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### **1. Introduction to the course**

Satellites are a key part of our daily lives. Usually we don't necessarily pay any attention to them. But without them, our lives would be very different. They affect us from the moment an alarm clock wakes us up until we go back to bed in the evening. Satellites connect people in different ways. They help us communicate, navigate, timing, travel, understand the weather and nature, and even allow us to look far into space. Without satellites our lives would be very different. Technical and scientific progress would be very undeveloped. In this course you will learn how satellites affect our lives. What types of satellites there are and what kind of devices they use.

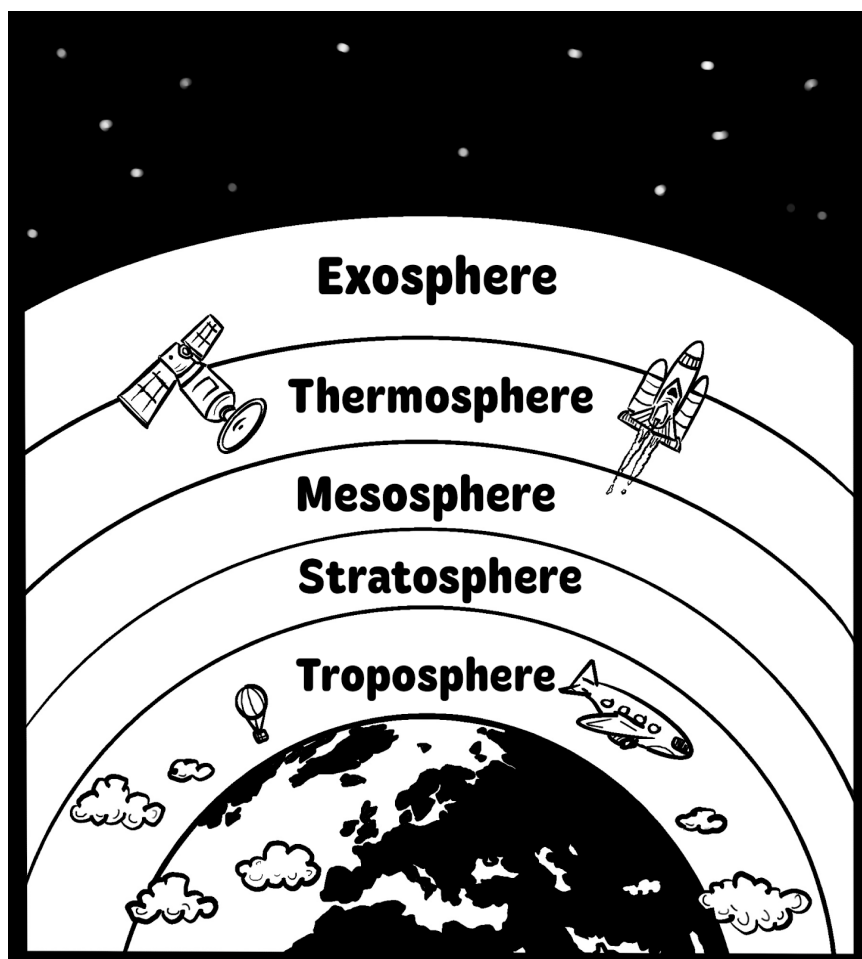
### **2. Satellites on the atmosphere**

#### **Satellites orbit the earth**

The atmosphere is the blanket of gases which surrounds Earth. Atmosphere is held in place by the gravity of the earth's mass. Earth is the only planet in the solar system with an atmosphere that can sustain life. Earth's atmosphere layers are Troposphere, Stratosphere, Mesosphere, Thermosphere and exosphere. Most of the satellites are placed in the Thermosphere. The thermosphere extends from about 90 km to between 500 and 1,000 km above the sea level, so Thermosphere is sometimes considered to be a part of space. Some of the satellites operate also in the Exosphere.

The satellite is launched into the Thermosphere by a carrier rocket. This rocket transports the satellite to a specific orbit, from where the satellite continues its journey to its final orbit with its propulsion engines. There satellites motion is handled naturally thanks to the Earth's Gravitational Field. The body of the satellite has measuring devices. The surface of the satellite has solar panels that provide the satellite with the energy it needs to operate its devices. Some satellites can even be powered by a small nuclear battery.

