



SATELLITE 101

Global Telecommunications
for
Non-Engineers

SATELLITES



- A satellite is any object that orbits or revolves around another object. The Moon is a satellite of Earth, and Earth is a satellite of the Sun.

A satellite with solar panels is shown in the upper left corner, orbiting above the Earth's horizon. The background is a dark space with red orbital lines and a bright red starburst light. The Earth's blue and white horizon is visible at the bottom left.

MAN-MADE SATELLITES



- Since 1957, hundreds of man-made satellites have been launched into orbit around the Earth. The vast majority of satellites currently in orbit are used for communications.



TYPES

- There are four main types of satellites:
- **Earth Remote Sensing** (identifying pollution, etc)
- **Weather** (storm tracking, etc)
- **Global Positioning** (navigation for aircraft, cars, etc)
- **Scientific Research** (climate change, etc)
- **Communications** (radio, TV, Internet, etc)

There are currently more than 100 communications satellites in orbit.



SATELLITE FLEET

- SES AMERICOM's parent company, SES GLOBAL, is the largest commercial satellite operator in the world. We currently have 42 communications satellites in orbit linked with an extensive network of teleports.





A dark blue world map is visible in the background, showing the continents. The map is centered on the Atlantic Ocean, with North and South America on the left and Europe and Africa on the right. The text is overlaid on this map.

TELEPORTS

SES AMERICOM's Teleport Network is one of the largest in the world. It links the West and East coasts of the United States with Central Europe through satellite and terrestrial fiber connections. Our Teleport Network has been in continuous evolution since 1965.



NETWORK

- Our network of satellites, teleports and terrestrial connections makes it possible for voice, data, video and Internet transmissions to be sent virtually anywhere in the world, reaching millions of people every day.
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POPULAR USES

- Broadcast (almost all Cable and TV/Radio network programming)
- Point-of-Sale and Multicast (credit card transactions, file transfers and training)
- Telephony (primarily where terrestrial wireline systems are expensive to deploy, like Alaska)



GROWING USES

- Broadband Internet and File Transfer
- Back-up to Terrestrial Fiber (to rerout fiber and central office failures in event of a catastrophe)



A composite image featuring a space shuttle launch on the left, a view of Earth's horizon at the bottom, and a red orbital diagram on the right. The shuttle is ascending with a large plume of fire. The Earth shows blue oceans and white clouds. The orbital diagram consists of several intersecting red lines forming elliptical paths, with a bright red starburst at one of the intersection points.

GETTING INTO ORBIT

The background of the slide is a composite image. On the left, a rocket is shown launching, with a bright white plume of fire and smoke. The rocket is angled upwards. In the bottom left corner, a curved horizon of the Earth is visible, showing blue oceans and white clouds. On the right side, there are several red, glowing lines that form a network or orbital path, with a bright red starburst at one of the intersections.

LAUNCH

- SES AMERICOM launches its satellites from:
- Kourou, French Guyana on Ariane 5 rockets
- Cape Canaveral, Florida on Atlas 2AS/5 rockets; smaller, lighter GEOs are also launched with Delta 2 rockets
- Biakonour Cosmodrome, Kazakhstan on Proton rockets
- Sea launches take place on the equator in the Pacific using Sea Launch rockets

