ECO: Efficient Collective Operations for Communication on Heterogeneous Networks

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http://www.cs.cmu.edu/~ECO

GOAL: To provide efficient collective communication for message passing applications written by scientific programmers for distributed heterogeneous systems

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Outline

- Optimal patterns in the distributed world
- Characterizing networks
- Network-aware communication patterns
- Results
- Future Work

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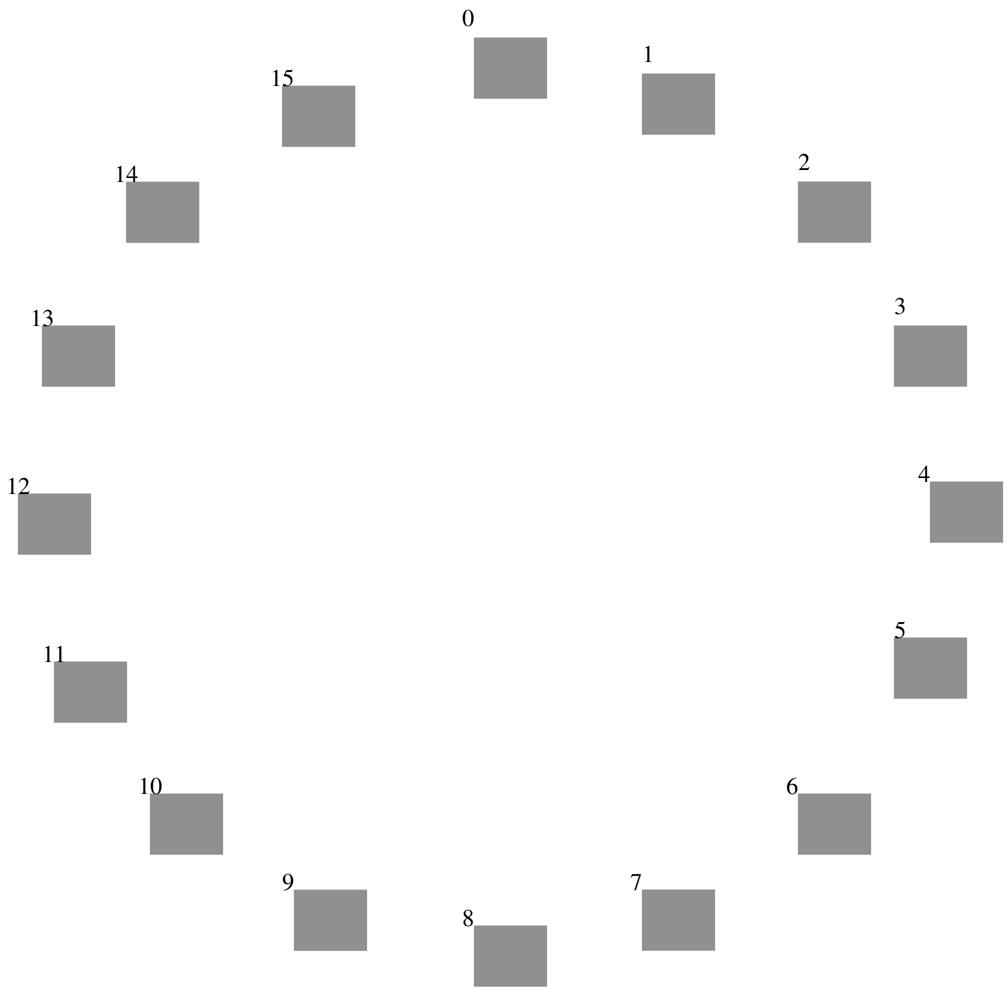
PVM's View



