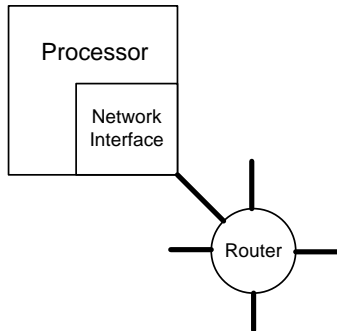
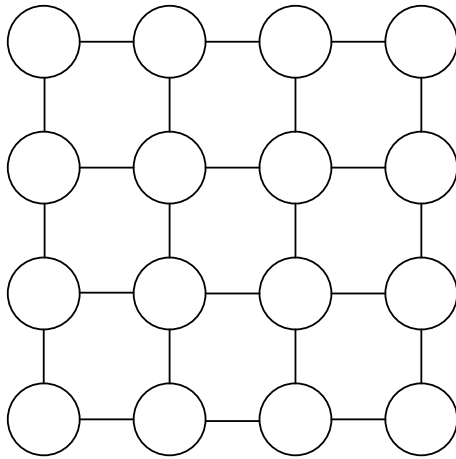


A Dynamic Link Allocation Router (DyLAR) for Asynchronous Network-on-Chips

— *A Proposal for a new Router*

Wei Song

The NoRC Platform



- NoRC: network on a reconfigurable chip
- Running multimedia applications
- Connection oriented flow control
- Stochastic routing algorithm
- GALS: fully asynchronous routers linked by CHAIN

Design Issues

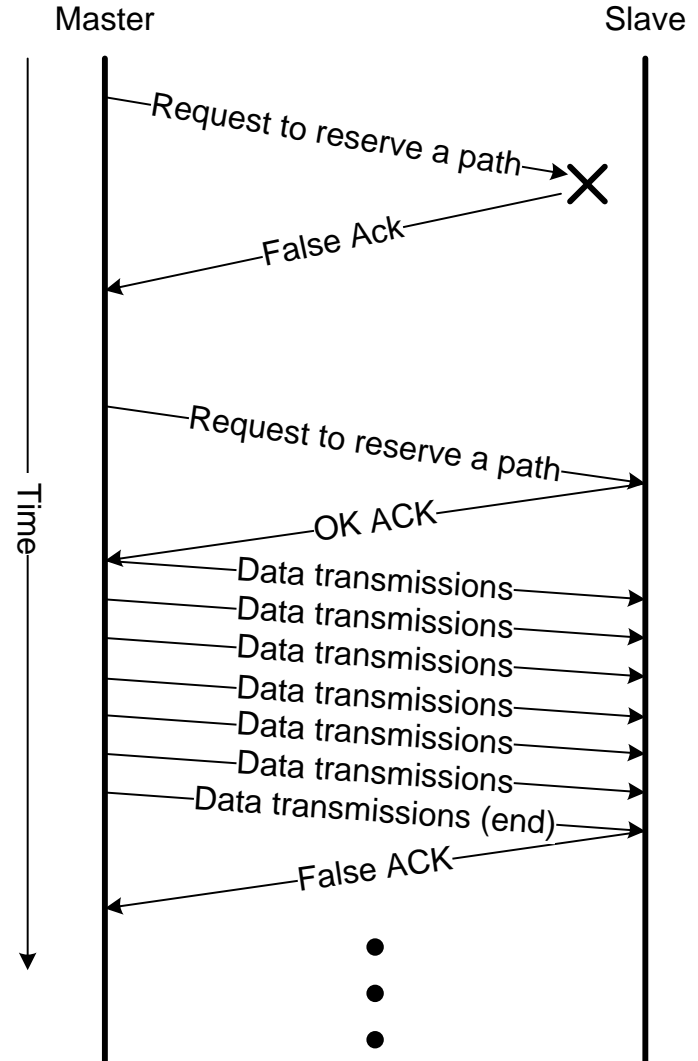
• Flit Definitions

Request Flit

| | | | |
|------|-----------------|-----------|-------------|
| data | request content | flit type | flit header |
|------|-----------------|-----------|-------------|

