



No. of questions : 5

|| Total Mark: 60 Marks

- ✓ Answer questions (1) and (2)
- ✓ Answer (Only) two questions of (3), (4), and (5)

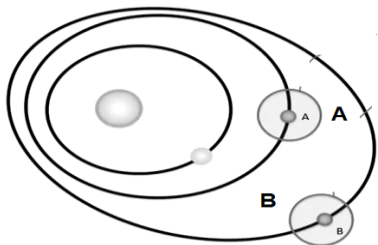
Question (1) (10 Marks)

Specify if the following statements are true or false (correct the false):

- a) The payload of the satellite system includes control mechanisms.
False, the payload is the actual user information conveyed through the system and doesn't include control mechanism
- b) Increase the gain of the antennas has no effect on the footprint of the satellite system.
False, increasing antenna gains improves the footprint
- c) Motorola's satellite-based mobile-telephone system (Iridium) is a GEO system utilizing a 66-satellite constellation orbiting approximately 770 Km above Earth's surface.
False, this is a LEO system
- d) The Ku band (designated as 14/12 GHz) can improve communication reliability while decreasing antenna size and cost compared to the C-band.
True
- e) Effective isotropic radiated power (EIRP) equals to the antenna input power times the receiving antenna gain.
False, times the transmit antenna gain

Question (2) (20 Marks)

- a) By using Kepler's Third law, find the periodic time of the orbit of satellite (B) in solar earth days, knowing that the semi-major axis of its orbit is 12 times of the earth radius while satellite (A) periodic time is 1.05 solar earth days and its orbit semi-major axis is 10 times of the earth radius as shown in Figure (1). (4 Marks)



Figure(1)

Answer

| | |
|---|--|
| <p style="text-align: center;">Solution (1)</p> $\left(\frac{P1}{P2}\right)^2 = \left(\frac{\alpha1}{\alpha2}\right)^3$ $\left(\frac{1.05}{P2}\right)^2 = \left(\frac{10 R}{12 R}\right)^3, P2 = 1.38$ | <p style="text-align: center;">Solution (2)</p> $\alpha1 = A(P1)^{2/3}$ $A = \dots$ $\alpha2 = A(P2)^{2/3}$ $P2 = 1.38$ |
|---|--|

b) Suppose that the Earth's circumference at the equator is 40,075 km, and the earth rotate about its axis at a speed of 1675 km/h. Suppose also that we have a satellite rotating around earth at a speed of 3400 km/h. **(6 Marks)**

i. How long (exactly) does the Earth take to complete one full turn around its axis?

$$t = \frac{40075}{1675} = 23.93 \text{ hours}$$

ii. Is the satellite posigrade or retrograde? Why?

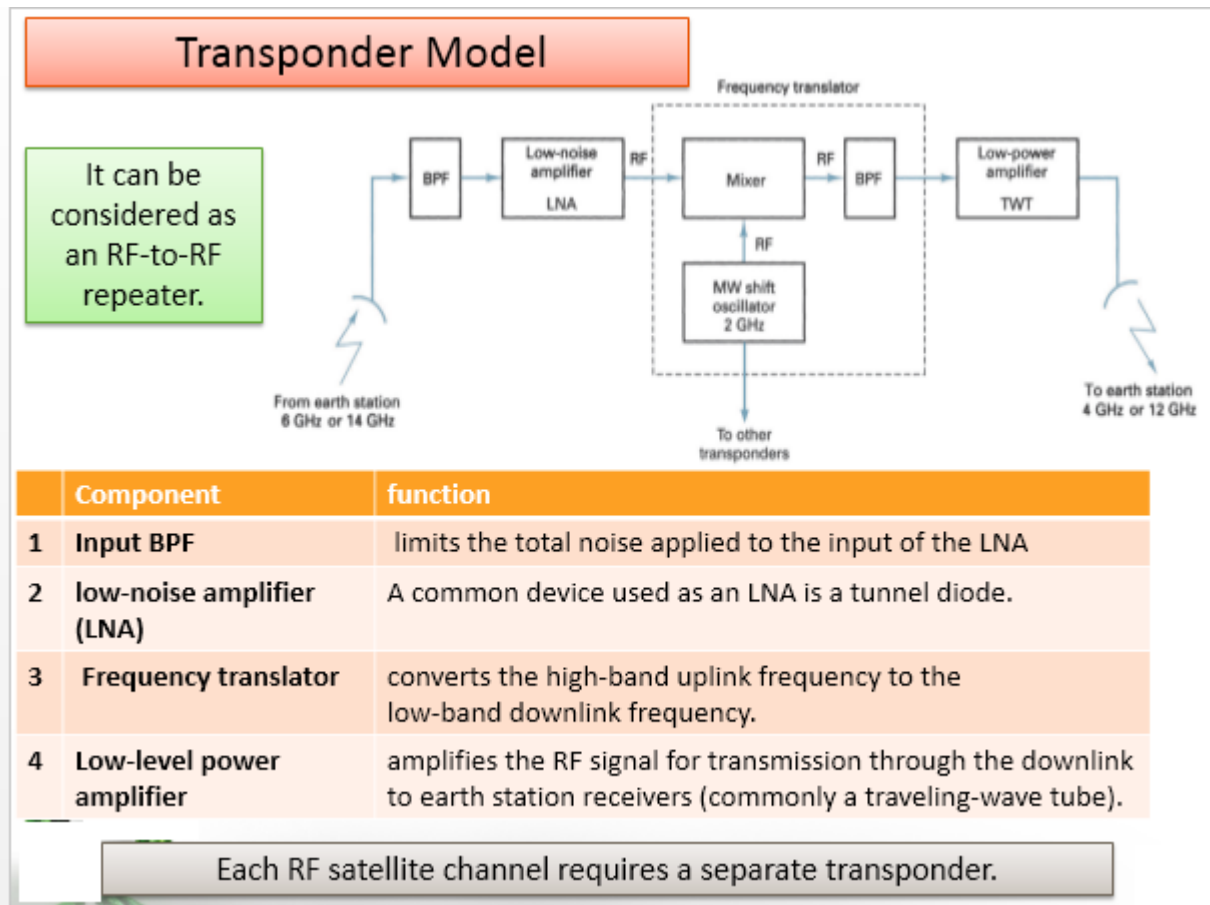
Posigrade as $\omega_{sat} > \omega_{earth}$