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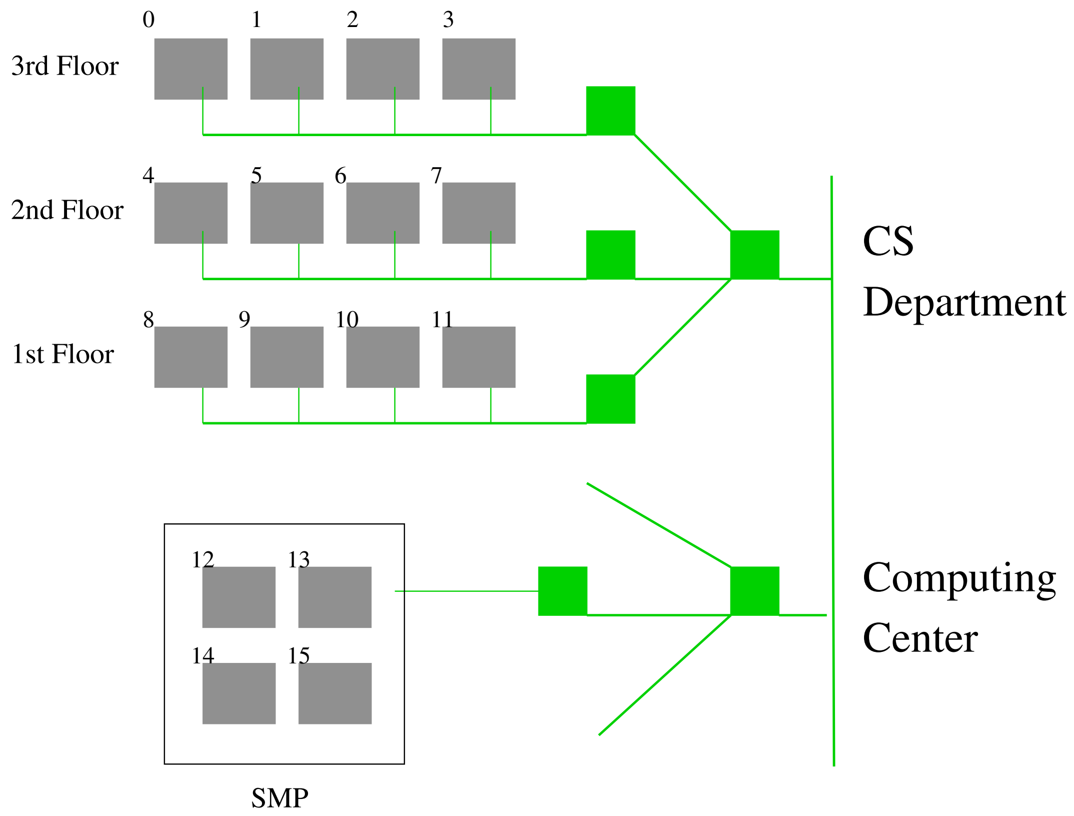
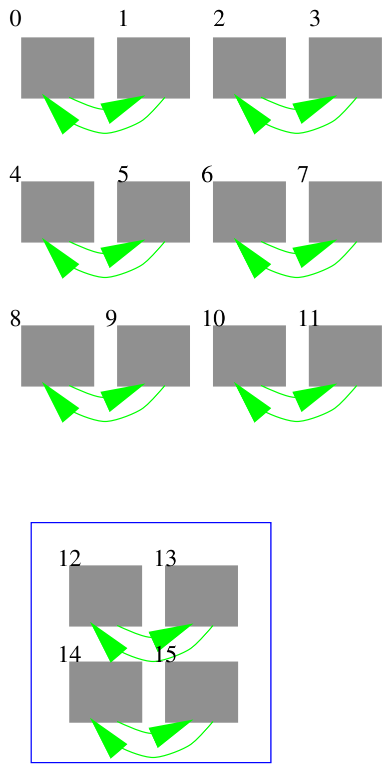
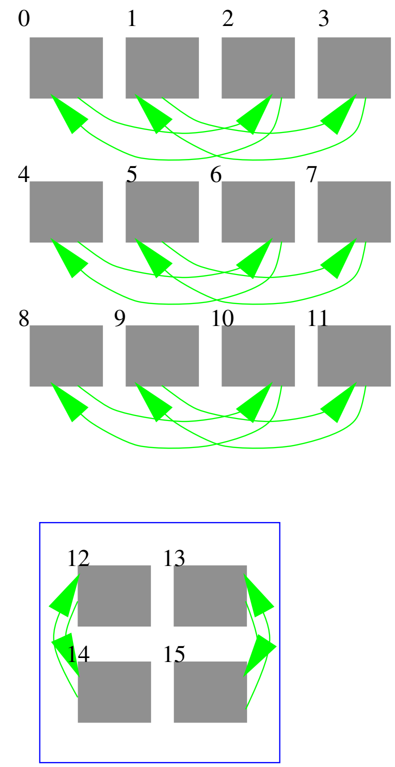
Real Network



