Multihop wireless networks

Adhoc / fixed mesh.

Key issues: routing and forwarding

challenge: performance issues

broadcast ⇒ contention

losses

Mobility ⟶ not an issue in fixed mesh n/ws such as that discussed in the paper

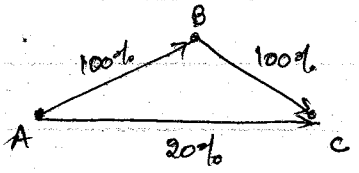
How to build good routing protocols

(I) try to get hop-by-hop routing similar to wired, but get the right metric

(II) Rethink routing from the ground up.

(I) ~~classic~~ What drives the design of the metric?

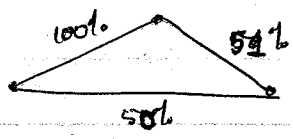
- hops ⇒ poor performance due to contention.
- many links are lossy.
- links are also asymmetric.



Options: (1) hop count is a bad idea

(2) Delivery ratio is not a great idea either.

└ need to account for link layer retransmissions and contention



A B B A B A B = 33%

A A A A = 50%

ETX = New metric

minimize total transmissions per packet

link throughput = $\frac{1}{\text{link ETX}}$

Pr (TX success) = Pr (Data) × Pr (Ack)

link ETX = $\frac{1}{\text{Pr (Tx success)}}$

Route ETX : (for short routes) = Sum of link ETX.

ETX metric can be combined with other routing protocols (e.g. DV) to compute end-to-end paths.

- Shown to improve performance of traditional approaches.

Probs: ① Abstracts radio link to look like a wire with a certain property / ability of delivery

② Identify a route, forward over links.

But radios are not wires.

- every packet is broadcast
- reception is probabilistic

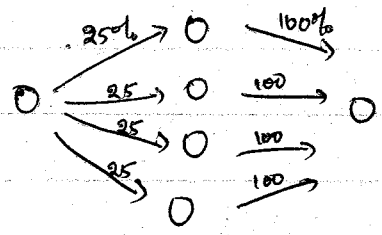
ExOR: ① exploit the opportunities that broadcast and probabilistic reception offer.

② Decide who gets to forward after reception

③ Goal: closest receiver should forward

Challenges: agree efficiently and avoid duplicate xmissions.

Why does EXOR improve throughput?

① 

Traditional routing

$\frac{1}{0.25} + 1 = 5$ TX.

EXOR

$\frac{1}{1-(1-0.25)^4} + 1 = 2.5$ TX.

② Exploit lucky long receptions or salvage unlucky receptions ⇒ thereby ensuring partial progress.

Protocol details:

① Batching for efficiency → Batch preparation
② Forwarder list- using ETX measurements.
③ Packet reception and Batch map update →
④ → gossip mechanisms carrying reception info from high priority nodes to low priority nodes
⑤ Scheduling transmissions.
Remember the last received fragment num.
use EWMA to update send rate.
Readjust timers to fire based on expected completion time.

Salient features:

① exploit any and all sending opportunities

② sending rate estimation facilitates fairness.

Issues:

- How often — use batches. and not per packet
- Who should participate - too many causes overhead to be high
- When to forward - schedule to avoid simultaneous xmission
- What to forward - avoid duplicate xmission.
- How and when does process complete - when left over of batch is small enough that overhead supercedes benefits.

Issues:

Static → no mobility is considered

ETX → works for short paths.

Applications → need batching → file download.

What about cross traffic. → hard to estimate xmission time of others?

ETX → costly, needs probing.

└ what about changes in ETX? Is this an issue?