CS 7260 – Internet Architecture and Protocols (IAP)

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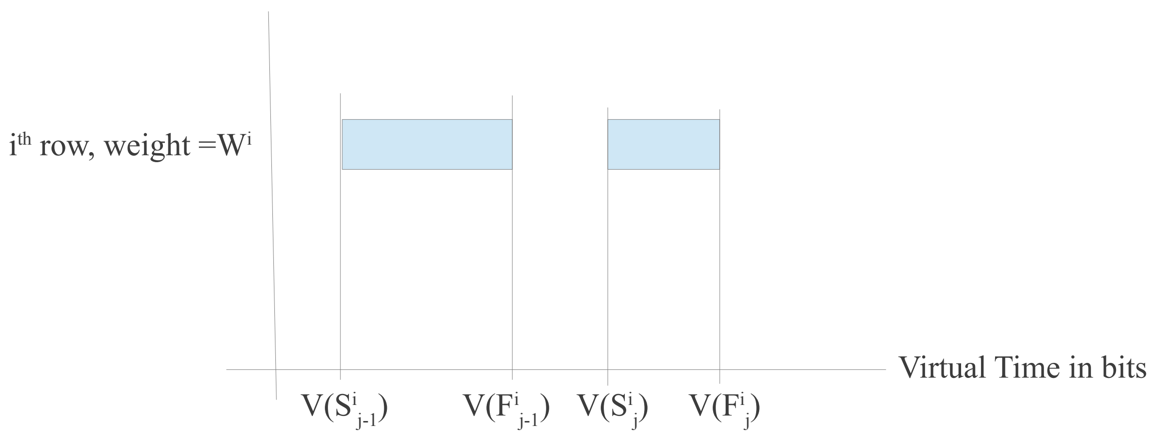
Generalized Processor Sharing (GPS) Packet Scheduling.

Every packet has a real start time and real finish time given as t with unit in seconds as well as virtual start time and virtual finish time given as V(t) with unit in bits.



Let F^i_j be the real finish time of jth packet in the ith row. $V(F^i_j)$ is virtual finish time of the same jth packet in the ith row.

A^i_j is real arrival time of the jth packet in the ith row. Similarly $V(A^i_j)$ is virtual arrival time of the same jth packet in the ith row.

S^i_j be the real start time of the jth packet in the ith row. $S(A^i_j)$ is virtual start time of the same jth packet in the ith row. Start time of a packet can be of a packet can be after its Arrival time.

L^i_j be the length of the jth packet in the ith row.

W^i is the weight of the packets in the ith row.

The Virtual start time of jth packet in ith row is given by:

$V(S^i_j) = \max \{ V(A^i_j), V(F^i_{j-1}) \}$ ----Eq 1

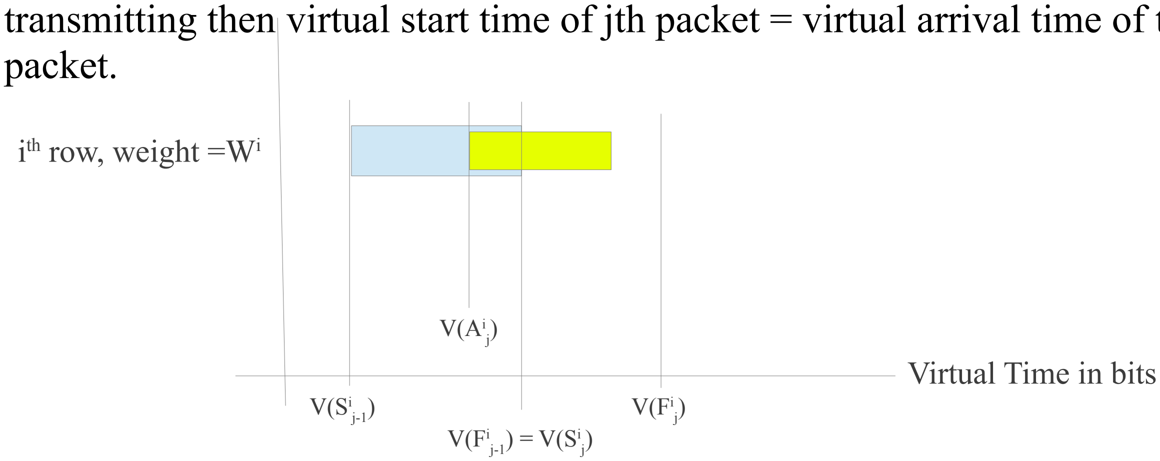
The packet j-1 and j are in the same ith row queue. j is the last packet which entered the queue and j-1 is the previous packet in the same ith row queue.

$V(F^i_{j-1})$ is the virtual finish time of the j-1 packet.

$V(A^i_j)$ is the virtual arrival time of the jth packet.

The above formula can be explained as below:

If the current packet j arrived after the previous packet j-1 has finished transmitting then virtual start time of jth packet = virtual arrival time of the jth packet.



From the figure above, If the current packet j arrived when the previous packet j-1 was still being transmitted then the current packet will be started only after the previous packet has finished transmitting. In this case virtual start time of jth packet = virtual finish time of the j-1 packet.

Note the difference between the terms virtual arrival time and virtual start time.

Calculation of Virtual Finish time of a packet:
$V(F^i_j)$ is virtual finish time of the same jth packet in the ith row is given by:

$$V(F^i_j) = V(S^i_j) + L^i_j/W^i \qquad \text{----Eq2}$$

virtual finish time of a packet = virtual start time of a packet + (length of the packet/weight)

$$V(F^i_j) = \max \{ V(A^i_j), V(F^i_{j-1}) \} + L^i_j/W^i \qquad \text{----Eq3}$$

Note: $V(F^i_{j-1})$ is the virtual finish time of the previous packet (j-1) in the ith row. Because of $V(F^i_{j-1})$ needs to be calculated to find $V(F^i_j)$, the above formula is a recursive formula.
The initial condition for the recursive function is V(0) = 0. i.e when the first packet enters the queue which is the beginning of the busy period after an idle period.

Note:
From Eq2, we can conclude that virtual finish time $V(F^i_j)$ of current transmitting packet can be calculated and fixed with only the current packet's virtual start time $V(S^i_j)$ and its length and weight even though its real finish time F^i_j can change

depending on another packet arriving before current packet has finished transmitting.

PGPS/WFQ rule:
Among all packets currently in queue, select the one with the earliest GPS finish time.

PGPS is a packetized variant of GPS scheduling. Hence at a time only 1 packet will be serviced into the output port unlike GPS where all current packets will be multiplexed into the output port. Hence in PGPS at the finish time of the every current packet, the next packet is chosen which has the earliest GPS finish time.