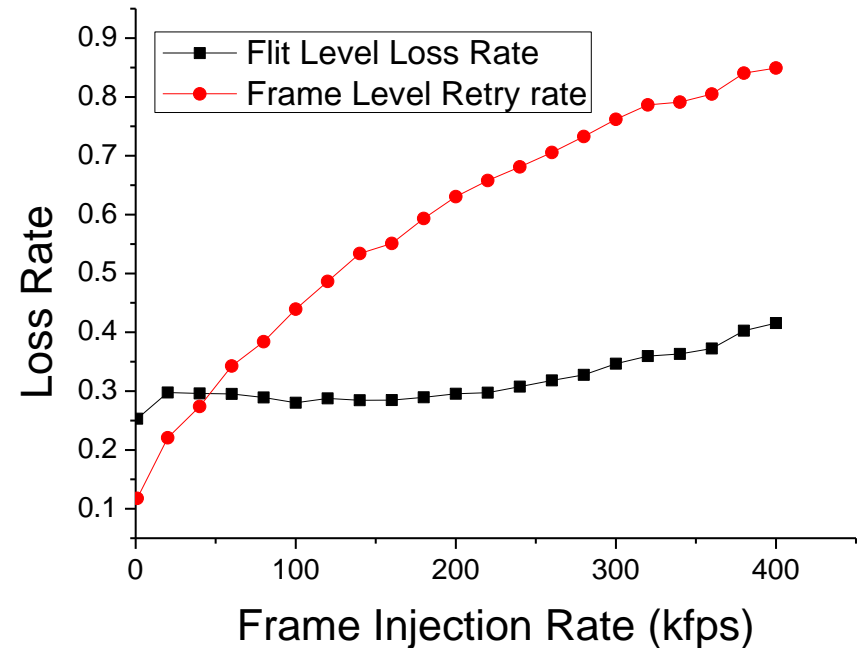
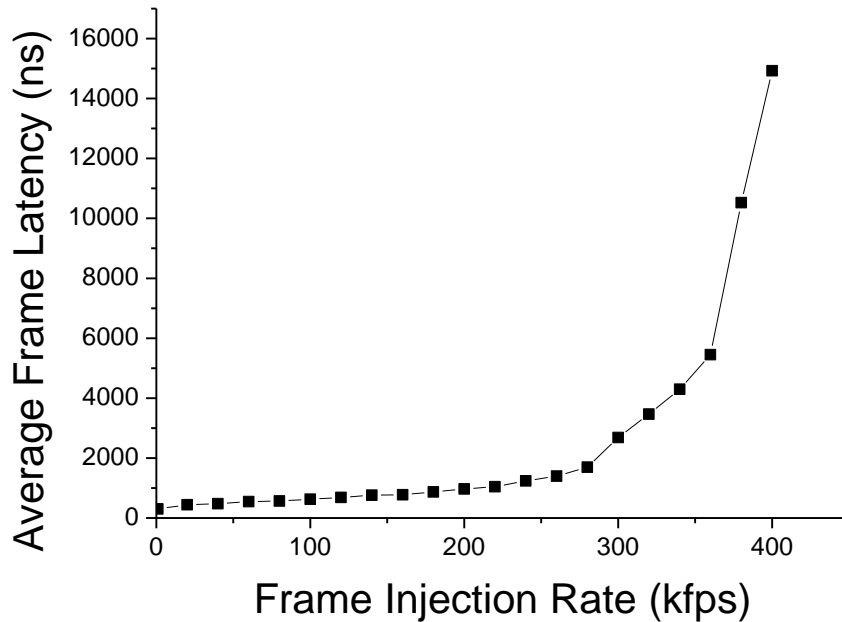
Other Flits

| | | |
|------|-----------|-------------|
| data | flit type | flit header |
|------|-----------|-------------|



