Exercice 1 : Principe de calcul utilisé par PCHAR :

Extrait de l'article : Using pathchar to estimate Internet link characteristics. Allen B Downey
Like traceroute, pathchar takes advantage of the time-to-live field (ttl) in an IP packet. The ttl determines how many links a packet can traverse before it expires. If a router receives a packet that has expired, it drops the packet and sends an ICMP error packet back to the sender. The source address of the error packet indicates which router the outgoing packet reached before expiring. By setting the ttl to a value n, it is possible to find the address of the nth router in the path. pathchar works by sending out a series of probes with varying values of n and varying packet sizes. For each probe it measures the time until the error packet is received. By performing statistical analysis of these measurements, pathchar infers the latency and bandwidth of each link in the path, the distribution of queue times, and the probability that a packet is dropped. The analysis is based on the network model in Figure 1.
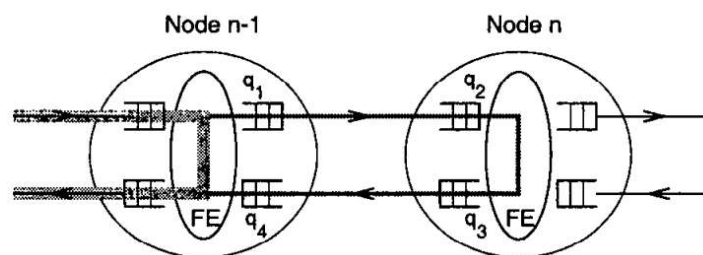

Figure 1: Network model.

Before a packet leaves the (n - 1)th node, it waits in queue to get onto the outgoing link. The time it spends on the network-transit is a linear function of the packet size, where the two parameters are the latency and bandwidth: *lat + size / bw*.

At node n, the packet waits in queue again until the router processes it and generates the error packet. The error packet waits in queue at node n, then returns to node n - 1 with transit time *lat + error_size/bw*, where *error_size* is the size of the ICMP error packet (56 bytes [5]).

Finally, it waits in queue at node n - 1. The round trip time (rtt) from the (n - 1)th to the nth node and back is:

rtt = q1 + (lat + packet_size/bw) + q2 + forward + q3 + (lat + error_size/bw) + q4 (1)

where the values *qi* are random variables representing the queue times and *forward* is the time it takes the forwarding engine to process the packet.

To simplify this expression pathchar makes three assumptions: (1) the size of the error packet is small enough that *error_size/bw* is negligible, (2) the forward time is negligible, and (3) if we make a large number of measurements of a given path, eventually one of the probes will make the round trip with negligible queue delays. Eliminating the negligible terms yields:

rtt = (lat + packet_size/bw) + lat

This equation is the basis of the analysis pathchar uses to estimate link characteristics.

1. Pathchar est un utilitaire de mesure passive ou de mesure active ?
2. De quels paramètres physiques le terme latency dépend-t-il ?
3. Rédigez une synthèse de cette article en français.
4. Quels sont les avantages de PathChar par rapport à iperf ?
5. Considérons un chemin entre une source et une destination composé de 4

routeurs. Expliquez comment pathchar détermine la BP du lien 3 (entre R2 et R3).