
 Marmara University, 2021

Wireless and Mobile Networks


Subject 14
Satellite Networks

Mujdat Soyuturk, Ph.D.
Associate Professor


 Contents


- Satellite Network
- Satellite Orbits
- Channel Access Methods for Satellite Communications
- Satellite Services

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 INTRODUCTION


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 Introduction




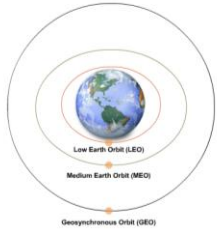
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 Introduction



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 Introduction



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SATELLITE NETWORK

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Satellites



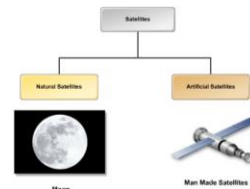
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Satellites



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Satellites



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Satellites



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Artificial Satellite Types

Satellite Type	Description
Communication satellites	
Navigational satellites	
Reconnaissance satellites	
Weather satellites	
Earth observation satellites	
Space stations	

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Artificial Satellite Types



Satellite Type	Description
Communication satellites	Used to provide cellular services and services to satellite phones. They act as a radio relay station that reflects electromagnetic signals. A communication satellite receives signals from a transmission station on earth, amplifies them, and re-transmits them to a different location on earth.
Navigation satellites	
Reconnaissance satellites	
Weather satellites	
Earth observation satellites	
Space stations	

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Artificial Satellite Types



Satellite Type	Description
Communication satellites	Used in GPS systems to determine the exact coordinates of a place, person, or location. They also help to find the routes to a specific destination.
Navigation satellites	
Reconnaissance satellites	
Weather satellites	
Earth observation satellites	
Space stations	

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Artificial Satellite Types



Satellite Type	Description
Communication satellites	Used by the military and intelligence departments to collect information about any military activity of a foreign country. Some examples of reconnaissance satellites are early warning satellites that detect any missile launches, nuclear explosion detection satellites that detect a nuclear explosion, and photo surveillance satellites that provide photos of military activities of a foreign country.
Navigation satellites	
Reconnaissance satellites	
Weather satellites	
Earth observation satellites	
Space stations	

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Artificial Satellite Types



Satellite Type	Description
Communication satellites	Provide scientific data to meteorologists to predict and monitor the weather and climatic conditions.
Navigation satellites	
Reconnaissance satellites	
Weather satellites	
Earth observation satellites	
Space stations	

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Artificial Satellite Types



Satellite Type	Description
Communication satellites	Used to monitor the earth, make maps, and also gather information on the earth's ecosystem.
Navigation satellites	
Reconnaissance satellites	
Weather satellites	
Earth observation satellites	
Space stations	

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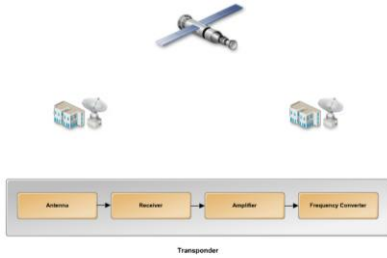
Artificial Satellite Types



Satellite Type	Description
Communication satellites	Structures for people to live in outer space.
Navigation satellites	
Reconnaissance satellites	
Weather satellites	
Earth observation satellites	
Space stations	

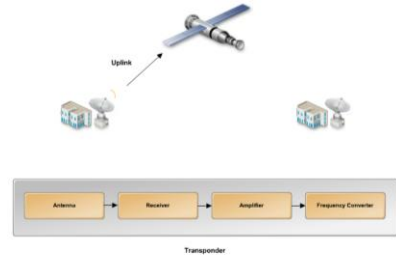
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Transponders



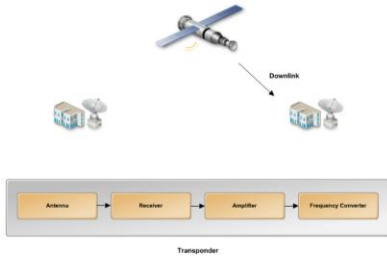
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Transponders