The satellites orbit the earth in the thermosphere because there is almost no friction slowing down the speed of the satellite. Air density is very low, so there is almost no air resistance. A satellite in a certain orbit does not need an engine to maintain motion. Propulsion engines are only needed to get to that orbit. The thermosphere is burning hot during the day but very cold at night. Humans cannot be in the Thermosphere's extreme conditions, but satellites can. This is where most satellites orbit Earth. The satellites are used for a variety of purposes to help us in our everyday life. Satellites send global positioning data (GPS), radio and TV signals, and even weather measurements back to Earth.



*pictured: layers of the atmosphere. In the troposphere, most of what we see in the sky happens.*

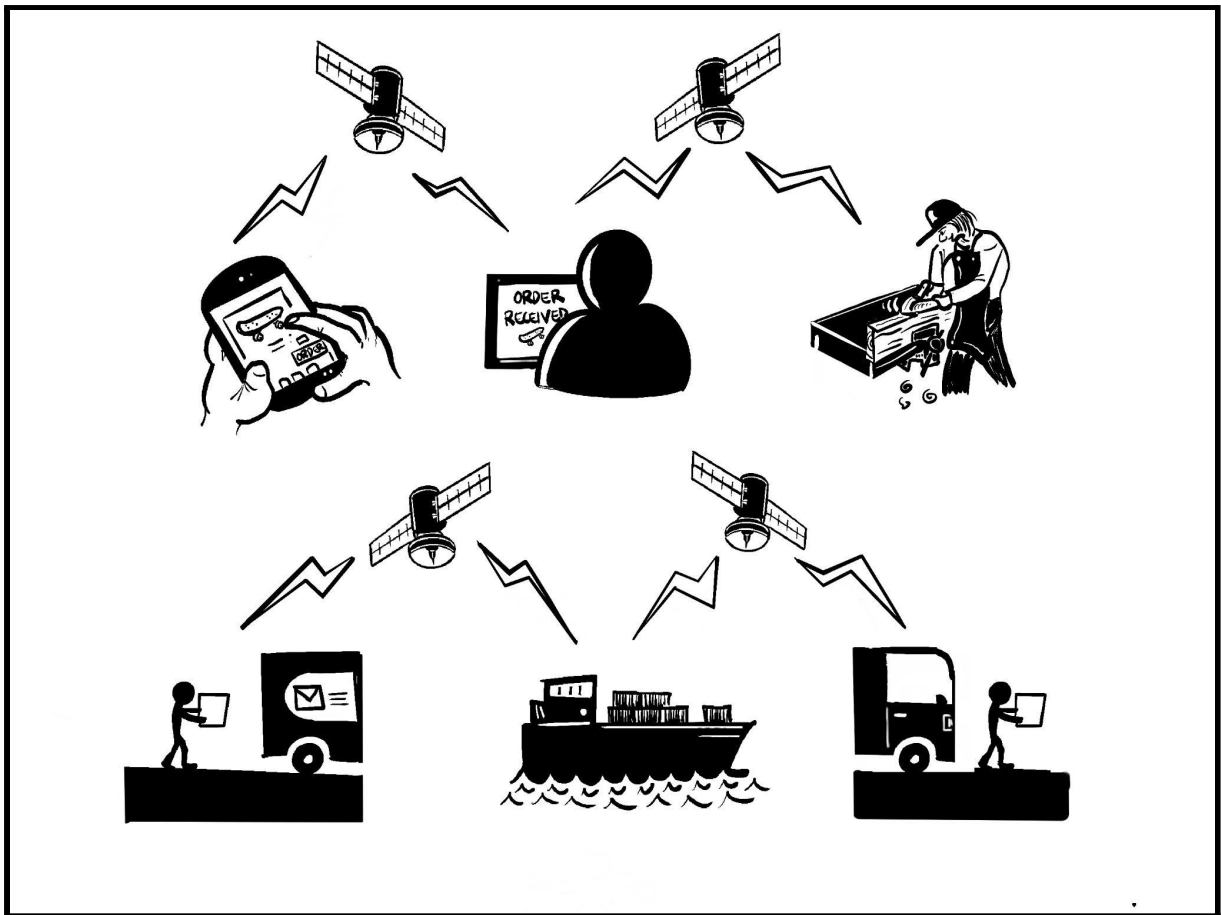
### **3. There are different devices on the satellites**

Satellites use various devices, which are meant to work in different ways. They take photographs and record videos and sound. Satellites transmit data in various formats. Without satellites it would be very hard to watch live sports events happening on the other side of the world or it would be impossible to make a video call to a relative living far away. Some of the devices measure the sun's rays reflected from the earth or the heat radiation from the earth. Some instruments send radio pulses or light pulses to the ground and measure the reflection back from the earth's surface or clouds. Some carry living organisms in it and analyze them. The way that satellites affect our life is huge. If all of the satellites would go off, then societies would go confused in hours.

