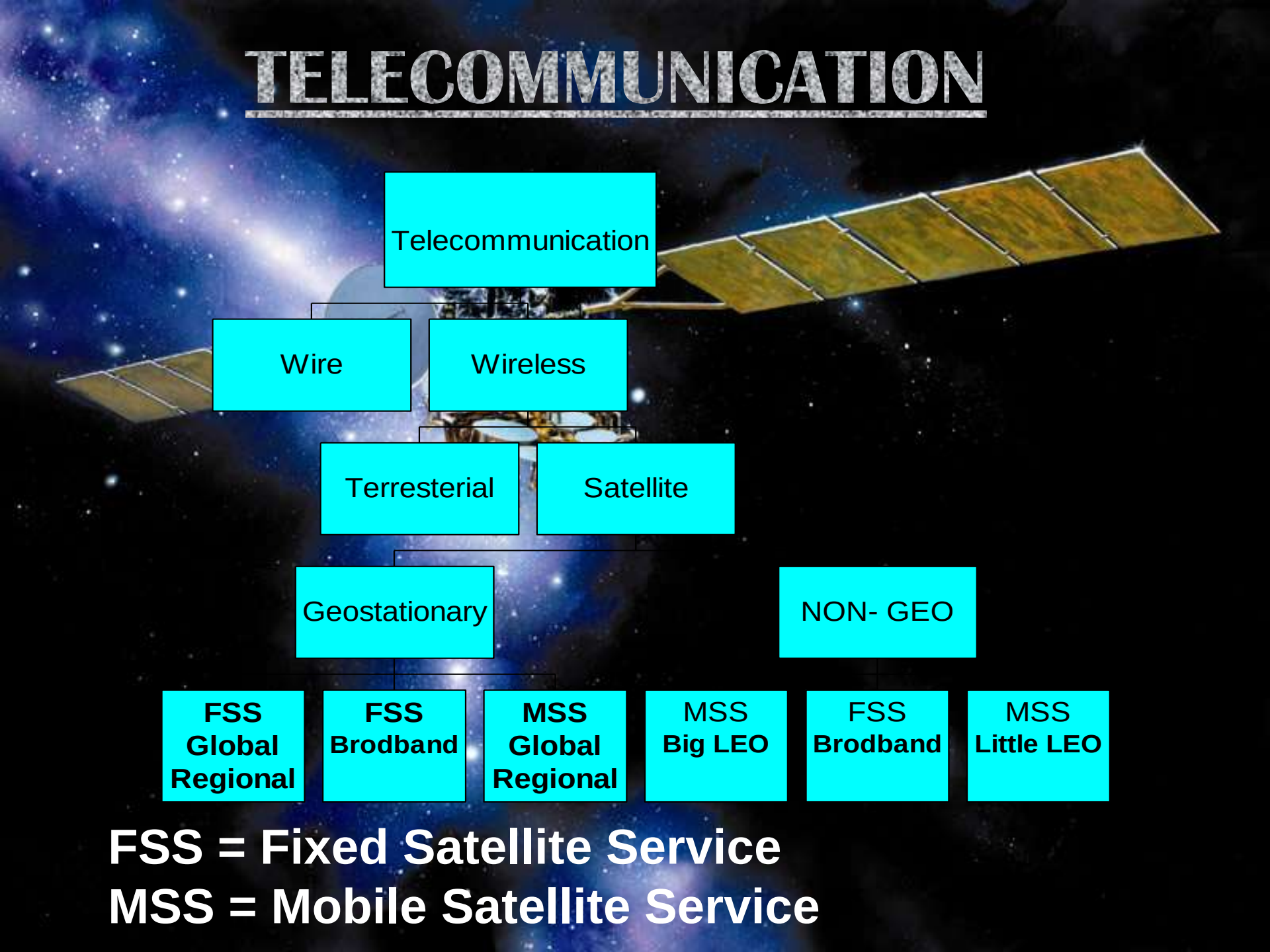
Topics of Presentation



TELECOMMUNICATION



FSS = Fixed Satellite Service

MSS = Mobile Satellite Service

INTRODUCTION

- Satellite is a microwave repeater in the space
- There are about 750 satellite in the space, most of them are used for communication.
- They are:
  - Wide area coverage of the earth's surface.
  - Transmission delay is about 0.3 sec.
  - Transmission cost is independent of distance.