Design Issues

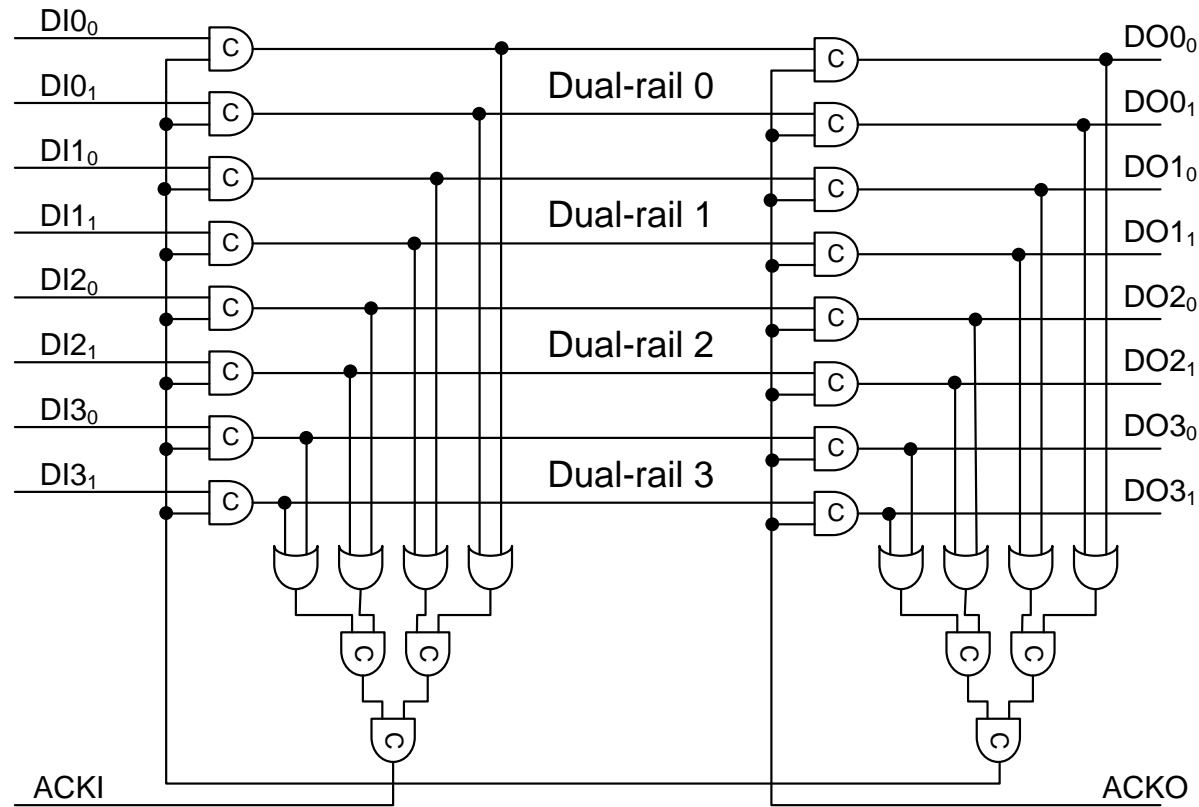
Simulation results of a 6x6 NoC with 12 functions in network.



Design Targets

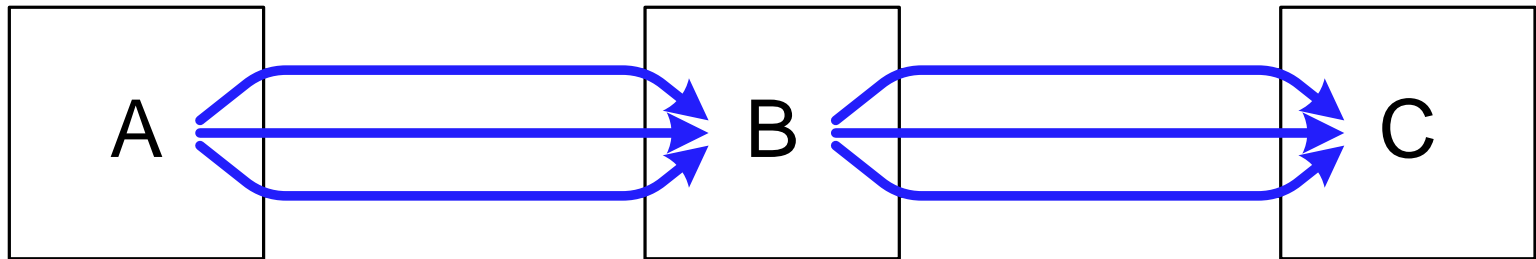
- *Increase the bandwidth of CHAIN link*
- *Implement some kind of virtual channels*
- Implement routers by asynchronous circuits
- *Reduce the area*
- Reduce the power
- Try to avoid livelocks caused by noises