ORBITS

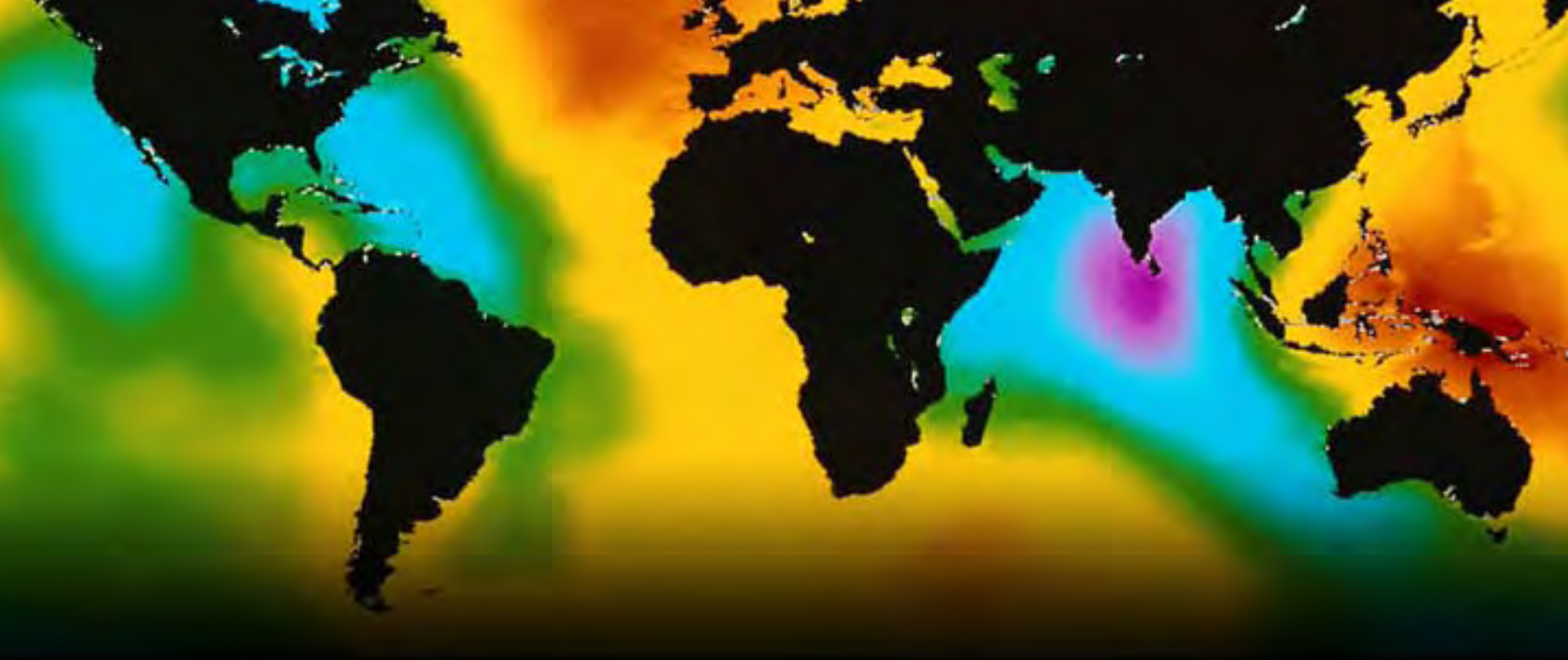
- There are two types of orbits: circular and elliptical.
- Circular orbits include geosynchronous (GEO), polar, sun-synchronous and equatorial.
- Elliptical orbits have many different shapes and sizes.
- Communications satellites are almost always in GEO orbits.

GEOSYNCHRONOUS ORBITS

- Geosynchronous (or geostationary) satellites orbit at 22,300 miles above the Earth's equator.
- GEO satellites move at the same speed as the Earth (6,879 miles per hour) so they can stay permanently over one spot.

DEPLOYMENT

- A satellite enters orbit about 40 minutes after launch.
- The satellite must be stabilized before it unfolds its panels and starts testing it's equipment and systems.
- Stabilizing a satellite is called attitude control. Satellites often use spinning gyroscopes to keep them stable.



HOW A SATELLITE WORKS



SATELLITE COMMUNICATIONS

- Communications satellites act as relay stations in the sky. Because GEO satellites are 22,300 miles above the earth, transmission signals can be “bounced” off one (or more) satellites to almost anywhere on Earth.