- In 1962, the American telecommunications giant AT&T launched the world's first true communications satellite, called Telstar. Since then, countless communications satellites have been placed into earth orbit, and the technology being applied to them is forever growing in sophistication

WHAT ARE COMMUNICATION SATELLITES ?

- A satellite is an object that orbits another large object like planet
- A communication satellite is a station in space that is used for telecommunication, radio and television signals
- The first satellite with radio transmitter was in 1957

HOW DO SATELLITES WORK ?

- Two Stations on Earth want to communicate through radio broadcast but are too far away to use conventional means.
- The two stations can use a satellite as a relay station for their communication
- One **Earth Station** sends a transmission to the satellite. This is called a **Uplink**.
- The satellite **Transponder** converts the signal and sends it down to the second earth station. This is called a **Downlink**.

ADVANTAGES OF SATELLITE

- The advantages of satellite communication over terrestrial communication are:
  - The coverage area of a satellite greatly exceeds that of a terrestrial system.
  - Transmission cost of a satellite is independent of the distance from the center of the coverage area.
  - Satellite to Satellite communication is very precise.
  - Higher Bandwidths are available for use.

DISADVANTAGES OF SATELLITE

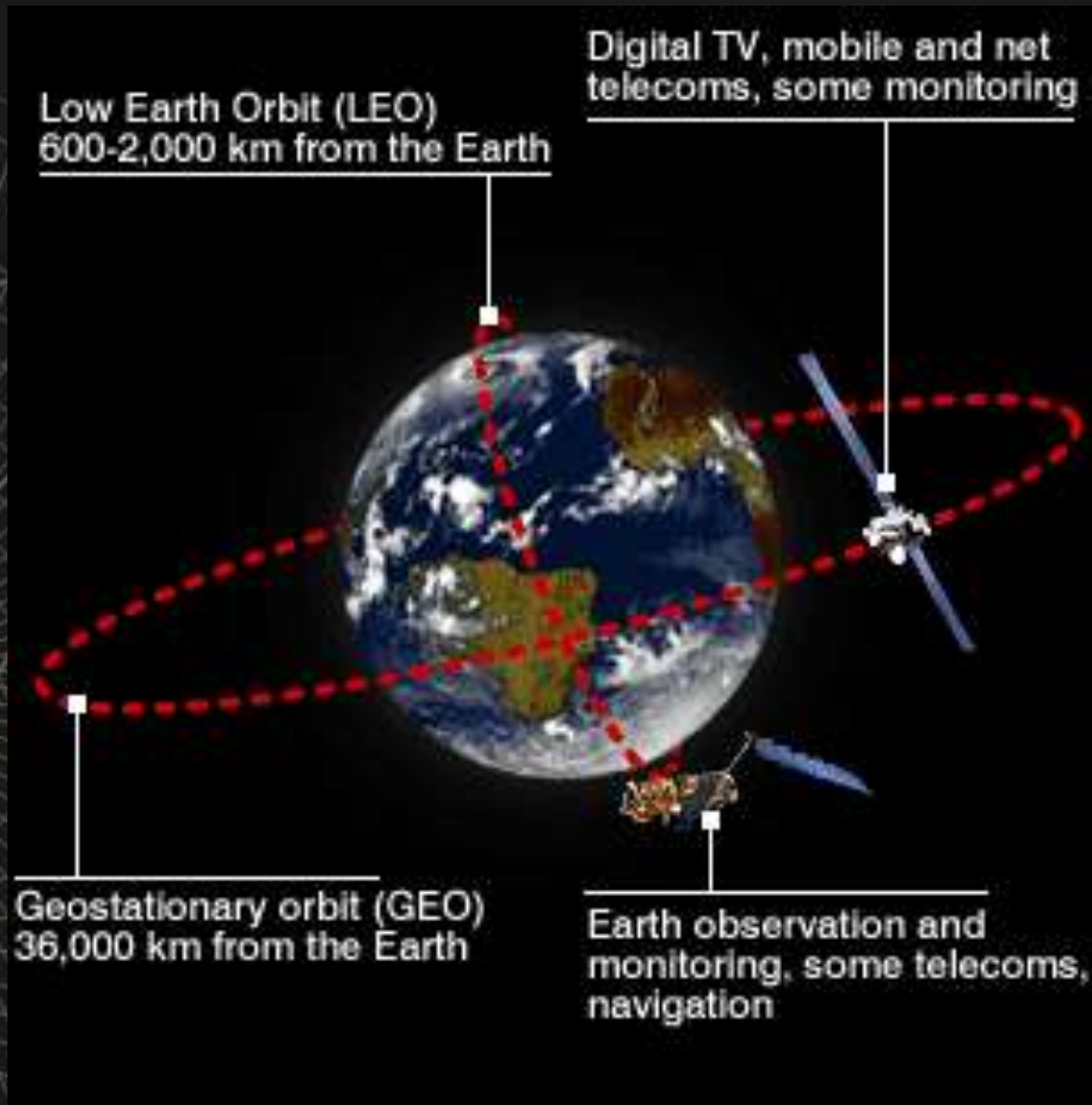
- The disadvantages of satellite communication:
  - Launching satellites into orbit is costly.
  - Satellite bandwidth is gradually becoming used up.
  - There is a larger propagation delay in satellite communication than in terrestrial communication