iii. How many times does this satellite pass by the same spot on the earth daily?

$$\text{number of times} = \frac{\omega_{sat}}{\omega_{earth}} = \frac{3400}{1675} = 2.029$$

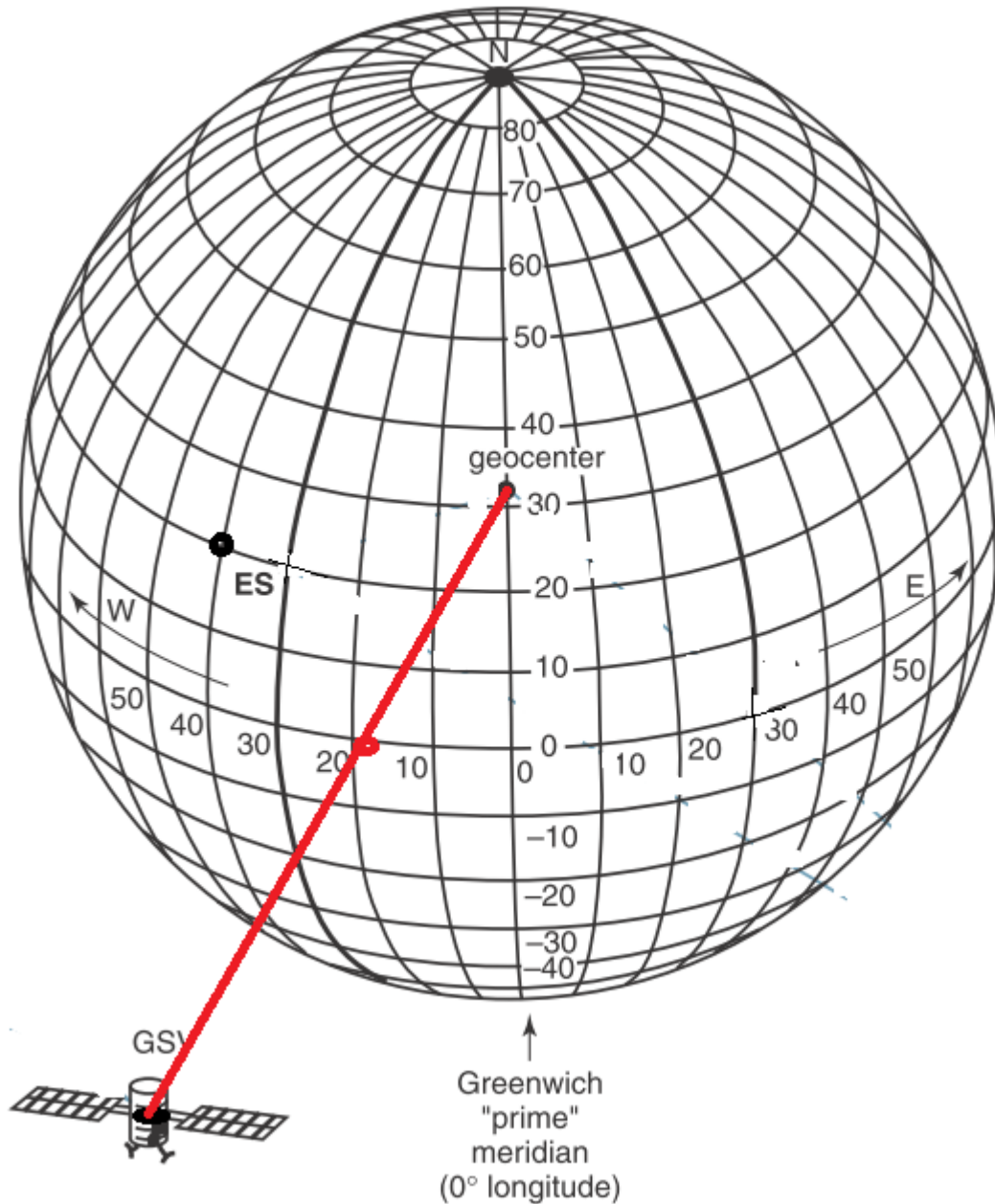
i. e. passes two times per day

c) Draw a block diagram of a satellite transponder explaining briefly the function of each block. **(5 Marks)**



d) Determine the coordinates of the SSP and the earth station of the geostationary satellite (GSV) using figure (2) (5 Marks)

- Connect the satellite center point to the geocenter and find the intersection with the equator which is the SSP.
- Its coordinates is (0, 18 W)
- Earth station coordinates is : (20N, 40W)



Select two questions only form (3), (4), and (5)

Question (3) (15 Marks): Software-Defined Networks (SDN)

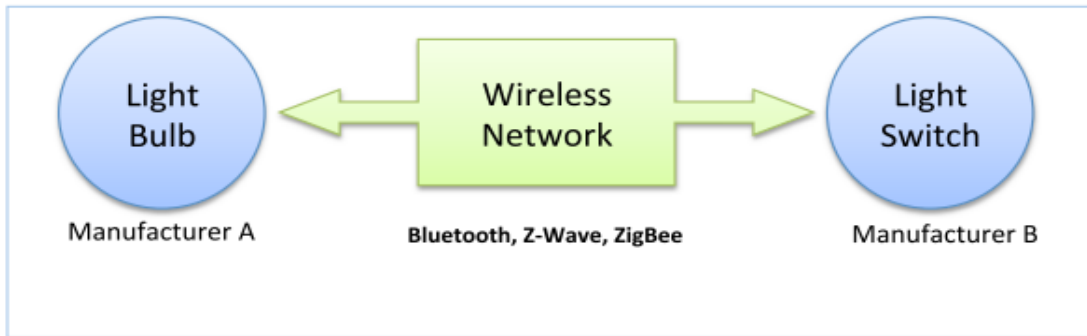
- a) Specify if the following statements are true or false (correct the false): **(6 Marks)**
- i. OpenFlow allows the modification of the flow tables of the switches, using by issuing commands from the routers.
False, command are issued from the controller
 - ii. Switches and routers are the main components of the control layer of SDN framework.
False, main components of the data layer
 - iii. NOX controller was is written in Java while the Floodlight is written in C++.
False, NOX is written in C++ and python while Floodlight is written in Java
- b) What is the benefits of using multiple controllers in SDN? **(3 Marks)**
