

Network performance, scalability & reliability

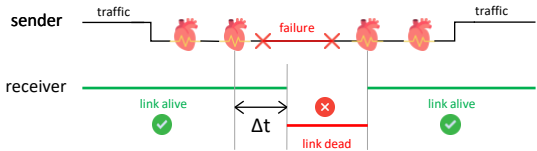
The 09_kahn way

Alkinoos Sarioglou, Elwin Stephan, Maša Nešić, Snow Man

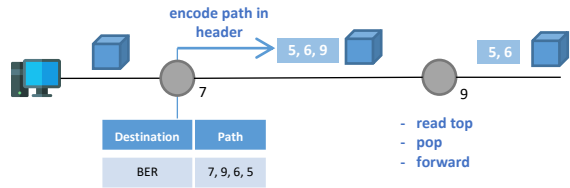


Failure detection

- Send heartbeats only if you're not sending regular traffic
- If you're not receiving any traffic → link is dead

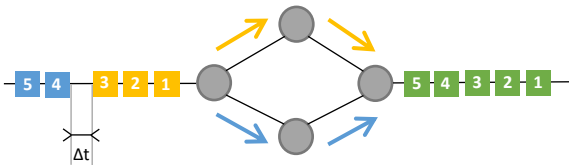


Static path encoding



- Reduces packet processing time in intermediate switches
- Only the source switch does a table lookup and encodes the entire path statically in the packet header

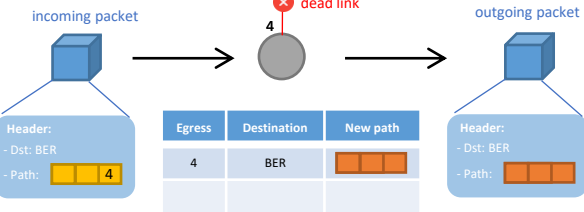
Flowlet-based routing for TCP



$$\Delta t = \text{avg}(\text{host_to_host_round_trip_time})$$

Fine-grained routing decisions **without packet reordering** at the destination

Fast rerouting

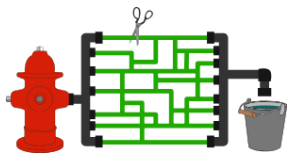


- Alternative path per (link, destination) pair
- Enables **fast sub-optimal convergence** within 100ms
- Once the controller updates forwarding details, optimal paths are used

Load balancing & traffic engineering

TCP

Per-flowlet



Max flow algorithm based on available **bandwidth** capacity

UDP

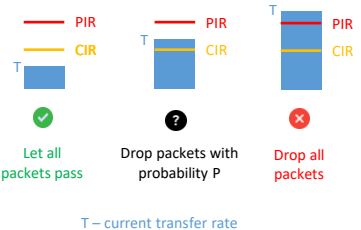
Per-packet

$P \{p_1, p_2, \dots, p_n\}$ Set of best paths

where $\text{delay}(p_n) \leq 1.5 * \text{delay}(p_1)$

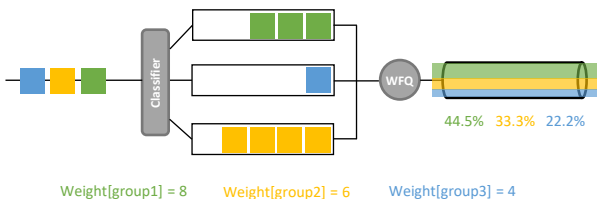
$$x_i = \frac{1}{\text{delay}(p_i)^3} \quad \text{probability}_i = \frac{x_i}{\sum_j x_j}$$

Minimizing overall delay by load balancing across several shortest paths



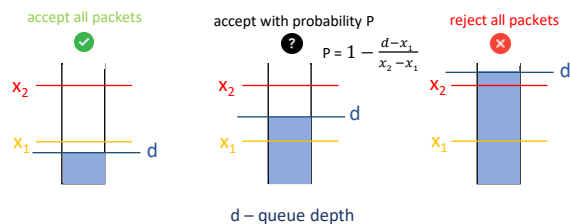
Prevent flow groups from taking monopoly over the link by **rate limiting**

Weighted fair queuing



- Prevents high-traffic flows from taking **monopoly** over links
- **Allows flow prioritization** by defining weights

Buffer acceptance – Random Early Detection



- Control TCP sending rate **preventively**, before the queue is filled
- **Prevents TCP flow synchronization**