HOW SATELLITES ARE USED

- Service Types
  - Fixed Service Satellites (FSS)
    - Example: Point to Point Communication
  - Broadcast Service Satellites (BSS)
    - Example: Satellite Television/Radio
    - Also called Direct Broadcast Service (DBS).
  - Mobile Service Satellites (MSS)
    - Example: Satellite Phones

SATELLIE ORBITS

- Satellite Orbits
  - GEO
  - LEO
  - MEO
  - MOLNIYA
  - HAP



Geostationary Earth Orbit (GEO)

- These satellites are in orbit 35,863 km above the earth's surface along the equator.
- Objects in Geostationary orbit revolve around the earth at the same speed as the earth rotates. This means GEO satellites remain in the same position relative to the surface of earth.

GEO (cont.)

- Advantages
  - A GEO satellite's distance from earth gives it a large coverage area, almost a fourth of the earth's surface.
  - GEO satellites have a 24 hour view of a particular area.
  - These factors make it ideal for satellite broadcast and other multipoint applications.

GEO (cont.)

- Disadvantages
  - A GEO satellite's distance also cause it to have both a comparatively weak signal and a time delay in the signal, which is bad for point to point communication.
  - GEO satellites, centered above the equator, have difficulty broadcasting signals to near polar regions

Low Earth Orbit (LEO)

- LEO satellites are much closer to the earth than GEO satellites, ranging from 500 to 1,500 km above the surface.
- LEO satellites don't stay in fixed position relative to the surface, and are only visible for 15 to 20 minutes each pass.
- A network of LEO satellites is necessary for LEO satellites to be useful

LEO (cont.)

- Advantages
  - A LEO satellite's proximity to earth compared to a GEO satellite gives it a better signal strength and less of a time delay, which makes it better for point to point communication.
  - A LEO satellite's smaller area of coverage is less of a waste of bandwidth.

LEO (cont.)

- Disadvantages
  - A network of LEO satellites is needed, which can be costly
  - LEO satellites have to compensate for Doppler shifts cause by their relative movement.
  - Atmospheric drag effects LEO satellites, causing gradual orbital deterioration.

