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1. (a)

Unique across different people. You can score as long as it makes sense. Draw diagrams and write descriptions clearly

(b)
Average transmit power (PT) = (5+15)/2 Watts = 10 Watts

Average Received Power (PR) = $D \int_2^{12} PT\ D^{-3} dD$ = [-PT D^{-1}]$_2^{12}$ = 25/6

2. (a)
Throughput for:

S1 successfully transmits data to R1 when S2 and S3 don't transmit at the same time as S1. Therefore, S1's throughput = P1 (1-P2) (1-P3)

S2 successfully transmits data to R2 when S3 don't transmit at the same time as S2. Therefore, S2's throughput = P2 (1-P3)

S3 successfully transmits data to R3 when S4 and S2 don't transmit at the same time as S3. Therefore, S3's throughput = P3 (1-P4) (1-P2)

S4 successfully transmits data to R4 whenever it has data to send as S4 is not in range of any other transmitter and R4 is not within range of any transmitter, too. Therefore, throughput = P4

(b)
Let:
- B, C denote conditions where B and C are in active mode respectively
- B', C' denote conditions where B and C are in standby mode respectively

P(C will receive packet from A in 2 timeslots) = P(B C) [Probability that B is active at the first timeslot and C is active at the second timeslot] = PB * PC
P(C will receive packet from A in 3 timeslots) = P(B' B C) + P(B C' C) = (1-PB)*PB*PC + PB*(1-PC)*PC
P(C will receive packet from A in 4 timeslots) = P(B'B'B C) + P(B'B C'C) + P(B C'C'C) = $(1-PB)^2$ * PB * PC + (1-PB)*PB*(1-PC)*PC + PB*$(1-PC)^2$*PC

10

P(C will receive packet from A within 4 timeslots) = adding the 3 above = PB*PC [1+(1-PB)+(1-PC)+(1-PB)^2+(1-PB)*(1-PC)+(1-PC)^2]

(c)

- Proactive or Table-driven:
  - Topology information maintained by periodic exchange of routing information
  - Path finding is based on processing of already available information
- Reactive or on-demand:
  - No topology information maintained in advance
  - Find path as and when necessary
- Hybrid:
  - Combines best features of both
  - Uses topology information for nearby nodes (routing zone), for remote nodes use on-demand approach

3. (a)

(i)SIR = 10 log(($\sqrt{3N}$)^2/6)

N=1, SIR = 10 log(3/6) = -3dB

N=2, SIR = 10 log(9/6) = 1.76dB

N=3, SIR = 10 log(12/6) = 3dB

:

:

N=12, SIR = 10 log(36/6) = 7.78dB

Therefore, the number of channels/cell = 120/12 = 10

(ii)

D1/R1 = $\sqrt{3N1}$ D2/**R1** = $\sqrt{3N2}$

MicroCell uses 3 sectors, so SIR of microcell =($\sqrt{3N2}$ * R1/R2)^2/2

MacroCell uses normal system, so SIR of microcell = ($\sqrt{3N1}$)^2/6

Area of MicroCell = 0.5 Area of MacroCell

R2^2 = 0.5 R1^2

3dB higher means approximately double.

SIR MicroCell = 2 SIR MacroCell

$(D2/R2)^2/2 = 2\ (D1/R1)^2/6$

$(\sqrt{3N2} * R1/R2)^2/2 = 2 * (\sqrt{3N1})^2/6$

$3N2 * 2 /2 = 2 * 3N1/6$

$N2/N1 = 1/3$

N1 from 3a(i) is 12. Therefore N2 (cluster size of overlay cell) = 4

X * ½(area of underlay cell) * 12 + X * ½(area of overlay cell) * 4 = 120(total channels)

X = 15

Improvements = (15-12)/12 * 100% = 25%

(b)

(i) Cost = λ* σ * T * (cost of searching VLR) + 1/T * (cost of location update)

1.6 = 0.05 (2) (2) * T + 1/T * (3.2)

T=4

(ii) Cost = 0.2 T + 3.2/T
dCost/dT = 0

$0.2 – 3.2\ T^{-2} = 0$

T = 4

Therefore, optimal cost = 1.6

4. (a)

Pr,1(d1) = -29 log(d1)

Pr,2(d2) = -29 log(d2) = -29 log(2000-d1)

RSS:

Pr,2(d2) > Pr,1(d1)

-29 log(2000-d1) > -29 log(d1)

2000-d1 < d1

d1 > 1000 km

RSS+ Threshold of -90dBm:

For Pold < Threshold,

-90 > -29 log(d1)

d1 > 1268.96 km

RSS + hysteresis of 2dBm:

Pr,2(d2) – Pr,1(d1) > 2

-29 log(2000-d1) + 29 log(d1) >2

Log(d1/(2000-d1)) > 2/29

d1 > 1079.23 km

RSS+hysteresis+threshold: 1268.96 km

(b)

(i) Home agent encapsulated the IP Packet inside another IP header and Sends it to the care-of-address of mobile. An IP packet is received at the Home agent from a correspondent host for a mobile host. An encapsulated IP packet is received at the foreign agent (or at the mobile Itself for a collocated care-of-address). Receiver understands that the packet is IP-IP encapsulated by looking to the protocol field (which is 4). Receiver forwards (not routes) the decapsulated IP packet to the mobile node using link-level mechanisms.

(ii) Forward and reverse paths are different. This causes triangular routing. Path from correspondent hosts to mobile hosts may not be optimal: All packets have to go through home agent.

(iii) Let the correspondent hosts know the current mobility binding or just binding (home address -> care-of-address mapping) for mobile hosts.

– They will store this binding.

– They will use this binding to directly send the packets to the current location of the mobile.

– They will again use encapsulation since the care-of-address may not be always collocated at the mobile node (foreign agent should decapsulate).

– The encapsulated packets will go to the care-of-address directly without going through the home agent.

– Correspondent hosts should support the binding protocol: Need for modification at correspondent hosts.

Graduating soon ☺ ! I will no longer accept any discussions and corrections.
Thank you and all the best for your exams! ☺