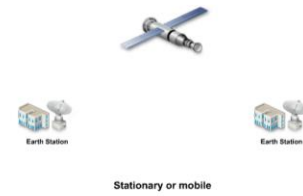
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Transponders



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Ground Stations



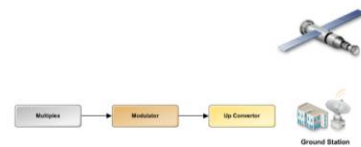
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Ground Stations



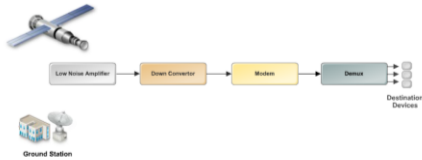
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Ground Stations



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Ground Stations



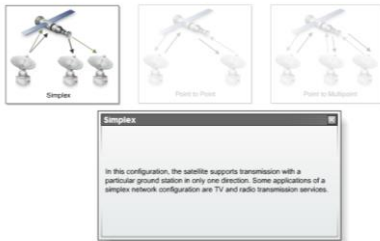
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Satellite Network Configurations



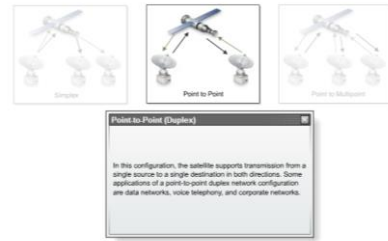
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Satellite Network Configurations



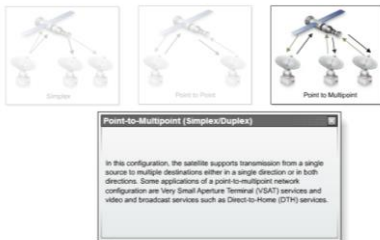
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Satellite Network Configurations



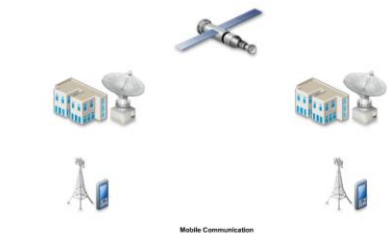
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Satellite Network Configurations



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Advantages of Satellite Networks



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Advantages of Satellite Networks



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Advantages of Satellite Networks



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Advantages of Satellite Networks



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Advantages of Satellite Networks



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Advantages of Satellite Networks



Provides scalability

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Advantages of Satellite Networks



Bandwidth

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SATELLITE ORBITS

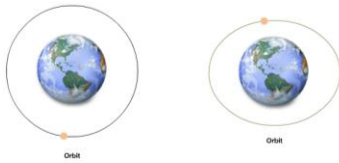
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Orbits



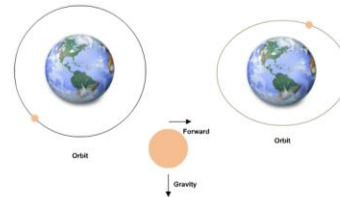
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Orbits



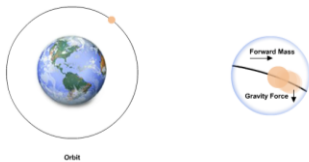
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Orbits



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Orbits



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Orbits



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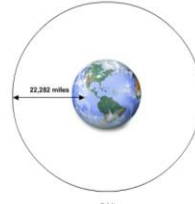
Geosynchronous Orbit (GEO)



Geosynchronous Orbit

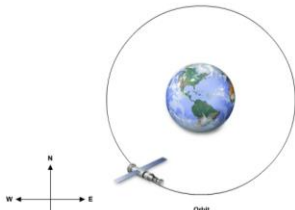
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Geosynchronous Orbit (GEO)



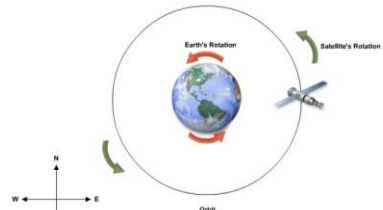
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Geosynchronous Orbit (GEO)