Butterfly





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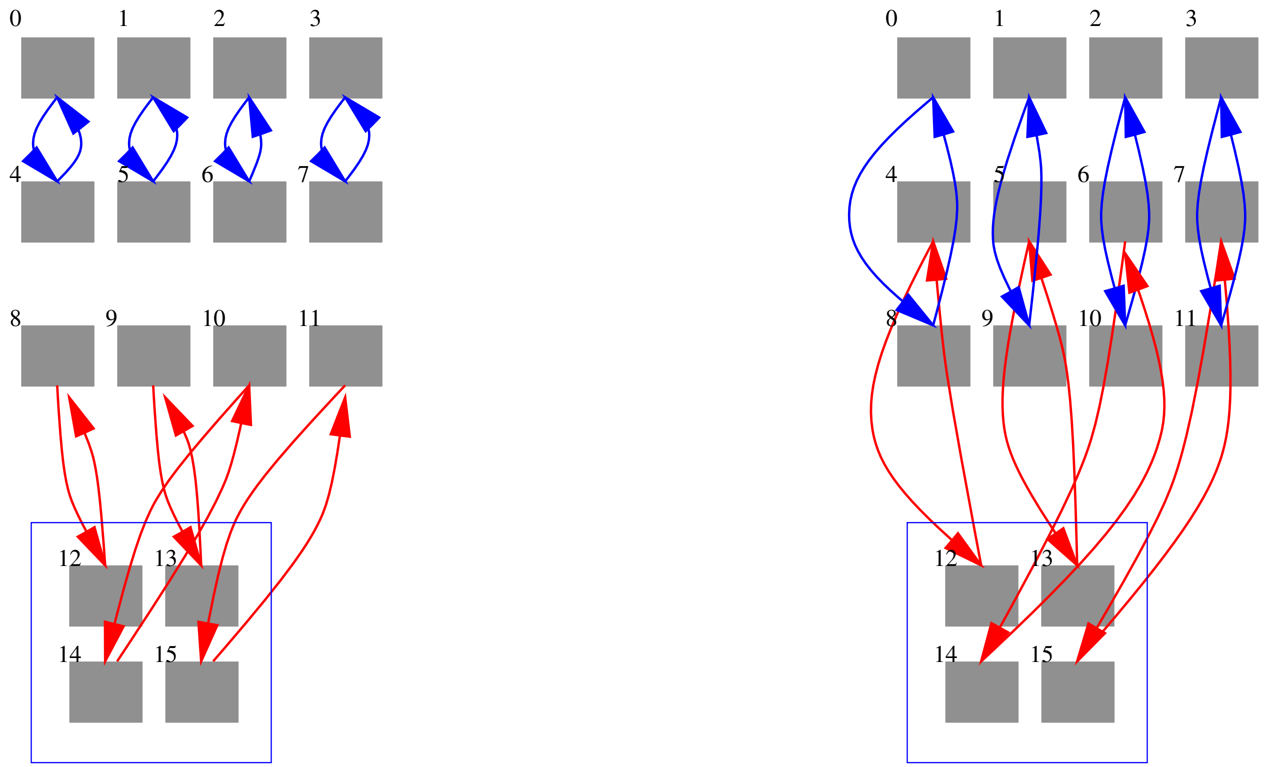

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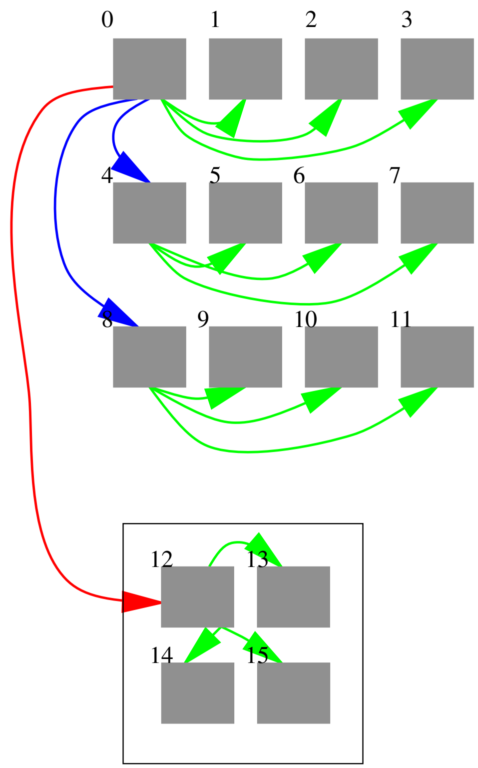
Goal



ECO's Solution

- Characterize Network
  - latency
  - partitioning
  - static
- Patterns designed at runtime
- Library of collective operations