Medium Earth Orbit (MEO)

- A MEO satellite is in orbit somewhere between 8,000 km and 18,000 km above the earth's surface.
- MEO satellites are similar to LEO satellites in functionality.
- MEO satellites are visible for much longer periods of time than LEO satellites, usually between 2 to 8 hours.
- MEO satellites have a larger coverage area than LEO satellites.

MEO (cont.)

- Advantage
  - A MEO satellite's longer duration of visibility and wider footprint means fewer satellites are needed in a MEO network than a LEO network.
- Disadvantage
  - A MEO satellite's distance gives it a longer time delay and weaker signal than a LEO satellite, though not as bad as a GEO satellite.

Frequency Bands

- Different kinds of satellites use different frequency bands.
  - L–Band: 1 to 2 GHz, used by MSS
  - S-Band: 2 to 4 GHz, used by MSS, NASA, deep space research
  - C-Band: 4 to 8 GHz, used by FSS
  - X-Band: 8 to 12.5 GHz, used by FSS and in terrestrial imaging, ex: military and meteorological satellites
  - Ku-Band: 12.5 to 18 GHz: used by FSS and BSS (DBS)
  - K-Band: 18 to 26.5 GHz: used by FSS and BSS
  - Ka-Band: 26.5 to 40 GHz: used by FSS

FREQUENCY BAND (Cont.)

- Three common bands:

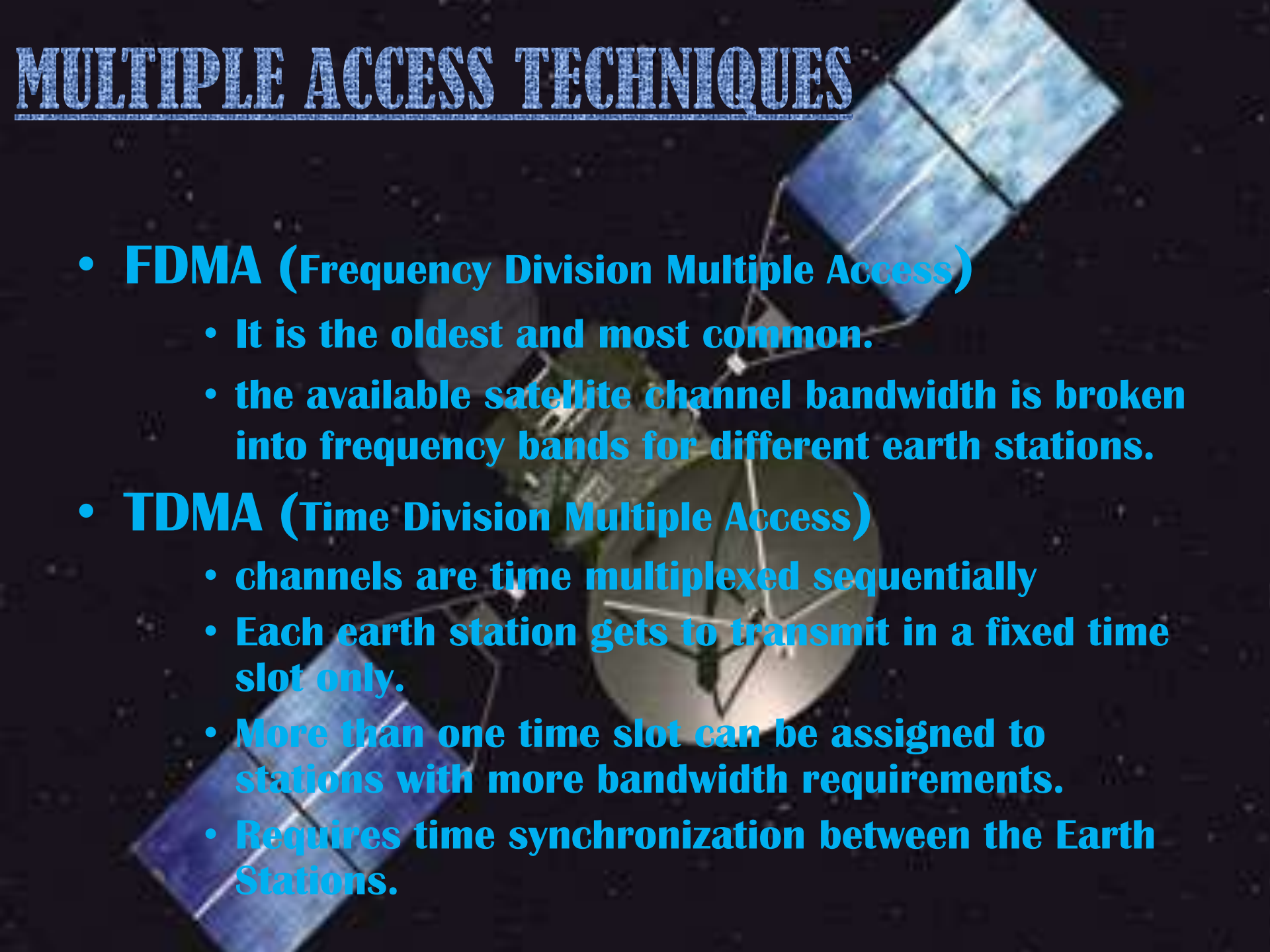
  1) C-Band.

