# Adaptive FatTree

## NoC Project Report

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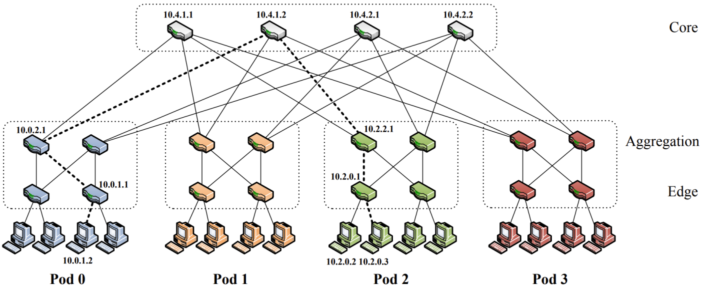
# FatTree Topology

- Three layers: Edge, Aggregation, Core.
- Hosts are linked to edge layer routers.
- Communication paths:
  - Intra-pod: Edge → Aggregation → Edge.
  - Inter-pod: Edge → Aggregation → Core → Aggregation → Edge.



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# Deterministic Routing Implementation

- Routing decisions are based on the current router's layer and the destination router's ID.
- Intra-pod routing:
  - If the current router is in the edge layer, packets go directly upwards to the corresponding aggregation router.
  - If the current router is in the aggregation layer, and the destination is within the same pod, packets are sent directly to the edge layer.
- Inter-pod routing:
  - If the destination is in a different pod, packets are routed from the aggregation layer to the core layer, and then down to the destination pod's aggregation and edge layers.

# Adaptive Routing Implementation

- Adaptive routing introduces flexibility by choosing the least congested path among multiple possible upward routes.
- Congestion information is dynamically updated, and the algorithm selects paths that minimize packet delay and avoid congestion hotspots.

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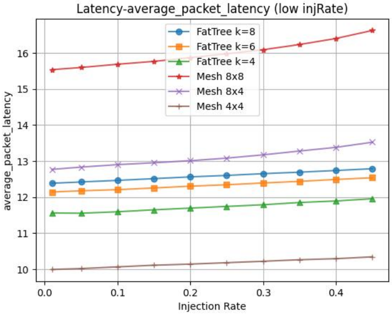
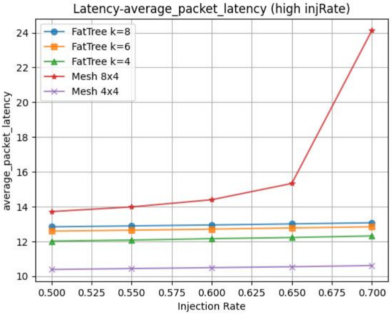
# Topology Comparison

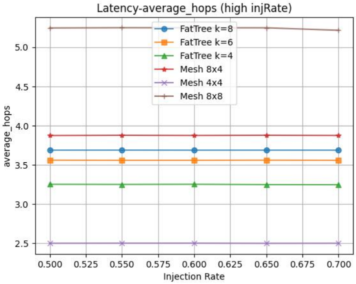
- Conducted experiments using different topologies:
  - Mesh $4\times4$, Mesh $8\times4$, Mesh $8\times8$
  - FatTree with pod sizes of 4, 6, and 8
- Objective: Measure average packet latency at varying injection rates to simulate real-world network traffic conditions.

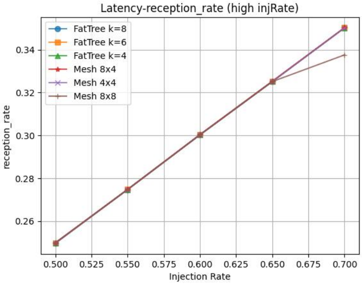
- Results:
  - FatTree topology demonstrated superior stability and scalability, especially under high traffic conditions.
  - Mesh topology experienced a significant increase in latency with higher injection rates, while FatTree maintained lower and more consistent latency levels.



# Congestion and Deadlock-Freeness

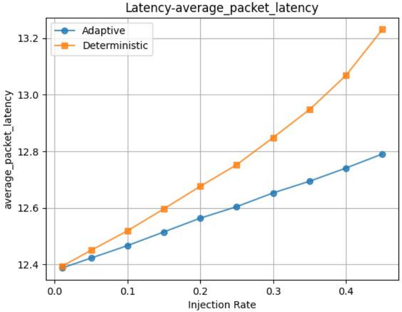


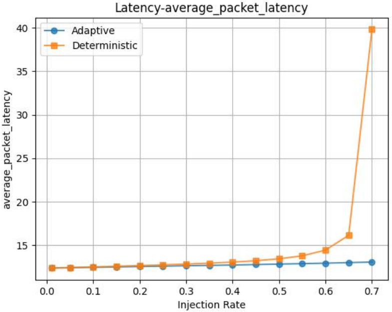




- Reception rate increases linearly with injection rate for both routing algorithms.
- The number of average hops stabilizes.
- No serious congestion occurs in these settings, validating the experiment. (Mesh $8 \times 8$ failed at large injection rates)
- No deadlock occurred in experiment.

# Routing Algorithm Comparison

- Deterministic Routing uses fixed outports, ignoring other available routes, which ultimately lead to congestion.
- Adaptive Routing dynamically selects the least congested path based on real-time network traffic conditions, which reduces network congestion and improves overall throughput.



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# Conclusion

- FatTree topology is superior in handling dense traffic.
- Adaptive routing improves network performance by leveraging real-time congestion data.
- Effective for large-scale network operations and data-intensive applications.

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# Division of Labor

- **Xinghan Li:** Routing algorithm, report, slides, presentation.
- **Bowen Yang:** Topology implementation, experiments, report, slides.