Programmer Sees:

- Characterization application
- Library

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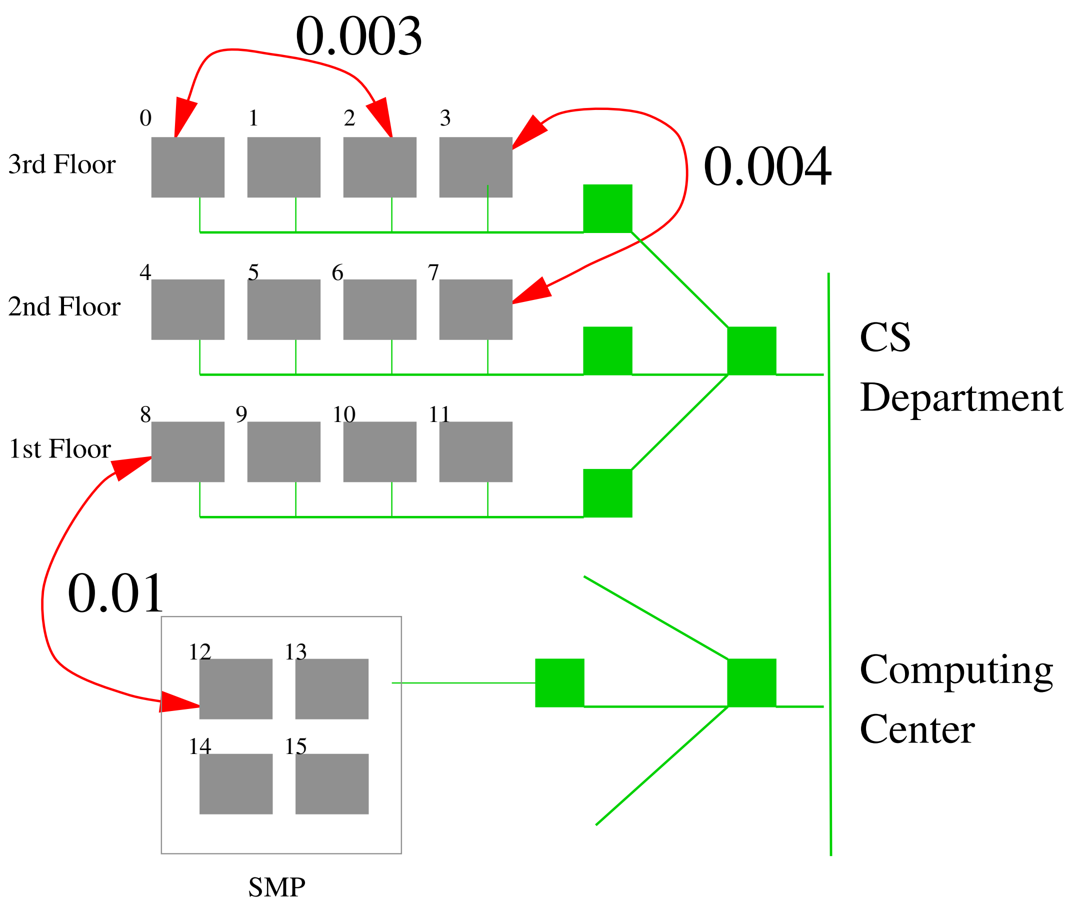
Network Characterization



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Models

- LogP: *L*, *o*, *g*, *P*
- Hockney's: $t = t_0 + \frac{m}{r_\infty}$

Problems:

- We only have one measurement
- We are interested in networks with varying latency

Our Solution:

- Let *L* vary
  - Assume delay is a fraction of *L*

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Patterns Used

- Between subnets—Model
  - Within Subnets—Tree
    - Within Machine—Tree

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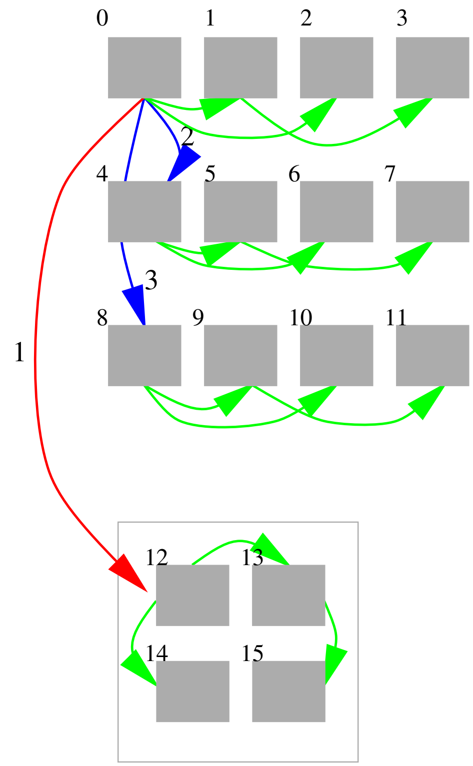
ECO Model Example