Increase the bandwidth

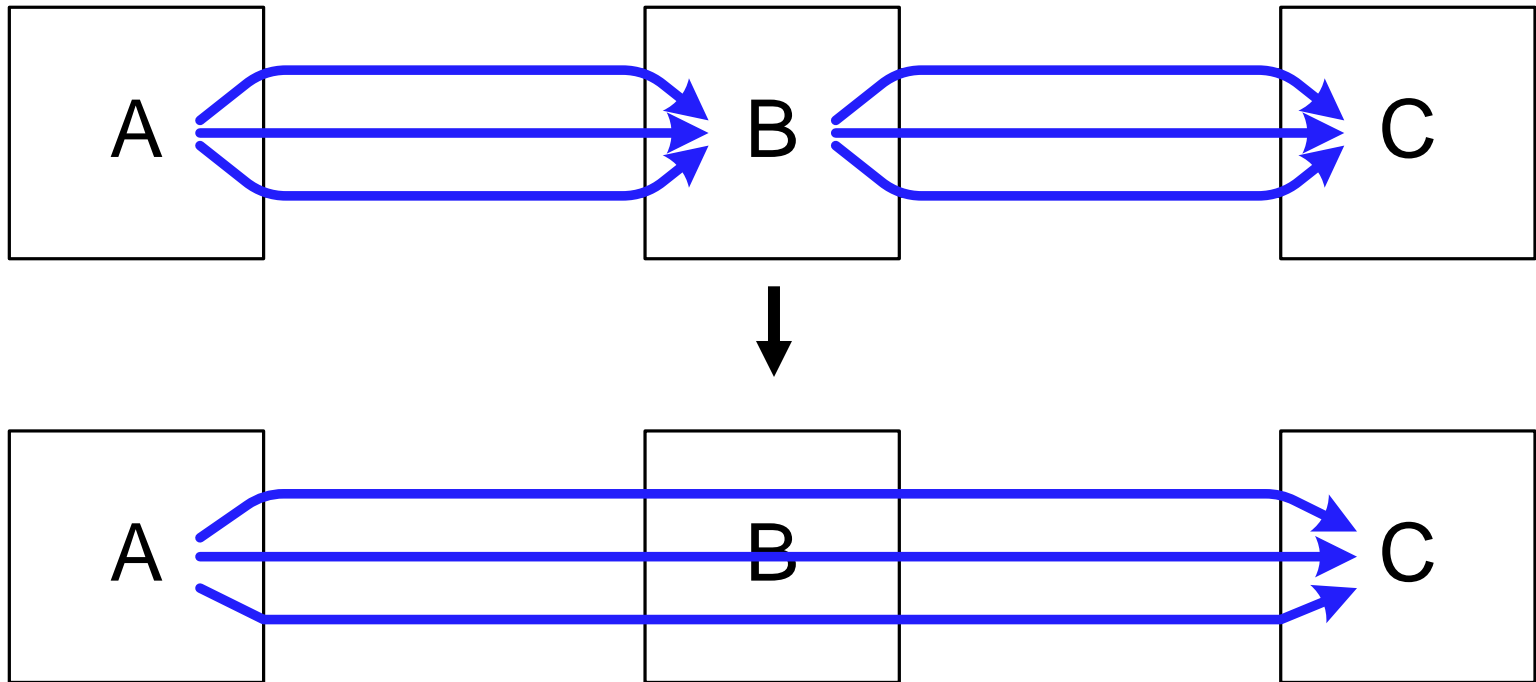


Asynchronous Links work better with the lower wire count.