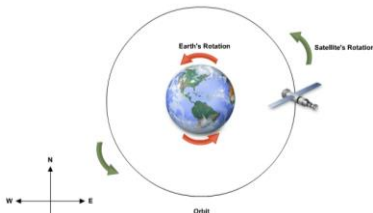
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Geosynchronous Orbit (GEO)



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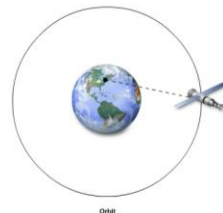
Geosynchronous Orbit (GEO)



23 hours, 56 minutes, and 4 seconds

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Geosynchronous Orbit (GEO)



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Geosynchronous Orbit (GEO)



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Geosynchronous Orbit (GEO)



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Geosynchronous Orbit (GEO)



Except for the polar regions

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Geosynchronous Orbit (GEO)



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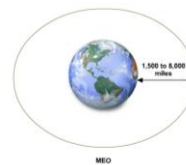
Medium Earth Orbit (MEO)



Medium Earth Orbit

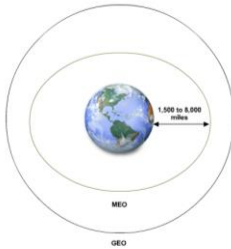
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Medium Earth Orbit (MEO)



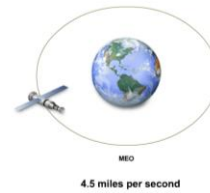
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Medium Earth Orbit (MEO)



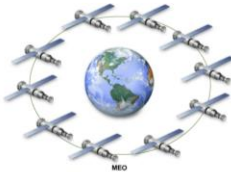
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Medium Earth Orbit (MEO)



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Medium Earth Orbit (MEO)



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Medium Earth Orbit (MEO)



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Medium Earth Orbit (MEO)



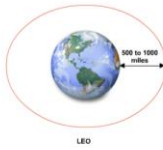
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Low Earth Orbit (LEO)



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Low Earth Orbit (LEO)



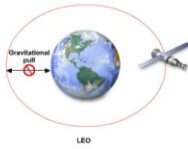
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Low Earth Orbit (LEO)



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Low Earth Orbit (LEO)



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Low Earth Orbit (LEO)



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Low Earth Orbit (LEO)



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Low Earth Orbit (LEO)



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Low Earth Orbit (LEO)



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Low Earth Orbit (LEO)



LEO

Very little or no delay

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Polar Orbits



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Polar Orbits



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Polar Orbits



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Polar Orbits



4.5 miles per second

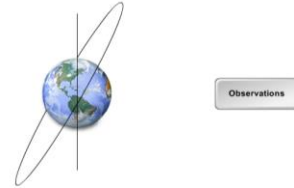
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Polar Orbits



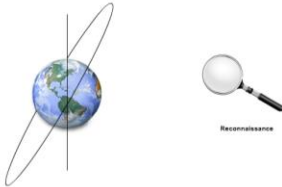
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Polar Orbits



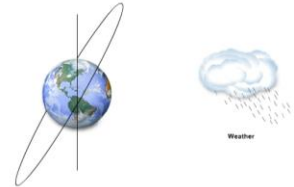
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Polar Orbits



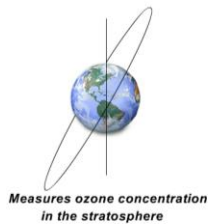
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Polar Orbits



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Polar Orbits



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Polar Orbits



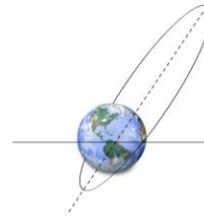
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Polar Orbits



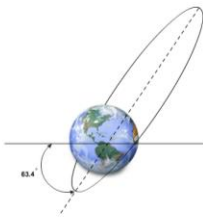
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Molniya Orbits



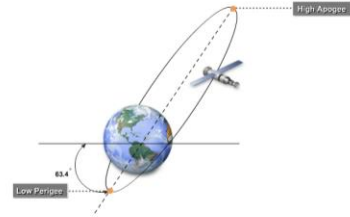
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Molniya Orbits