The controller can be distributed and replicated (i.e. using multiple controllers) for fault tolerance and/or better performance
- c) What is the meaning of having '*' in all fields of the last row in the shown switch's flow table? **(3 Marks)**
This means that the packet represented by this entry is "unknown packet"
- d) What action is taken by the switch in question 3.c. **(3 Marks)**
The default behaviour of the switch when it receives an unknown packet is to forward it to the controller to take a decision about what to do with this packet.

Question (4) (15 Marks): Internet-of-Things (IoT)

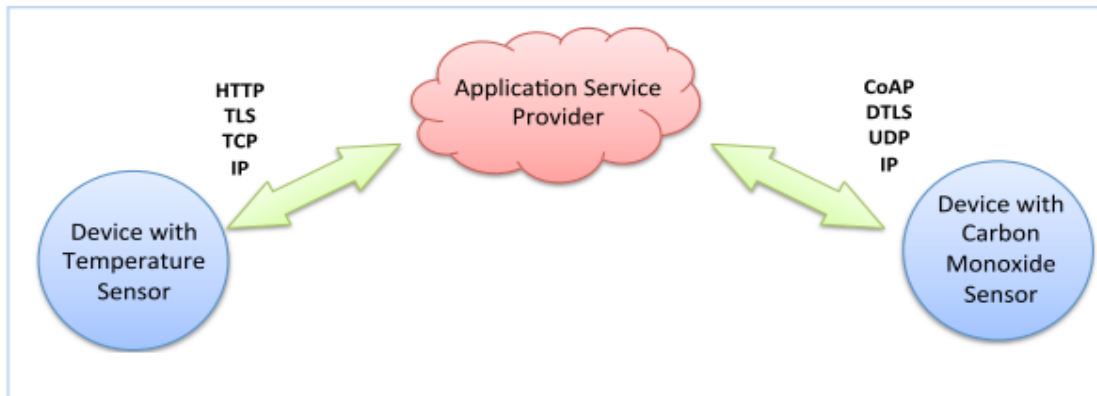
- a) Which of the following IoT communication models is most suitable for the applications in (I and ii), and why?
(Device-to-Device Communications, Device-to-Cloud Communications - Back-End Data-Sharing) **(6 Marks)**
- i. Producing IoT application that supports the user's desire for granting access to the uploaded sensor data from a cloud service in combination with data from other sources.
Back-End Data-Sharing, because this model supports sharing data from third-party
 - ii. Producing IoT application which typically use small data packets of information to communicate between devices with relatively low data rate requirements.
Device-to-Device Communications, This communication model is commonly used in applications like home automation systems with small number of sensors with small data packets