Increase the bandwidth

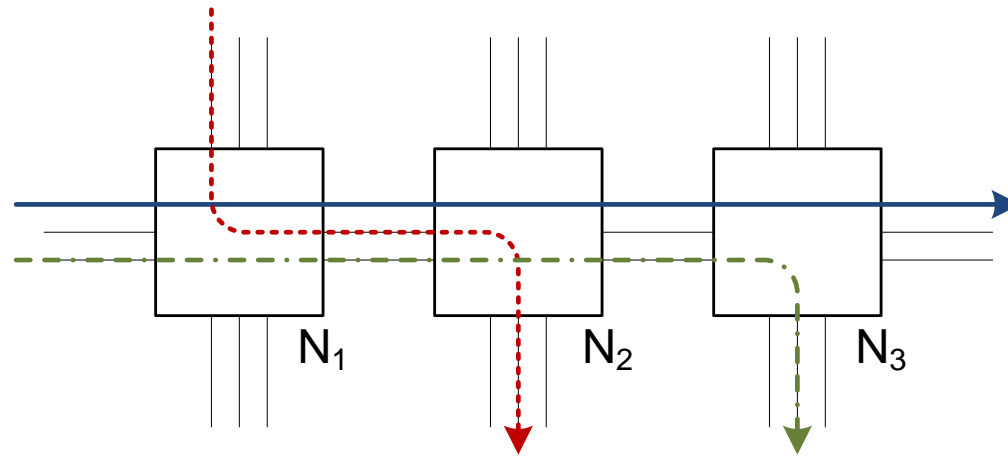


Increase the bandwidth



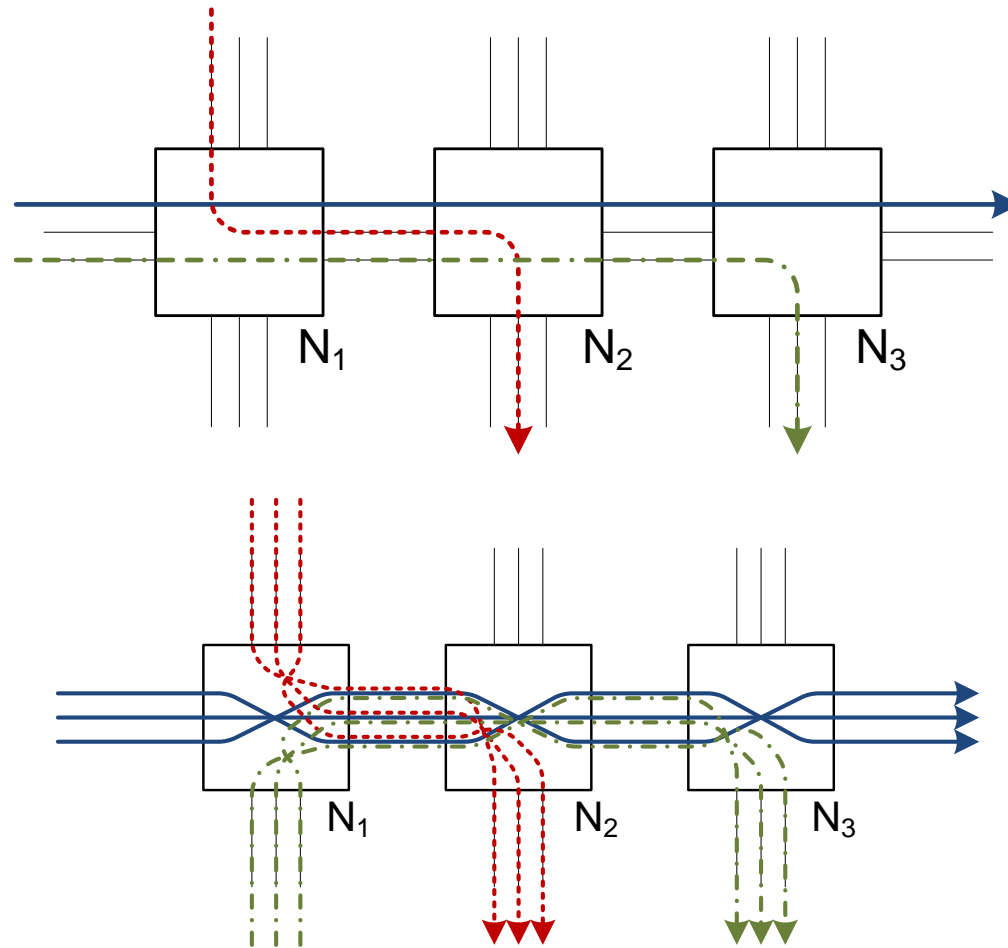
Spatial division multiplex (SDM) is a good choice for asynchronous NoCs.