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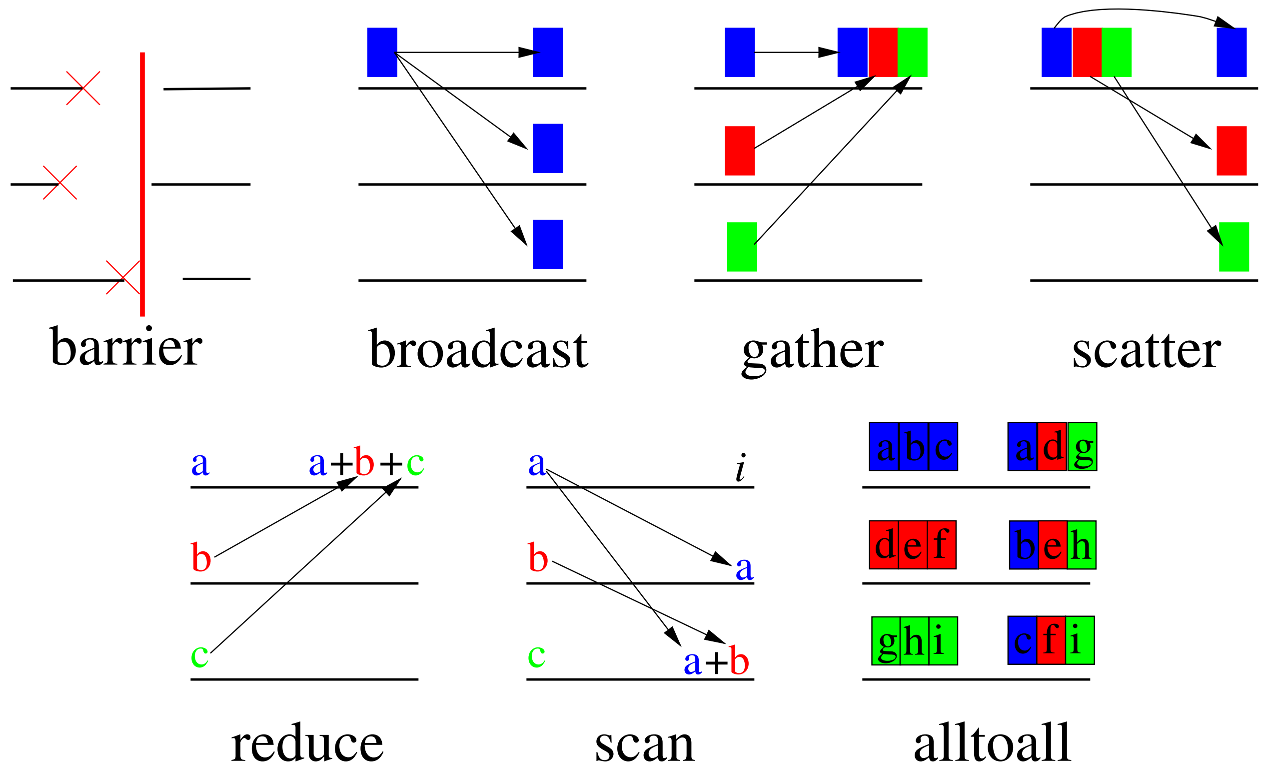
Operations



