CS4628 - P4 - MULTIHOP EDGE NETWORK DOWNSTREAM ROUTING  
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Question P4 [4 MARKS]: Storing mode vs. Non-storing mode

In the routing example implemented in the practical, nodes operate in storing mode. This means nodes record where a packet came from to build a routing table. Alternatively, the non-storing mode could be used where the routing path is recorded in a packet travelling upstream to the sink. The sink can then use this information to send a packet over multiple hops to the destination; the path the packet should take is included in the packet. Compare and discuss storing mode and non-storing mode. Which advantages and drawbacks have both modes in comparison to each other?

The differences between storing and non-storing modes lie in the propagation of DAO messages, the creation of routing tables in all nodes in storing mode, and the routing of data messages. In non-storing mode, nodes typically only maintain knowledge of their parent and neighbor nodes, while the root node has complete knowledge of the paths to each node in the network. In storing mode, all nodes maintain routing tables containing the topology of the network.

Now, focusing on the differences in the propagation of DAO and data messages:

* **DAO messages**: In storing mode, DAO messages are sent in unicast mode to a subset of parent nodes, with each parent node storing the DAO message and forwarding it to its own parents towards the root. In contrast, in non-storing mode, all DAO messages are forwarded by intermediate ancestors towards the root, and this path is stored in the DAO message. The root then receives the path traversed towards each node.
* **Data messages**: In non-storing mode, all messages typically travel upwards towards the root unless the destination is on the way, if the root receives the message it will then forward it to the destination based on the knowledge of the paths it learned via DAO messages. However, in storing mode, because all nodes maintain a routing table, messages destined for nodes that are descendants of the current node are forwarded downwards, while messages for other destinations are forwarded upwards until they reach a common ancestor capable of delivering the message to its destination.

These two approaches to message propagation in the network have different performance outcomes:

* **Latency**: Non-storing mode typically has higher latency since routing decisions are made hop-by-hop instead of being stored at the nodes.
* **Routing Overhead**: Storing mode has higher routing overhead as packets contain routing information.
* **Storage**: Storing mode demands more resources in nodes to maintain the routing tables, which may be a significant challenge for IoT devices, which often have limited resources.
* **Scalability**: Due to storage constraints, storing mode may struggle with scalability as networks grow larger, making it difficult for nodes to maintain all topology routing information.
* **Topology Changes**: Non-storing mode may offer faster adaptation to topological changes, as storing mode requires continuous modification of routing tables by nodes.