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Subject :- Radar and Satellite communicatcon

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Q No 01.

(a) is There any difference between Backscatter and clutter. if yes then briefly discuss.

Ans:

Backscatter is the portion of the outgoing radar signal that the target redirects directly back towards the radar antenna. Backscattering is the process by which backscatter is formed. The scattering cross section in the direction toward the radar is called backscattering. Yes The normalized measure of the radar return from a distributed target is called backscatter. and if the signal formed by backscatter is undesired it is called clutter.

(b) Ans.

in telecommunication an interface is That which modifies a signal in a discriptive manner as it travel along a communication channel b/w its source and reciver.

Three types are

1) Radio frequency interferance:

This type of interferance is caused by radio frequency (RF) signal on or ~~not~~ near the frequency of the effected wireless reciver. The interfering signal might have been transmitted.

2) Electrical interferance:

Electrical interferance does not benefit anyone and its almost never intentional. with a few exception, the equipment causing electrical interferance problems was not intended to be source of RF Energy.

3) intermodulation:

intermodulation is intermod is a type of interferance somtimes encontured in wireless microphone system. intermodulation differ from other forms of interference is that it is created in the wireless system.

c) Range Resolution:

Range Resolution is the ability of a radar system to the distinguish between two are more target on the same bearing but at different ranges

The degree of range resolution depend on width of the transmitted pulse.

$$Sr = \frac{c_0 . P_w}{2} [m]$$

Radar system term constructed on the basis of the generalized detector for noise signal yield more high range resolution and radar range in compareision with modern raddar systems. These radar system are able to operate at very low signal-to-noise ratio at the input of receiver are highly tolerant of interference and very hard to detect themselves.

Q No 2: Calculate the following antenna parameter.

a) The gain in dBi of a 3 m parabolic reflector antenna of frequencies of 8 GHz and 14 GHz.

b) The effective are of an antenna with 46 dB gain at 12 GHz. An efficiency factor of 0.55 can be assumed.

Sol:

a) $d = 3\,m$

$f_1 = 8\,GHz$

$f_2 = 14\,GHz$

$$g = \eta_A \left(\frac{\pi d}{c/f} \right)^2$$

$$g = \eta_A \frac{\pi^2 f^2 d^2}{c^2}$$

$$= \frac{(3.14)^2}{(3 \times 10^8)^2} \times f^2 d^2 \eta_A$$

$$= \frac{9.8596}{9 \times 10^{16}} \times f^2 d^2 \eta_A$$

$$g = 109.55 \times f^2 d^2 \eta_A$$

to find Gain OB

$G = 10 \log (109.55 \times f^2 \times d^2 \eta_A)$

As we know $\eta_A = 0.55$, $d = 3m$

so for f_1

$G_1 = 10 \log (109.55 \times 8^2 \times 3^2 \times 0.55)$

$= 10 \log (34705.44)$

$G_1 = 45.40 dB_i$

for $f_2 = 14$ GHz

$G_2 = 10 \log (109.55 \times 14^2 \times 3^2 \times 0.55)$

$= 10 \log (106285.41)$

$G_2 = 50.26 dB_i$

Ans

$G = 10\log(109.66 \times 64 \times 9 \times 0.55)$

$G_r = 50.179\,dBi$

for f_2)

$G = 10\log(109.66 \times 14^2 \times 3^2 \times 0.55$

$= 10\log(109.66 \times 196 \times 9 \times 0.55$

$= 10\log(106392.13)$

$G_2 = 50.2\,dBi$

b)

find

$A_e = ?$

gain = 46 dBi

$f = 12\,GHz$

$\eta_A = 0.55$

we know from gain formula

$G = 10\log(109.66 \times f^2 \times d^2 \times \eta_A)$

$G = 10\log(109.66 \times 12^2 \times d^2 \times 0.55$

$46 = 10\log(8685.072 d^2)$

$46 = \log(8685.07 d^2)$

taking antilog both side

$$8685.072 d^2 = 10^{46}$$

$$d^2 = \frac{10^{46}}{8685.072}$$

$$d^2 = 4.5838$$

$$\boxed{d = 2.14 m}$$

we know $A_e = \eta_A$

where

$$A = \frac{\pi d^2}{4}$$

$$A = \frac{3.14 (2.14)^2}{4}$$

$$\boxed{A = 3.59 m^2}$$

So,

$$A_e = (0.55)(3.59)$$

$$\boxed{A_e = 1.977 m^2}$$

Q3: Determine the range and free space path loss, and downlink path loss for the following satellite.

The services and feeder links b/w an iradium satellite located 760km altitude and ground location with 70° elevation angle. The service link frequency is 1600 MHz and the feeder link frequencies are 29.2 GHz uplink and 19.5 GHz downlink.