FOOTPRINTS

- The very broad area that the satellite can "see" from its orbit is called a "footprint." This is the satellite's direct service delivery area where electronic transmissions can be received and sent.
- A geosynchronous satellite is ideal for communications because its footprint is constant and covers a very wide area


The background of the slide is a composite image. In the top left, a satellite with solar panels is shown against a black background. In the bottom left, a curved horizon of the Earth with blue oceans and white clouds is visible. In the bottom right, a large satellite dish antenna is silhouetted against a bright orange and yellow sky, with red lines representing signal paths connecting it to a satellite in the upper right.

RELAYING SIGNALS

- The communications satellite:
 - Receives signals from Earth station
 - Changes frequency of signal
 - Amplifies sound
 - Retransmits signal to Earth station





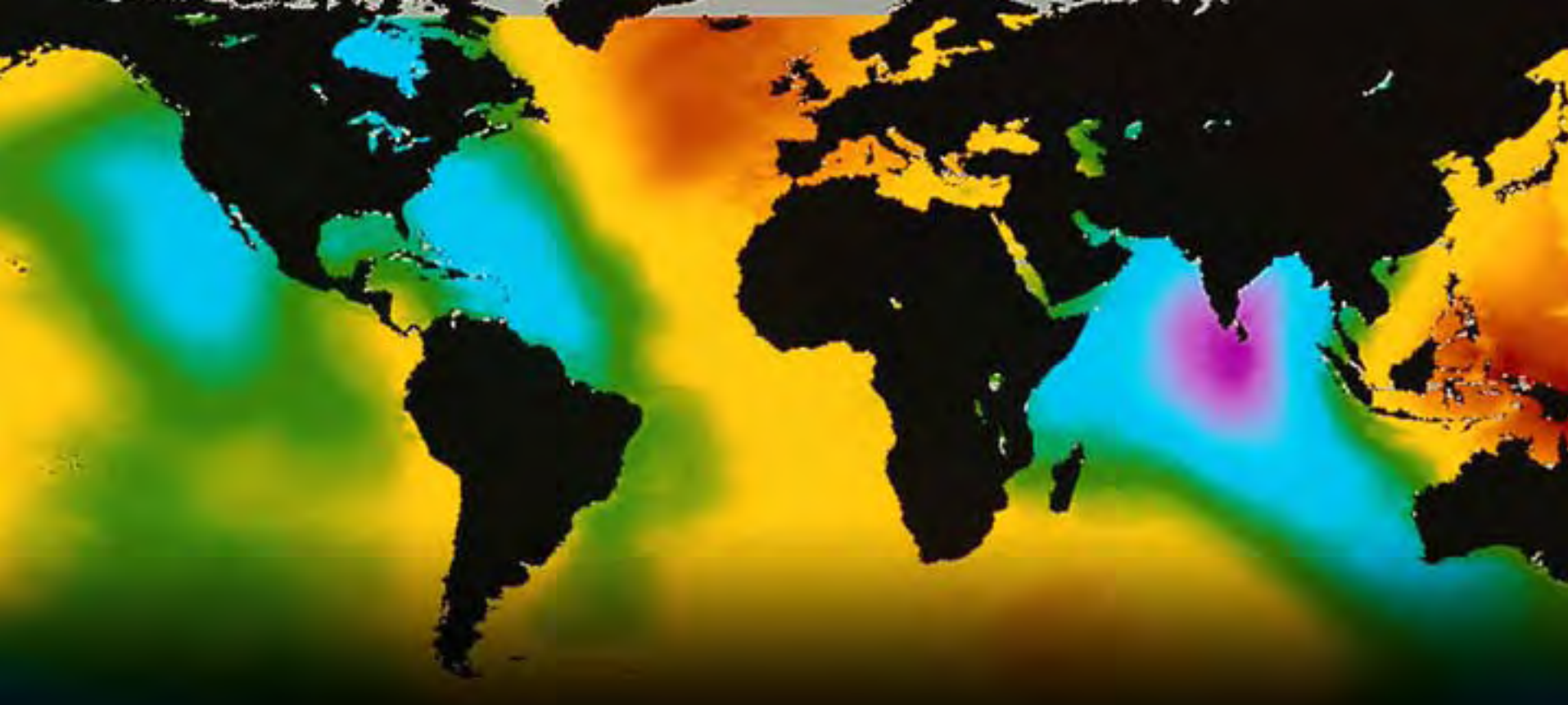
UPLINK/DOWNLINK

- Uplink is the term used to describe signals directed at satellites from earth stations.
 - Downlink is the term used to describe signals redirected by satellites to earth stations.
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STATIONKEEPING

- Stationkeeping is the name for the controls the satellite uses to stay in a fixed orbit by counterbalancing the gravitational effects of the sun, the moon and the Earth itself. Uncorrected, the orbit will 'decay' over time.
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POWER CONTOURS

- The strength of transmitted signals is represented by contours superimposed on the area of the Earth covered.



BEAMS

There are two types of signals relayed by satellite:
Spot Beams and Wide-Area Beams.

Spot Beams are optimal for local content:

- Broadband point-to-point bandwidth on demand