b) Draw the communication model of the three IoT communication models mentioned in question 4.a.

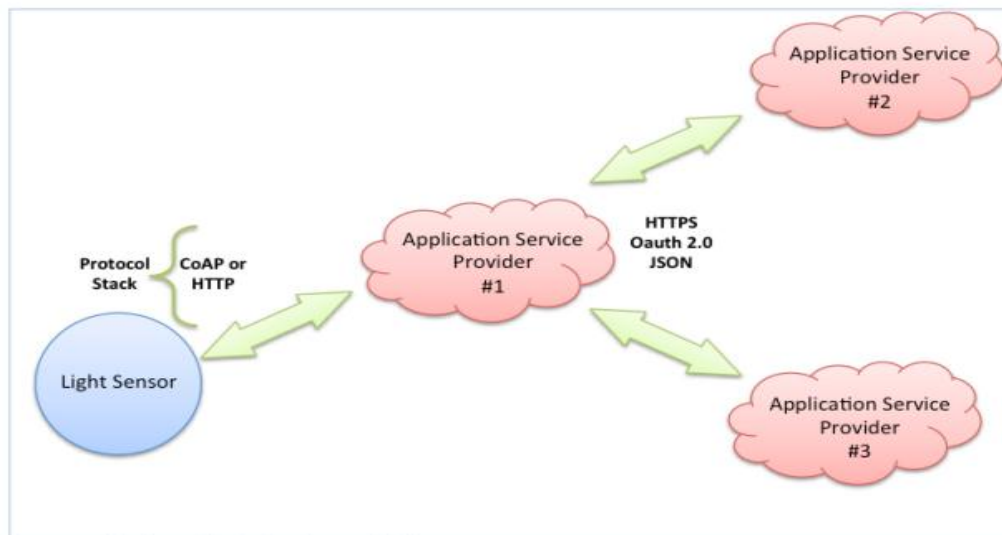
(6 Marks)



. Example of device-to-device communication model.



Device-to-cloud communication model diagram.



Back-end data sharing model diagram.

c) Explain briefly how the following point represents a security risks to IoT:

“Many IoT deployments will consist of collections of identical or near identical devices”

(3 Marks)

This homogeneity magnifies the potential impact of any single security vulnerability by the sheer number of devices that all have the same characteristics. For example, a communication protocol vulnerability of one company’s brand of Internet-enabled light bulbs might extend to every make and

model of device that uses that same protocol or which shares key design or manufacturing characteristics.

Question (5) (15 Marks): Device-to-Device Communications (D2D)

a) Explain briefly different communication modes for D2D communication.

(6 Marks)

Answer

(i) *Cellular*: All devices are in cellular mode.

(ii) *Force D2D*: D2D mode is always selected for all the communicating devices.

(iii) *Path-loss D2D*: D2D mode is selected if any of the path losses between a source device and its serving eNB, or a destination device and its serving eNB, is greater than the path loss in the direct link between the source node and the destination node.

b) Specify if the following statements are true or false (correct the false), and correct the false (6 Marks)

i. When one fraction of the total subchannels is occupied by cellular users while the other fraction is occupied by D2D users, this is called underlay D2D sharing.

False, this is an overlay D2D sharing

ii. In self-organized power control D2D network, The D2D users make power changes in a self-organized way according to a predefined SINR threshold in order to meet the QoS without affecting the cellular users.

True

iii. The D2D scenario that can be used to extend the coverage of the cellular network is called "group communication".

False, this is called multihop relay communication scenario

c) Uplink and downlink resources of cellular users could be shared with the D2D users. Which one (Uplink or downlink) is preferred to be shared knowing that the amount of downlink data of cellular users is much more the uplink data? Why?

(3 Marks)

Since the downlink requirements of cellular users are much more the uplink data requirement, it is better to share the uplink resources because sharing reduces the achievable rate because of the interference.

Best Wishes
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