Networks and Performance

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Communication networks

• Between compute nodes
• Between processors and memory unit
Communication networks

An HPC network consists of nodes, links and switches

- Static network (does not contain switches)
- Dynamic network (contains switches)
Store and forward routing

- Store and forward routing
- Cut-through routing
Store and forward routing

The message is completely received and stored in each intermediate step and then it is forwarded.
Store and forward routing

Cost(m, h) = \( t_s + t_h \cdot h + m \cdot t_m \cdot h \)

A hop
Cut-through routing

\[
\text{Cost}(m,h) = t_s + t_h \cdot h + m \cdot t_m \approx t_s + m \cdot t_m
\]
Dynamic network topologies

- Bus network
- Crossbar switch
- Multistage networks
Bus network

Cheap: $O(1)$ cost
Broadcast is easy
Shared bandwidth
Can not have many nodes
Crossbar switch

- Expensive $O(p^2)$
- Good bandwidth
Multistage Networks: multistage omega network

Log$_2$ p stages * p/2 switches per stage $\rightarrow O(p \log_2 p)$ cost
Example network topologies

Two basic properties of communication networks:
• Diameter
• Bisection width