gather and reduce can return results to all

All operations support strides and multiple vectors

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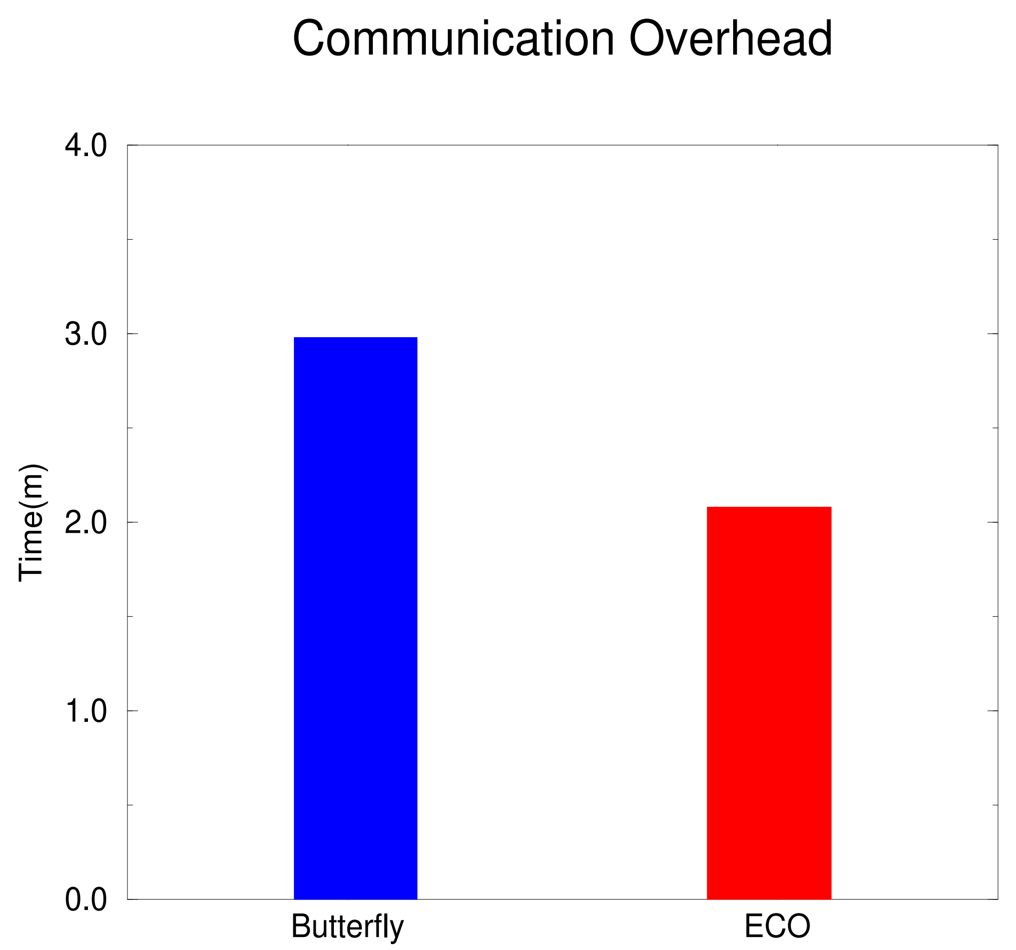
CHARMM on Ethernet



