University of BADJI MOKHTAR - Annaba
Faculty of technology
Computer Science Departement

Class : RSA 01

Tutorial n: 03 "Flow and Assignement problems"

Exercise 01

A regional Internet Service Provider (ISP) operates a backbone network connecting its central Data Center (DC) to three major metropolitan PoPs (Points of Presence) : A, B, and C, which in turn serve end-users. The ISP wants to know the maximum amount of data (in Gbps) it can push from the DC to all PoPs combined, given the capacity limits on each link.
In the table below, edges represent fiber links with their maximum capacity in Gbps and nodes represent routers/switches.

From → To	Capacity (Gbps)	From → To	Capacity (Gbps)
DC → R1	20	R2 → B	10
DC → R2	15	R3 → C	15
R1 → R2	5	R3 → R1	10
R1 → A	10	R3 → R2	5

1. Model the network as a flow graph and calculate the maximum amount of data (in Gbps) that ISP can push to the PoPs.
2. Which link is the network's bottleneck ?
3. If the ISP can upgrade only one link by +5 Gbps, which upgrade yields the largest increase in total throughput ? Explain.

Exercise 02

A corporate campus has four new user devices (UD 1–4) that must each associate with one of four available Wi-Fi Access Points (AP A–D). The goal is to minimize the total expected latency (in milliseconds) between devices and their assigned APs.
Below is the measured latency cost matrix (in ms) between each UD and each AP :

	AP A	AP B	AP C	AP D
UD 1	12	19	8	15
UD 2	14	7	11	12
UD 3	10	18	13	9
UD 4	16	8	12	11

1. How to connect each device to the Wi-Fi Access Points (AP) in order to minimize latency between devices and their APs ?
2. How would the assignment change if AP-B's latency to UD-3 dropped by 5 ms ? Recompute briefly.