Sols

$r = 760km$

Servic link freq = 1600 MHz = 1.6 GHz

feeder link freq UL = 29.9 GHz

feeder link freq DL = 19.5 GHz

find

$L_{FS} = ?$

$L_{FS(UL)} = ?$

$L_{FS(DL)} = ?$

We know that formula L_{FS} as

$L_{FS} = 20\log(f) + 20\log(r) + 92.44$

$= 20\log(1.6) + 20\log(760) + 92.44$

$= 4.0823 + 57.6162 + 92.44$

$L_{FS} = 154.1385\ dB$

$L_{FS(UL)} = L_{FS} + 20\log(f_u/f_s)$

$= 154.1385 + 20\log\left(\frac{29.24\ Gz}{1.6\ Gz}\right)$

$= 154.1385 + 20\log(18.275)$

$= 154.1385 + 25.23$

$L_{FS(UL)} = 179.3685\ dB$

$L_{FS(UL)} = L_{FS} + 20\log(f_d/f_s)$

$= 154.1385 + 20\log\left(\frac{19.5\ Gz}{1.6\ Gz}\right)$

$= 154.1385 + 21.718$

$L_{FS(DL)} = 175.8565$

Scanned with CamScanner

Q NO 4:

Sol: we have to find the transmitted power P_t; As we know for VSAT network.

$$\left(\frac{C}{N_o}\right) = \left[\frac{\eta_t \eta_r A_t A_r}{L_o k}\right] \frac{P_t}{\lambda^2 s^2 t_s} \quad \text{——} (1)$$

Given Data:

$\eta_t = 0.65$

$\eta_r = 0.55$

$r = 35900\,km$

$d_t = 3.2\,m$

$d_r = 1.2\,m$

$k = 1.39 \times 10^{-23}\,J/K$

$C/N_o = 55\,dBH$

$t_s = 400\,K$

$f = 12.25\,GHz$

$L_o = 1.2\,dB$

$$A_t = \frac{\pi d^2}{4}$$

$$= \frac{\pi (3.2)^2}{4}$$

$$= \frac{(3.14)(3.2)^2}{4}$$

$$A_t = 8.038\, m^2$$

$$A_r = \frac{\pi d_r^2}{4}$$

$$= \frac{\pi (1.2)^2}{4}$$

$$= \frac{3.14\,(1.2)^2}{4}$$

$$A_r = 1.13\,04\, m^2$$

Also

$$\lambda = c/f$$

$$= \frac{3 \times 10^8}{12.25 \times 10^9}$$

$$\lambda = 0.024 m$$

$$L_0 = 1.2\ dB$$

$$L_0 = 10^{1.2/10}$$

$$L_0 = 1.318$$

$$C/N_0 = 55\ dBHz$$

$C/N_o = 10^{5.5}$

$\frac{C}{N_o} = 316227.76$

from EV ①

P_t can be written as

$$P_t = [C/n_o] \frac{\lambda^2 r^2 t_s t_o k}{\eta_t \eta_r A_t A_r}$$

$$= \frac{316227.76 \times (0.024)^2 (35900)^2 \times 400 (1.318)(1.39 \times 10^{-23}}{(0.65)(0.55)(1.1304)(8038)}$$

$$\therefore P_t = 5.295 \times 10^{-10} W$$

Ans

DS!

Ans,

①

$E_{RP} = P_t \cdot G_t$

$= 2000000 \times 300$

$= 6000,000.000$

②

$\frac{P}{A_E} = \frac{P_T}{4\pi R^2 / G_{T}^2}$

: 350nmi Equals 648200

$A = 4\pi r^2$

$= 4 \times 3.14 (648200)$

$= 5.28 \times 10^{12}$

Raddar cross-section 10m²

$\frac{1}{3000} \times 5.28 \times 10^{12}$

$= 1760000000 m^2$

The total transmitted power

2000000

$= \frac{2000000}{1760000000}$

$= 0.001136\ w/m^2$

Direct formula of

$\frac{R}{AF} = \frac{2000000 \times 3000}{4(3.14)(648200)}$

$= 0.07962\ w/m^2$

3) $P_{rgt} = \frac{P_g G}{4\pi R_1^2} \quad \frac{1}{4\pi Re^2}$

$\frac{P}{AB} = P_{rg} \ast \frac{1}{4\pi Re^2}$

$= 0.001136 \times \frac{1}{4(3.14)(648200)}$

$= 2.153 \times 10^{-10}\ w/m^2$

(4) Effective area = 20 m²

power density of echo

$= 2.153 \times 10^{-16}$

$P_r = 2.153 \times 10^{-16} \times 20$

$= 4.36 \times 10^{-8}$ W

we can also write echo power as.

$$P_r = \frac{P_T G_T \sigma A_E}{(4\pi)^2 R^4}$$

Above the simplified version of rada Equation but it ignore all Losses

$$P_R = \frac{K_R \sigma}{R^4 L_A}$$

$$K_R = \frac{P_T G_T A_E}{(4\pi)^2 L_S}$$

$$K_R = \frac{P_T G_T^2 \lambda^2}{(4\pi)^3 L_S}$$

$$K_R = \frac{(2000000)(3000)(20)}{4(3.14)(1)}$$

$$K_R = 9.42 \times 10^{10}$$

$$P_R = \frac{K_R 6}{R^4 L_R}$$

$$= \frac{9.42 \times 10^{10} \times 3}{648200}$$

$$\boxed{= 4.69 \times 10^{-14}}$$ Ans

——— x ——— x ——— x.