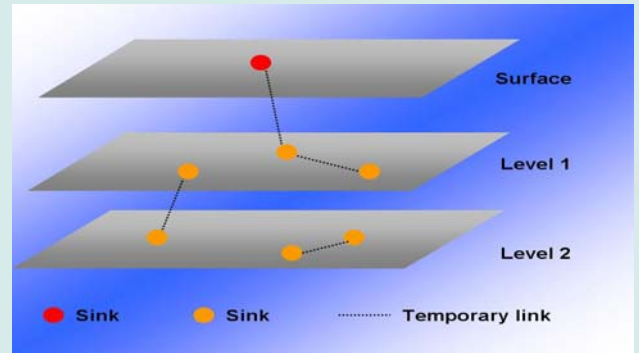


Adaptive Routing in Underwater Delay/Disruption Tolerant Networks

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Problem:

- Underwater DTN: expensive sensors, sparse deployment, strict battery, low bandwidth, limited buffer ...
- Multi-copy routing: flooding based or gossip based, minimizing delay but high energy consumption.
- Single-copy routing: no best reference for route selection, minimizing energy consumption but long delay.
- Our objective: Achieving a good tradeoff among delay, energy consumption and delivery ratio.



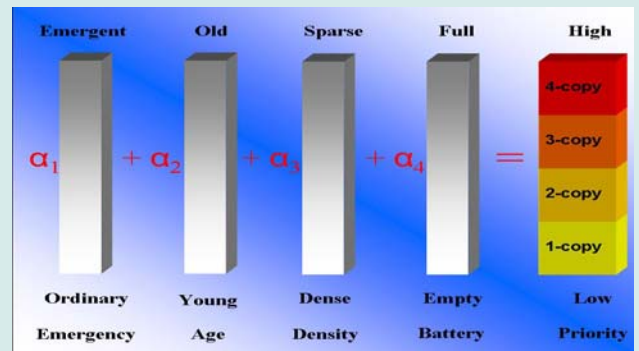
Proposed solution: Adaptive routing protocol for underwater sensor networks.

Main idea:

- Different packets with different priorities use different routing statuses.
- A routing spectrum with one extreme as single-copy forwarding and the other extreme as 4-copy forwarding.

Information vector and priority calculation:

- Packet properties: Emergency level (E), Age of packet (A).
- Relay properties: Spatial-temporal Density (D), Battery level (B).
- Priority $P = \alpha_1 E + \alpha_2 A + \alpha_3 D + \alpha_4 B$, where $\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 = 1$, and $\alpha_i \geq 0$, for $1 \leq i \leq 4$.

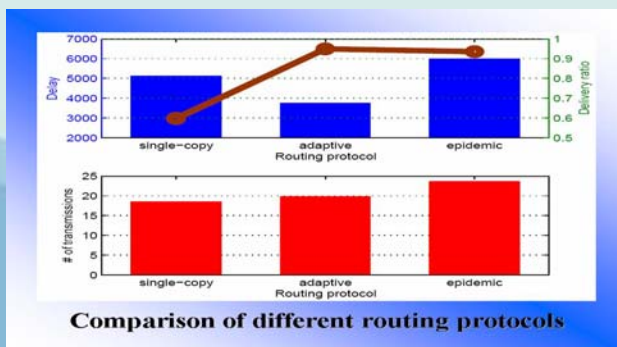


Mechanisms to control number of replica:

- Geographic routing: restricted forwarding area avoids unnecessary replica.
- Expiration timer: delete useless undelivered replica.
- Priority adjustment: estimation of neighboring replica.
- Epidemic ACK: inform relays to delete received packets.

Performance evaluation:

- Deploy 5 layers, each layer is $1\text{km} \times 1\text{km}$ and contains 15 nodes, distance between layers is 60m.
- Node: transmission range: 300m, buffer: 20 packets, battery: 40 packets, speed: $[0, 2]$ m/s.



	Delivery ratio	# of transmissions	Delay
Epidemic	0.9359	23.5976	6000.02
Adaptive	0.9497	19.7667	3752.48
Single-copy	0.5974	18.5156	5122