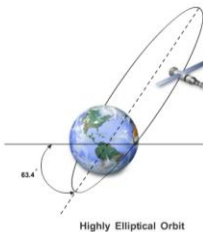
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Molniya Orbits



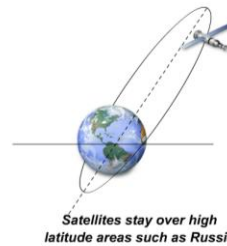
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Molniya Orbits



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Molniya Orbits



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Molniya Orbits



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CHANNEL ACCESS METHODS FOR SATELLITE COMMUNICATIONS

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Satellite Frequency Bands

Satellite Frequency Band	Description
C	
Ku	
Ka	

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Satellite Frequency Bands

Satellite Frequency Band	Description
C	Occupies the 4 GHz to 8 GHz frequency range. Since the C-band frequencies have large wavelengths, a larger satellite antenna is required for them. The antenna size ranges from 2 to 3 meters.
Ku	
Ka	

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Satellite Frequency Bands

Satellite Frequency Band	Description
C	Occupies the 11 GHz to 17 GHz frequency range. Since the Ku-band frequencies have smaller wavelengths than C-band, a smaller satellite antenna is required for them. The antenna size is about 18 inches in diameter.
Ku	
Ka	

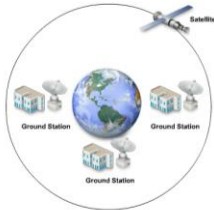
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Satellite Frequency Bands

Satellite Frequency Band	Description
C	It occupies the 20 GHz to 30 GHz frequency range. The Ka band frequencies are not very widely used in satellite communication.
Ku	
Ka	

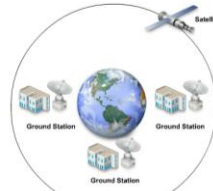
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Multiple Access Schemes



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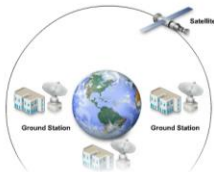
Multiple Access Schemes



Multiple access scheme

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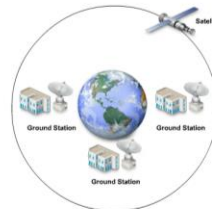
Multiple Access Schemes



This scheme determines the system capacity and the cost of satellite network

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Multiple Access Schemes



Channel 1
Channel 2
Channel 3
Bandwidth

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Multiple Access Schemes

Multiple Access Scheme	Description
Fixed assignment	
Random access	
Controlled access	

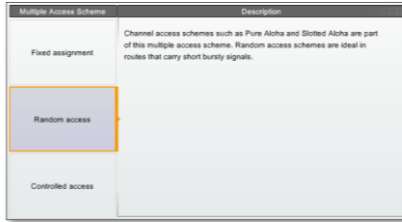
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Multiple Access Schemes

Multiple Access Scheme	Description
Fixed assignment	Channel access schemes such as FDMA, TDMA, and CDMA are part of this multiple access scheme. In this scheme, a fixed part of a resource such as frequency, time, or code is assigned to each earth station. This resource is shared by the earth station during transmission. Fixed assignment schemes are used in routes that carry large quantities of steady signals.
Random access	
Controlled access	

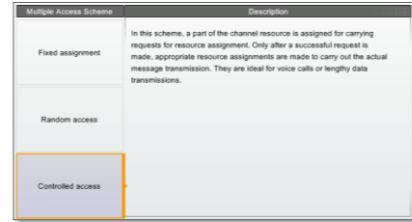
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Multiple Access Schemes



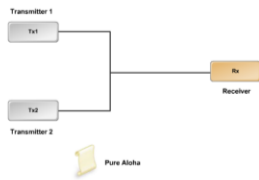
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Multiple Access Schemes



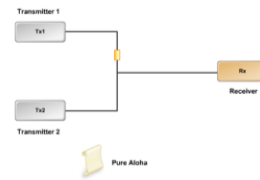
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Pure Aloha Protocol



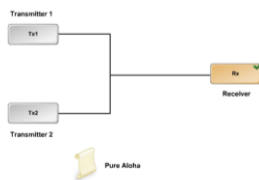
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Pure Aloha Protocol