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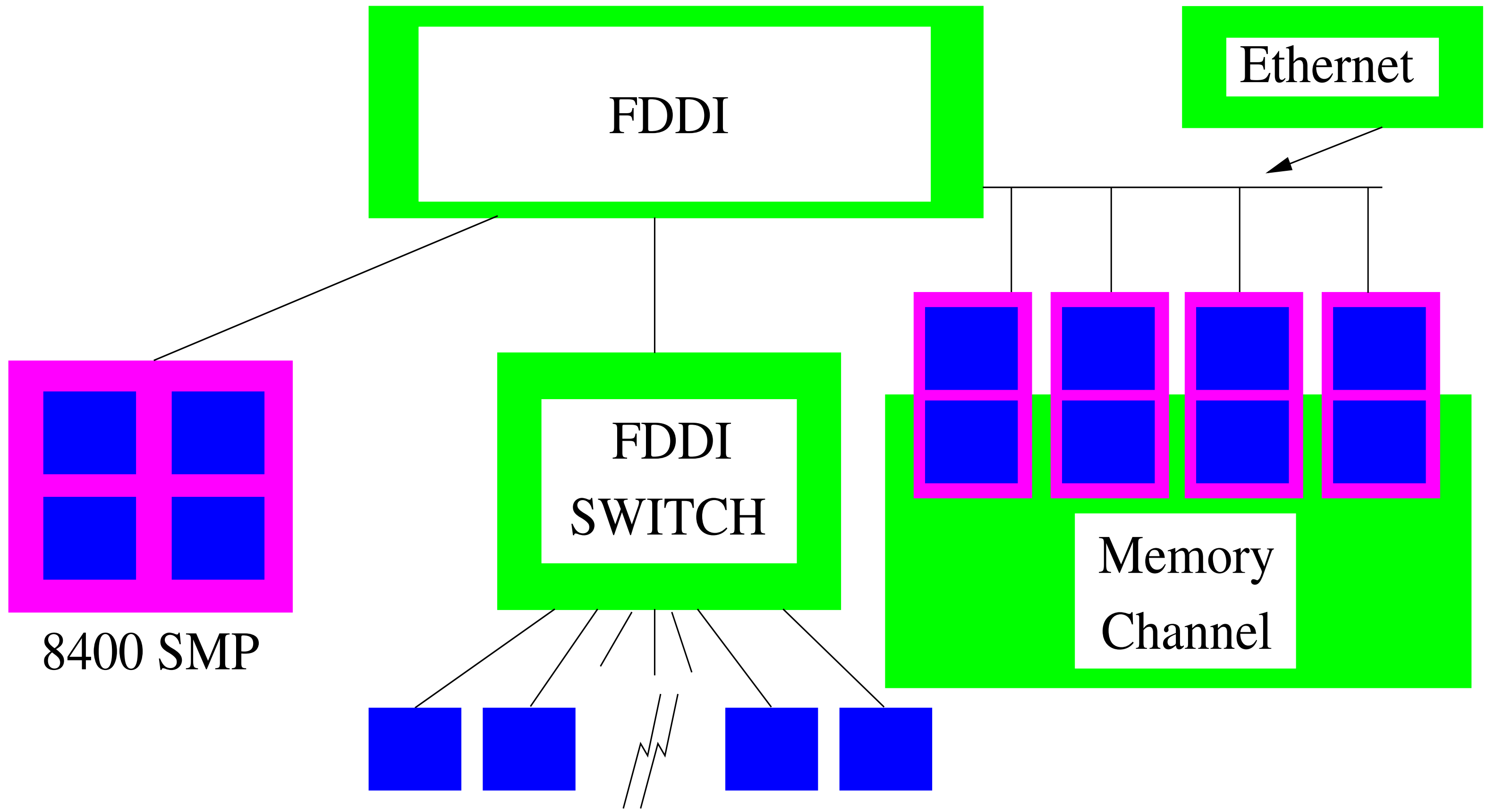
PSC Alpha Systems



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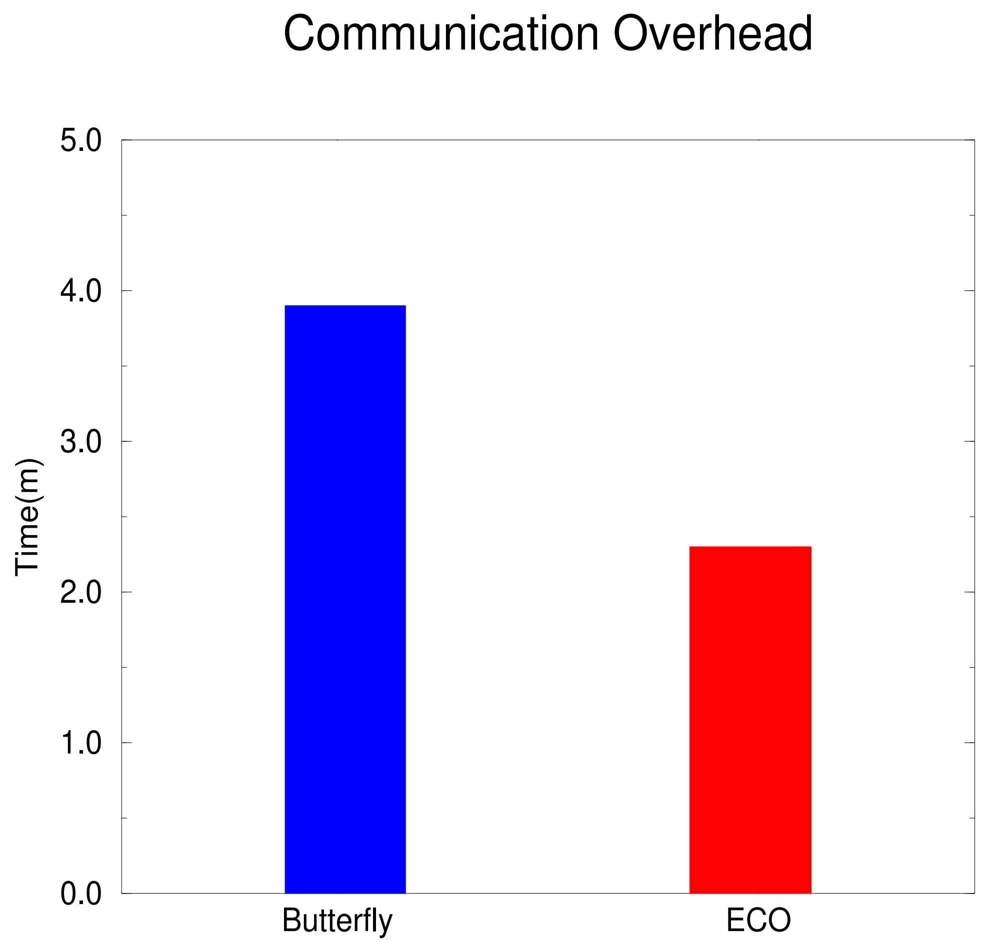
CHARMM on PSC Alphas