Problems of SDM



SDM has the low bandwidth efficiency.

Problems of SDM



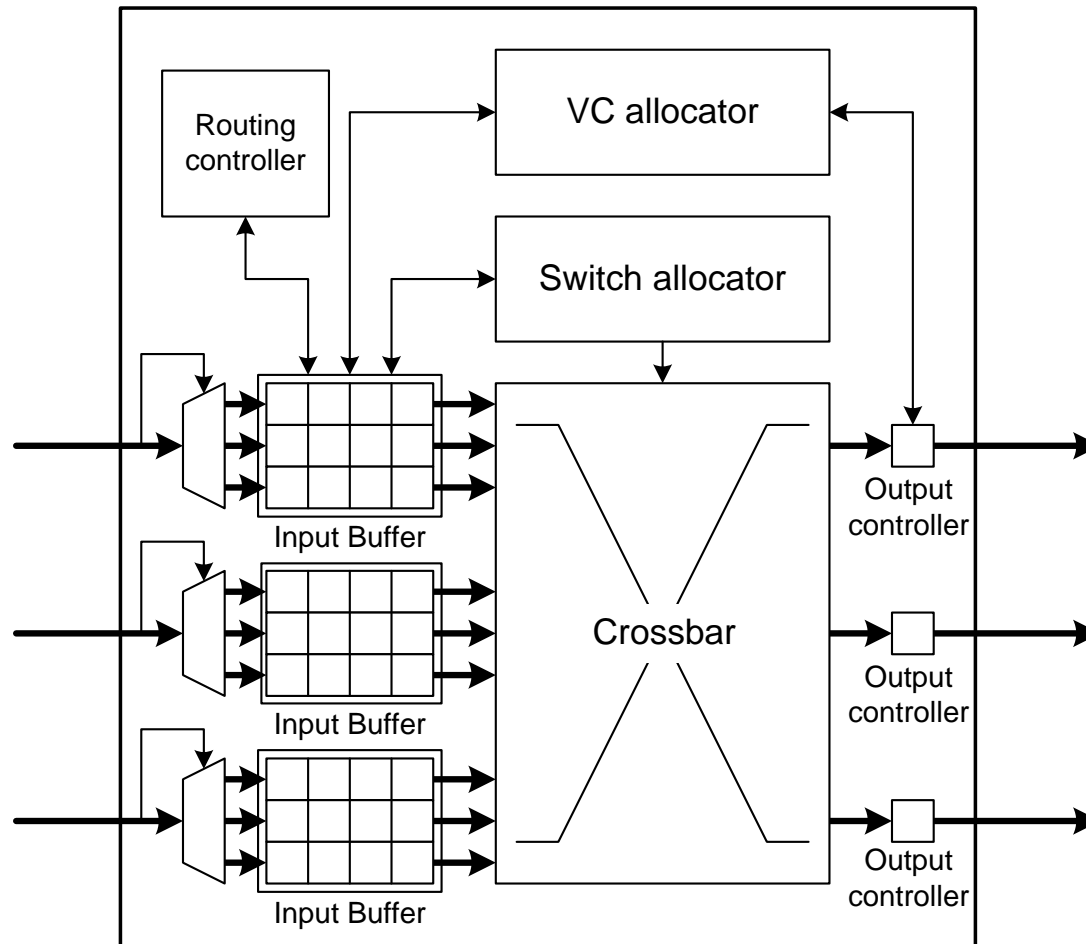
Dynamic Link Allocation

- Each sub-link runs without synchronization to other sub-link.
- Router allocates sub-links on a flit by flit basis.