  2) KU-Band.

  3) KA-Band.

- Most common are C-Band & KU-Band.
- C-Band occupy 4 to 8 GHz frequency:
  - Low frequency.
  - Large antenna (2-3 meters).
- KU-Band occupy 11 to 17 GHz:
  - Large frequency.
  - Small antenna (18-inches!)

MULTIPLE ACCESS TECHNIQUES



- **FDMA (Frequency Division Multiple Access)**
  - It is the oldest and most common.
  - the available satellite channel bandwidth is broken into frequency bands for different earth stations.
- **TDMA (Time Division Multiple Access)**
  - channels are time multiplexed sequentially
  - Each earth station gets to transmit in a fixed time slot only.
  - More than one time slot can be assigned to stations with more bandwidth requirements.
  - Requires time synchronization between the Earth Stations.

CDMA : (Code Division Multiple Access)

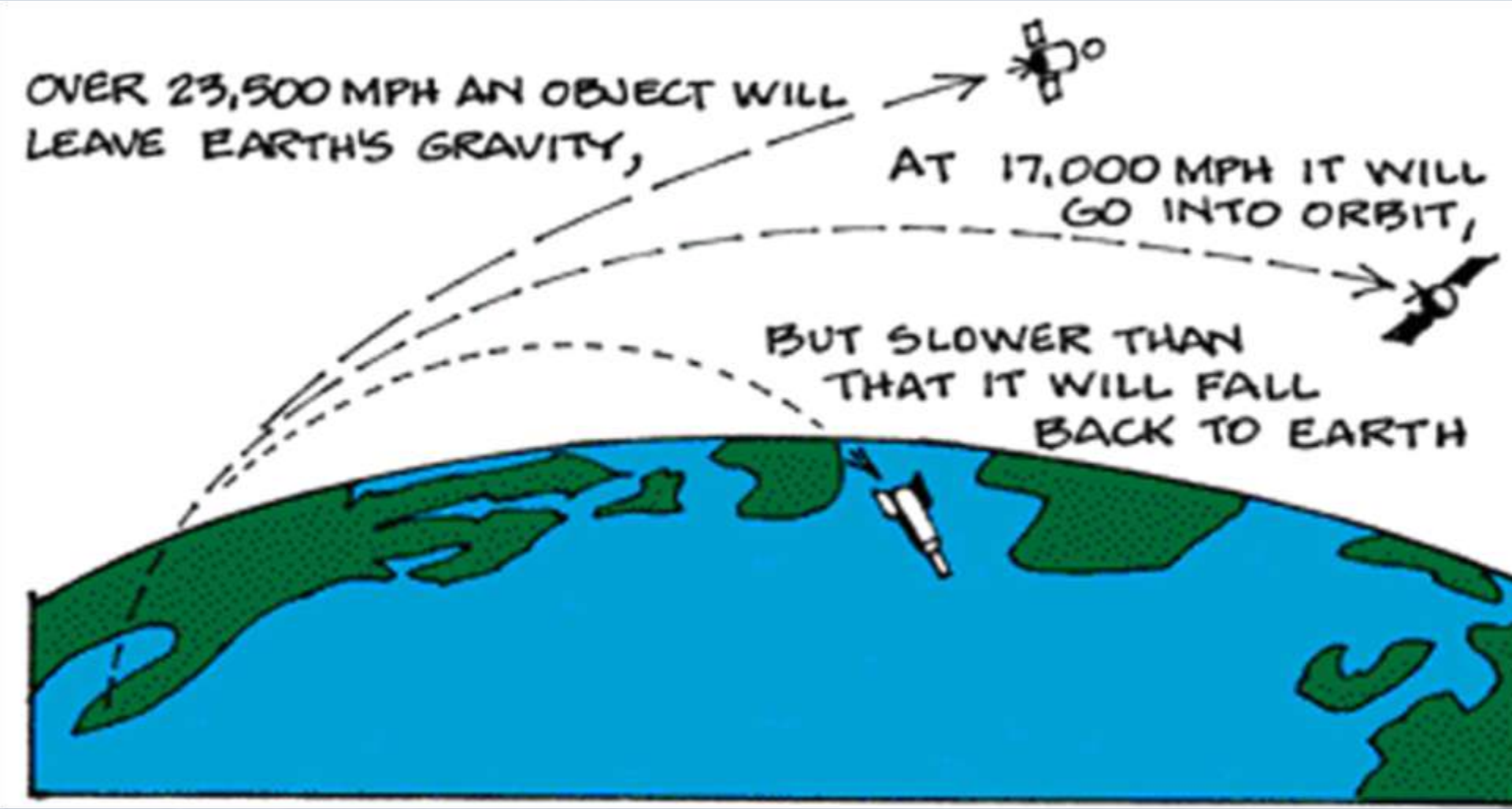
Combination of time/frequency multiplexing

(a form of spread spectrum modulation).

It provides a decentralized way of providing separate channels without timing synchronization. It is a relatively new scheme but is expected to be more common in future satellites.

Launching Satellites

- How does a satellite stay in it's orbit?



Applications

Telephony

- Fixed points> earth station> Satellite> earth station> fixed points.

Televesion & Radio

- e.g. Direct broadcast satellite (DBS) & Fixed service satellite (FFS).

Mobile satellite technology

- Special antenna called mobile satellite antenna.
- No matter where or how this antenna is mounted on.

Applications(Cont..)

- **Amateur radio**
  - Access to OSCAR satellite.
  - Low earth orbits.

- **Internet**
  - High Speed.
  - Useful for far away places.