- Regional multicast

Wide-area (broadcast) Beams are for:

- Broadcast to large geographical area
- Full connectivity within large geographical area





INSIDE SATELLITES



PAYLOAD AND BUS

- **Payload** is all the equipment and electronics in the satellite that are involved in receiving and retransmitting TV or telephone signals to Earth.
- The **bus** is the part of the satellite that carries the payload and all its equipment into space. It holds all the satellite's parts together and provides electrical power, computers, and propulsion to the spacecraft.



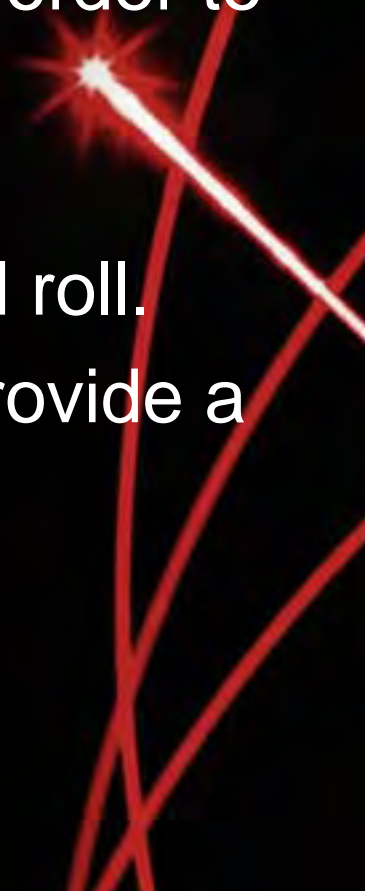
COMPUTER

- The 'brain' of a satellite is a computer program called Telemetry Tracking and Control (TT&C).
- It logs every activity of the satellite, receives information from the ground station, and takes care of all "housekeeping" the satellite needs to do.



ATTITUDE CONTROL

- Satellites need to adjust their position in order to maintain their performance in orbit.
- Gyros are used to maintain stability.
- Bias Coils are used to regulate pitch and roll.
- Earth, sun or star sensors are used to provide a frame of reference.





TRANSPONDERS

There are typically 24 transponder channels on satellites, each one 36 MHz in bandwidth.

A transponder is an instrument used on communications satellites that receives a signal from a station on Earth at one frequency, amplifies it, and retransmits it on a new frequency.



ANTENNAS

- All satellites receive and send communications using some type of antenna.
- Since the information is transmitted using radio waves, which move at the speed of light, this method allows for very fast communications (and with very small time lags)



Satellite 102

Some links to learn
more about satellites:

www.americom.com

www.nasa.gov

www.jpl.nasa.com

www.spaceweather.com