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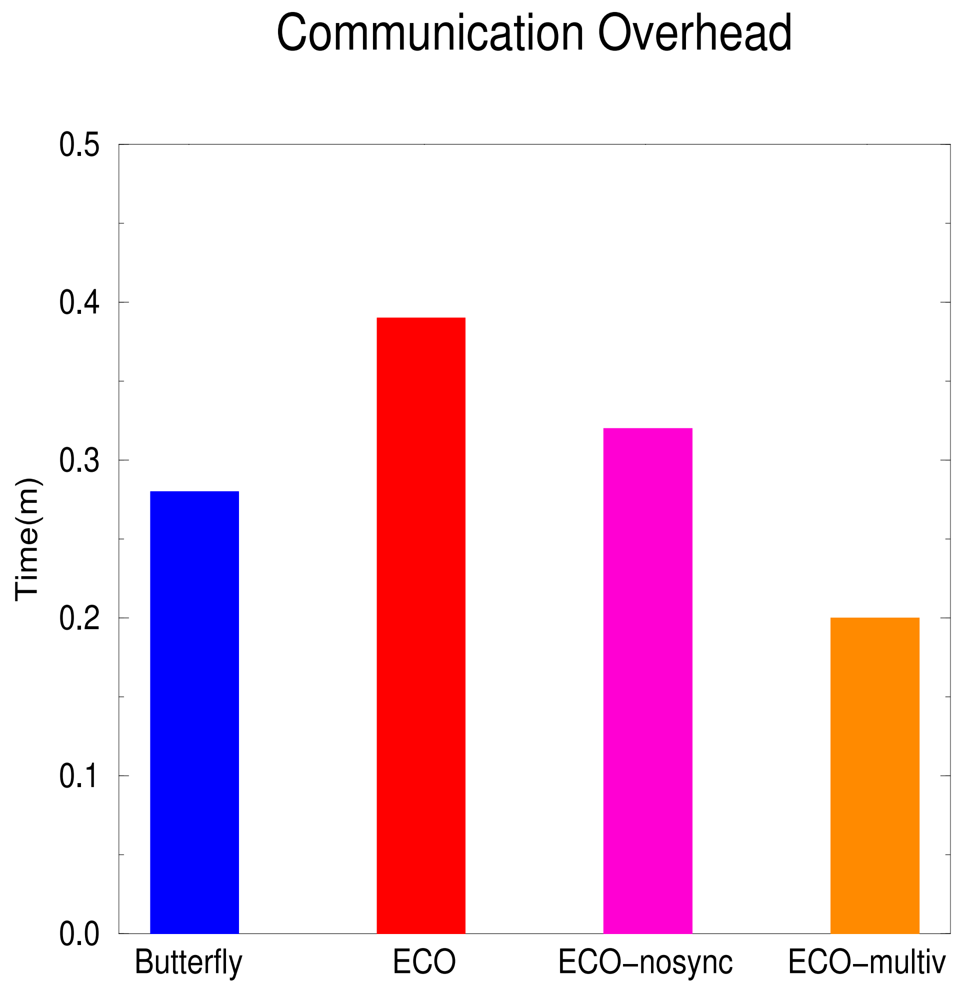
CHARMM on Memory Channel



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Conclusions

- ECO improves application performance on networks
- HPC benefits
- Need to use different patterns for different situations
- Library encourages efficient programming

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Future Work

- High bandwidth recognition and patterns
- Local network patterns
- Dynamic adaptations
- Topologies
- Native Multicast

BETA TESTING

ECO is now available for beta testing.

If you want to beta test ECO, send mail to:

lowekamp@cs.cmu.edu

For more information:

http://www.cs.cmu.edu/~ECO

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