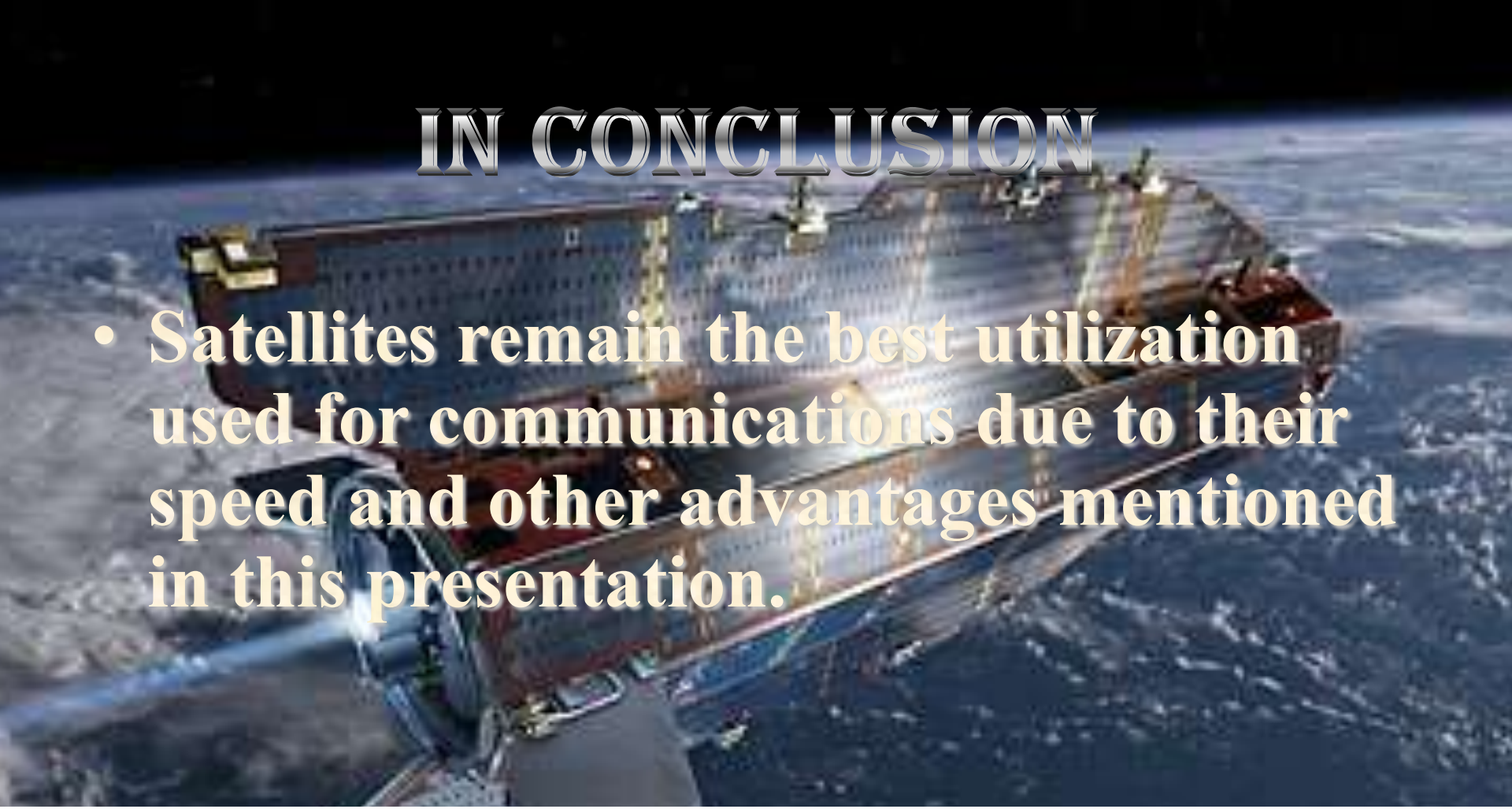
- **Military**
  - Uses geostationary satellites.
  - Example: The Defense Satellite Communications System (DSCS).

Disadvantages

- The antenna noise due to energy
  - Unwanted radiation sources (stars – galaxies - …etc).
  - Worsen S/N ratio.
- Atmosphere behaves as a resistive medium
  - Supplies noise power to the antenna.
- Meteors
  - Have to be programmed to avoid any rock or any harmful thing.
  - Rules of orbits.
- Expensive
  - only for governments or large organizations.

In Conclusion

- Satellites remain the best utilization used for communications due to their speed and other advantages mentioned in this presentation.



Thanks