Packet Scheduling

CS 7260

• Generalized Processor Sharing

Generalized Processor Sharing (GPS), also called Infinitesimal Round Robin algorithm, is a packet scheduling algorithm developed to decongest communication links of a network through bandwidth sharing. GPS is used as a benchmark against which realizable service disciplines can be measured, such as Packet-by-packet Generalized Processor Sharing (PGPS), also called Weighted Fair Queuing (WFQ).

The example from the previous lecture for packet scheduling that contained no packet delays works fine for PGPS but is insufficient to demonstrate GPS. Therefore, an improved example has been provided.

• Example

In the previous lecture, the example shown in fig. 1 was proposed for packet scheduling.

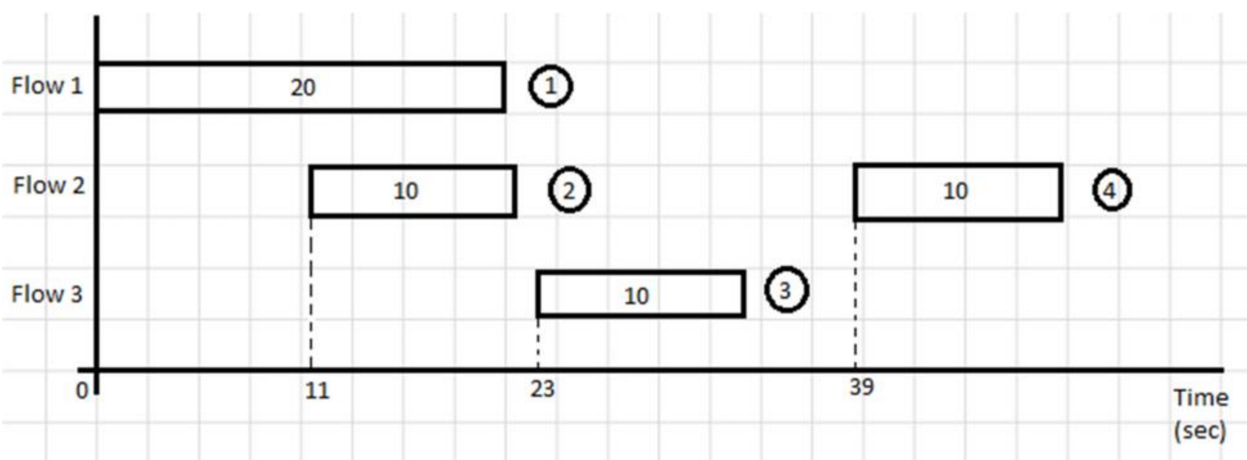

Fig. 1: Packet Scheduling (not GPS yet)

The example shows packets originating from three flows having equal weights (1 each). As proved in the previous lecture, by WFQ, the order of packet serving is as shown in the fig. 1:

1. Packet of flow 1 with execution time 20 sec arriving at time 0 sec (Packet no. 1)
2. Packet 1 of flow 2 with execution time 10 sec arriving at time 11 sec (Packet no. 2)
3. Packet of flow 3 with execution time 10 sec arriving at time 23 sec (Packet no. 3)
4. Packet 2 of flow 2 with execution time 10 sec arriving at time 39 sec (Packet no. 4)

Let us tweak the above example a notch to suit the GPS algorithm. In fig. 2, the modified example is shown with a few minor changes:

1. Weight of flow 3 has been doubled (i.e. time 10 sec= 5 sec * 2)
2. Time progresses, not in terms of seconds, but in terms of bits. A bit can correspond to 1 sec or n sec, depending on the number of flows executing in parallel

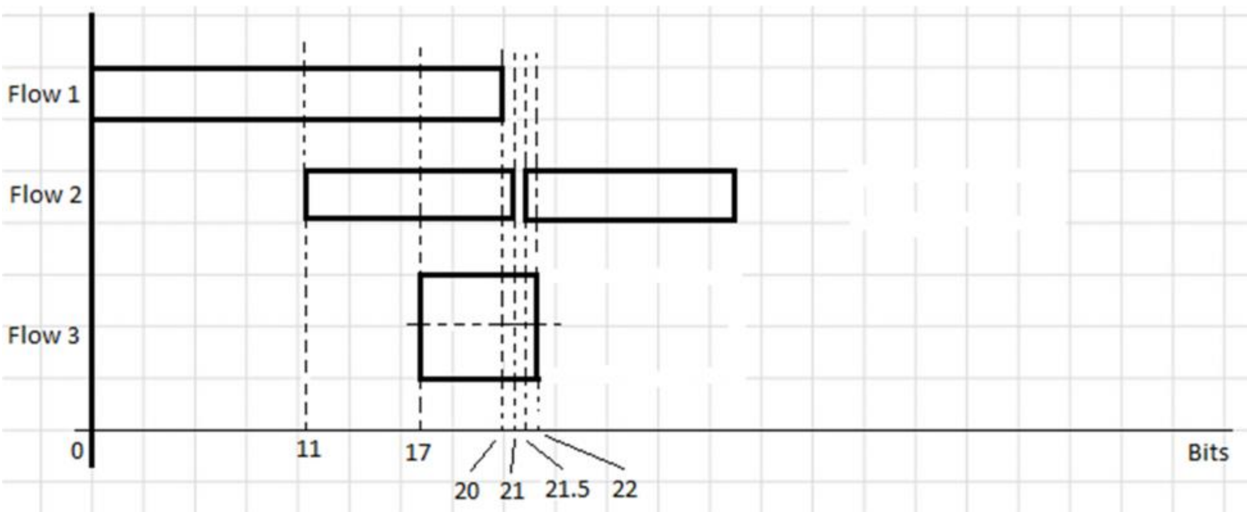

Fig. 2: Packet Scheduling (GPS)

GPS algorithm schedules the packets as described in table 1:

Packets Arrived	Time Slices (sec)				Cumulative Time (sec)	Bits Utilized
	Packet 1	Packet 2	Packet 3	Packet 4		
1	11	-	-	-	11	11
1, 2	6	6	-	-	11+12=23	11+6=17
1, 2, 3	3	3	3+3=6	-	23+12=35	17+3=20
1, 2, 3	-	1	1+1=2	-	35+3=38	20+1=21

1, 2, 3	-	-	0.5+0.5=1	-	38+1=39	21+0.5=21.5
1, 2, 3, 4	-	-	0.5+0.5=1	0.5	39+1.5=40.5	21.5+0.5=22
1, 2, 3, 4	-	-	-	9.5	40.5+9.5=50	22+9.5=31.5

Table 1: GPS Packet Scheduling

The time slices for packet 3 are calculated on the principle of Virtual Time, which will be covered at a later time. The GPS start and finish times are tabulated in table 2:

Packet no.	**GPS Start Time (sec)**	**GPS Finish Time (sec)**
1	0	35
2	11	38
3	23	40.5
4	39	49

Table 2: GPS Start and Finish Times

Select, among all packets **currently in queue**, the one with the **earliest GPS finish time**.

(Note: GPS finish time is dependent on the number of packets)