#### **Satellite navigation systems**

Satellite tracking is often the first thing that comes to mind about a phone tracking service or car GPS tracking. In these cases, the phone or auto-transmit will share the location information with the satellites that route the information to the ground station. At the station, the data is collected, modified and transmitted back to the users. Then the user is placed on the digital map. Users can be provided with information on, for example, traffic jams or roadworks. Those machines working on roadworks also get help from satellites. The 3D modeling of the road made by the engineer is transmitted via satellites to the work machines, so that they know how to work in the right place in the right way. Urban pipelines will also be placed using accurate satellite positioning. In the case of a pipeline rupture, it can be repaired as quickly as possible.

Navigation systems are also used in other traffic, such as airplanes and airports. At sea, ships also rely on satellite positioning. When traveling by public transport, satellite systems organize vehicle trips so that as many passengers as possible can travel smoothly. Satellites are very helpful in this kind of logistical tasks. It is the same way with cargo. If you order something over the Internet, computer algorithms make the models using satellite data. Entrepreneurs can use models to calculate when your order is ready to be picked up, even if the order is made on a different continent and the goods are transported by numerous different transport companies. If the order encounters logistical surprises that delay delivery. Satellites provide data on alternative routes for transportation. Based on them, computers calculate the most efficient new route.



*pictured: satellites control the online ordering of the skateboard at every stage.*

Satellites help people if they need help from the emergency services. If a man gets lost on a hiking trip. His phone gives the coordinates of his location to emergency services. The rescue service checks which rescue unit is closest to the location of the missing person. They will send the unit best suited for the site assignment. The traffic lights are connected to each other and also to the rescue facility by means of satellites so that the traffic lights stop other traffic and allow the ambulance to continue moving with the green lights. If a traffic jam occurs that prevents the ambulance from continuing its journey, the rescue service will receive information from the satellites and will be able to send a rescue helicopter instead of an ambulance.

### **Time information from satellites**

satellites are very accurate in time data. They are able to report the exact time in nanoseconds. One nanosecond is a millionth of a second. This service is used by mobile phone base stations, which synchronize with each other using time information systems. Energy business uses time

information data in the energy network. It ensures that there is enough electricity everywhere so you can charge your phone in a warm heated home.

### **Remote sensing satellites**

Scientists and environmentalists are using data from satellites. They can monitor changes in natural conditions, such as eutrophication of the seas, pollution, thinning of the Arctic ice and forest fires in the wilderness.

Tractors on the farms navigate by satellites. Farmers get knowledge of the soil of the fields, like the need to add more nutrients or even grain growth measurements by using remote sensing satellites. It is the most effective way to get the best possible growth for grain.

## **4. Types of satellites**

### **Communications satellite**

Communications satellites relay and amplify radio telecommunication signals. It creates a communication channel between a source transmitter and a receiver at different locations on Earth. Communications satellites transmit radio and television signals. They are used by telephone, internet and military applications.

### **Weather satellites**

Weather satellites monitor the changes in weather and climate. They help meteorologists forecast the weather. Today, the main source of information for making weather forecasts is satellites. Photographs taken by satellites are the most important instrument for predicting near-term weather. Photos help aeroplanes to plan their routes.

### **Bio satellites**

Bio satellites carry small lifeforms in space. There they can research how they cope there. Biosatellites carry small life forms such as microorganisms, plants, or even human tissue into space.

There, satellites analyze how plants and microorganisms survive and change under space conditions.

### **Space telescope**

A space telescope works like a terrestrial observatory, but it is a device in outer space. A space telescope is used to study distant planets, galaxies, stars, and other space objects. They have little effect on our daily lives other than observing distant comets and capturing beautiful shots of distant galaxies.

### **Spy satellites**

Some of the satellites are made to spy on and collect secret information. These satellites are called spy satellites. They are usually administered by the intelligence services.