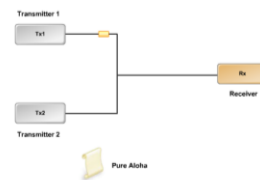
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Pure Aloha Protocol



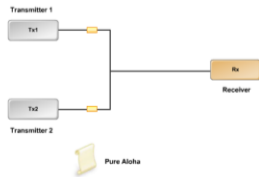
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Pure Aloha Protocol



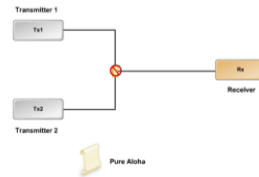
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Pure Aloha Protocol



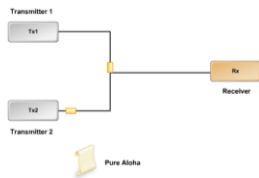
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Pure Aloha Protocol



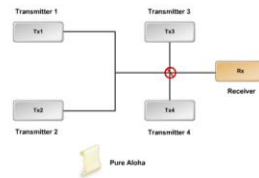
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Pure Aloha Protocol



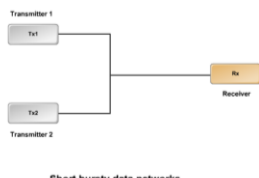
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Pure Aloha Protocol



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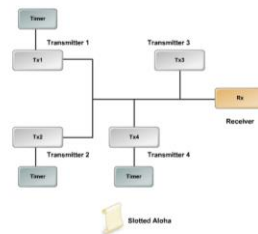
Pure Aloha Protocol



Short bursty data networks

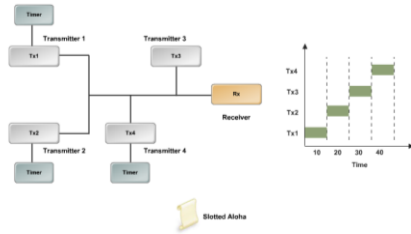
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Slotted Aloha Protocol



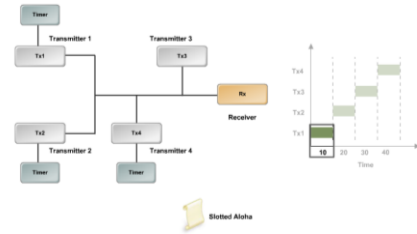
14 - 108 Mujdat Soyuturk, Wireless and Mobile Networks, Spring 2021, Marmara University

Slotted Aloha Protocol



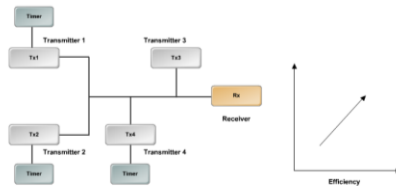
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Slotted Aloha Protocol



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Slotted Aloha Protocol



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SATELLITE SERVICES

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Satellite Internet



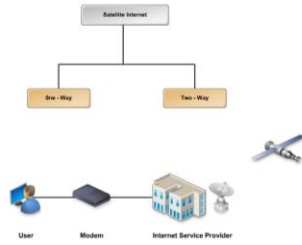
14 - 113 Muidat Soyuturk, Wireless and Mobile Networks, Spring 2021, Marmara University

Satellite Internet



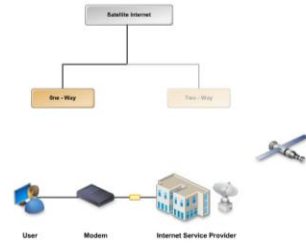
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Satellite Internet



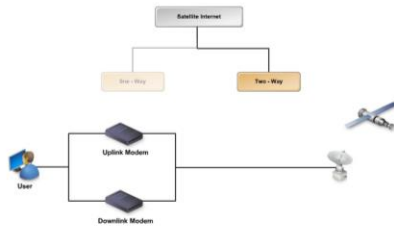
14 - 115 Mujdat Soyuturk, Wireless and Mobile Networks, Spring 2021, Marmara University

