# Predictable Communication Performance in On-Chip Networks

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### **Overview**

### **Buses are Efficient for Small Systems**







# **Buses Do Not Scale**



# **Buses + Pipelining**



### **Buses + Pipelining + Parallelism**



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# **Phases of Communication**

#### **Minimal Guarantees require Minimal Provision**

- Provision Phase
  - Providing the resources
  - May not offer guarantees
  - Design time Start up time Run time
- Transmission Phase
  - Guarantee for delivery
  - Guarentee for minimum bandwidth
  - Guarantee for maximum latency
- Deallocation Phase

# **Circuit Switching**

#### **Exclusive Resource Allocation**



# **Circuit Switching Resource Chain**





# **Circuit Switching Inflexibilities**



# **Circuit Switching Pros & Cons**

Disadvantages:

- Exclusive allocation of resources
- Long setup phase
- Advantages:
  - High performance throughput and latency
  - Low power consumption
  - Low overhead during transmission phase
  - Predictable transmission

# **Time Division Multiplexing**

### **Time Slot Based Resource Allocation**



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# **Time Slot Based Resource Allocation**



- Network is synchronized by a global time
- Connections are defined by routing tables in switches
- Repetitive traffic patterns/window
  - Setup
    - Constrained optimization problem
    - Path selection
    - Slot allocation

# **Aggregate Resurce Allocation**

### **Aggregate Resource Allocation**



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### **Aggregate Allocation of a Channel**



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- Characteristics of channel
- Characteristics of flows
- Arbitration policy for channel access

# **Bounds for Aggregate Resource Allocation**



# Summary

# **Trade-offs in the Design Space**



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