Satellite Internet



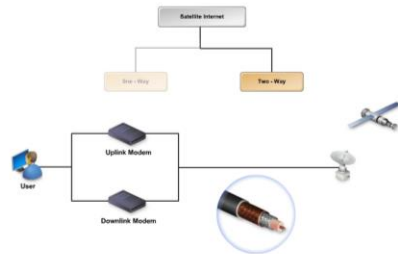
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Satellite Internet



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Satellite Internet



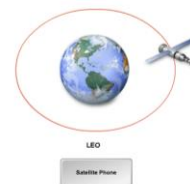
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Satellite Internet



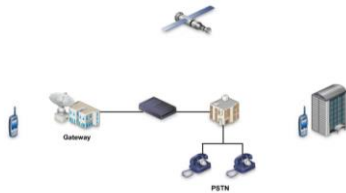
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Satellite Phone Network



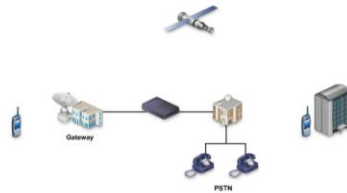
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Satellite Phone Network



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Satellite Phone Network



*Satellite phones work well
in open spaces*

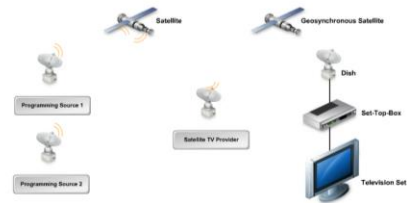
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Satellite Television



14 - 123 Mijdat Soyuturk, Wireless and Mobile Networks, Spring 2021, Marmara University

Satellite Television



14 - 124 Mijdat Soyuturk, Wireless and Mobile Networks, Spring 2021, Marmara University

Satellite Television



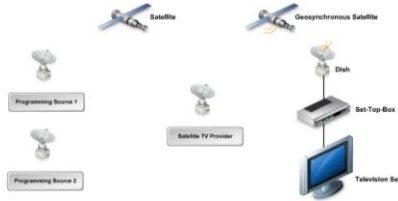
14 - 125 Mijdat Soyuturk, Wireless and Mobile Networks, Spring 2021, Marmara University

Satellite Television



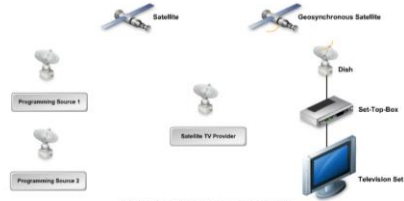
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Satellite Television



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Satellite Television



Satellite TV does not need a line-of-sight arrangement

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Very Small Aperture Terminal (VSAT) Technology



Very Small Aperture Terminal

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Very Small Aperture Terminal (VSAT) Technology



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Very Small Aperture Terminal (VSAT) Technology



1.2 to 2.4 meters

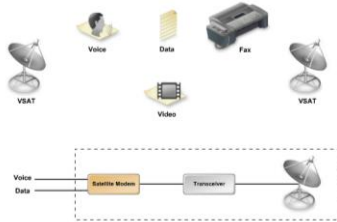
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Very Small Aperture Terminal (VSAT) Technology



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Very Small Aperture Terminal (VSAT) Technology



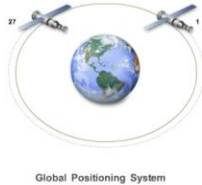
14 - 133 Mujdat Soyuturk, Wireless and Mobile Networks, Spring 2021, Marmara University

Very Small Aperture Terminal (VSAT) Technology



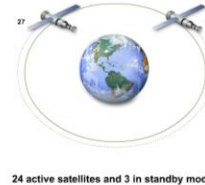
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Global Positioning System (GPS)



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Global Positioning System (GPS)



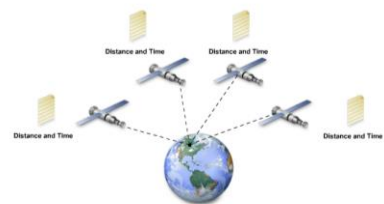
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Global Positioning System (GPS)



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Global Positioning System (GPS)



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Global Positioning System (GPS)



Needs an unobstructed view

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