- Frame occupies all bandwidth when the network load is low.
- Router fairly allocates bandwidth to multiple frame when the network is saturated.

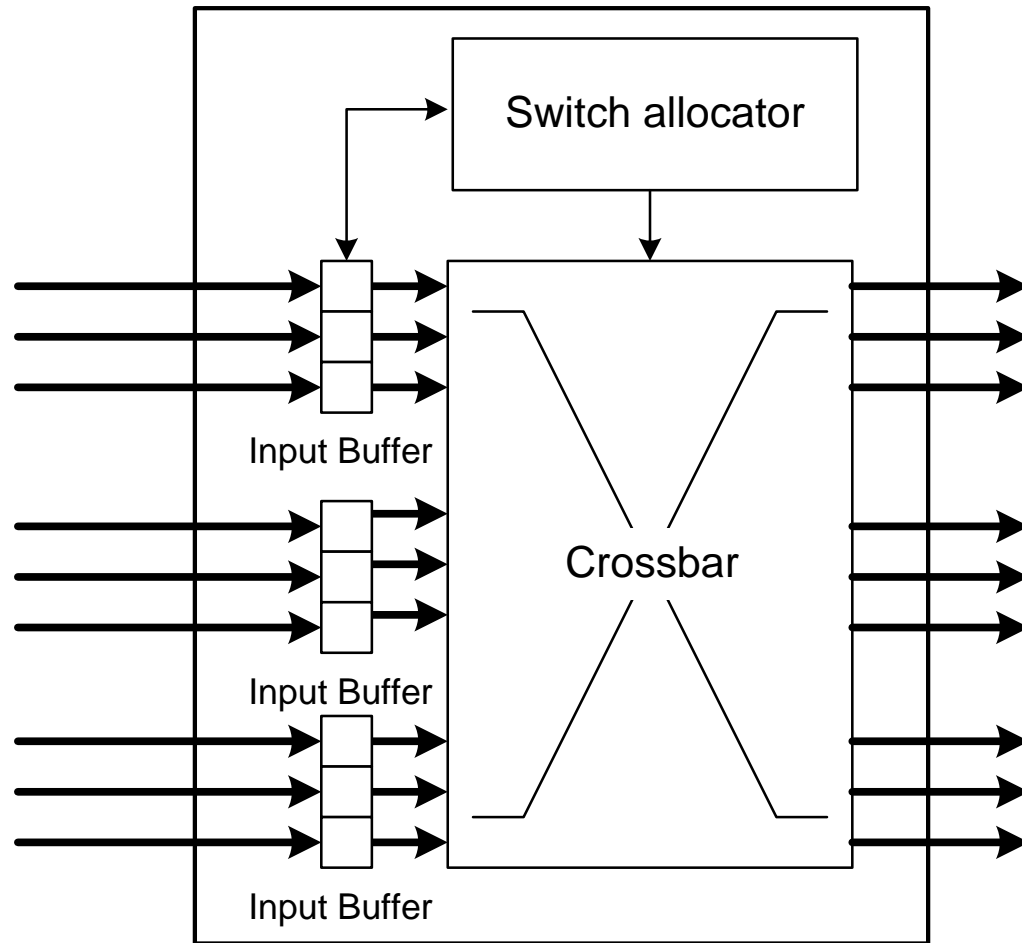
Problems to Answer

- How to reserve a path?
- How a frame occupies the whole bandwidth?
- How to avoid the head-of-line problem?

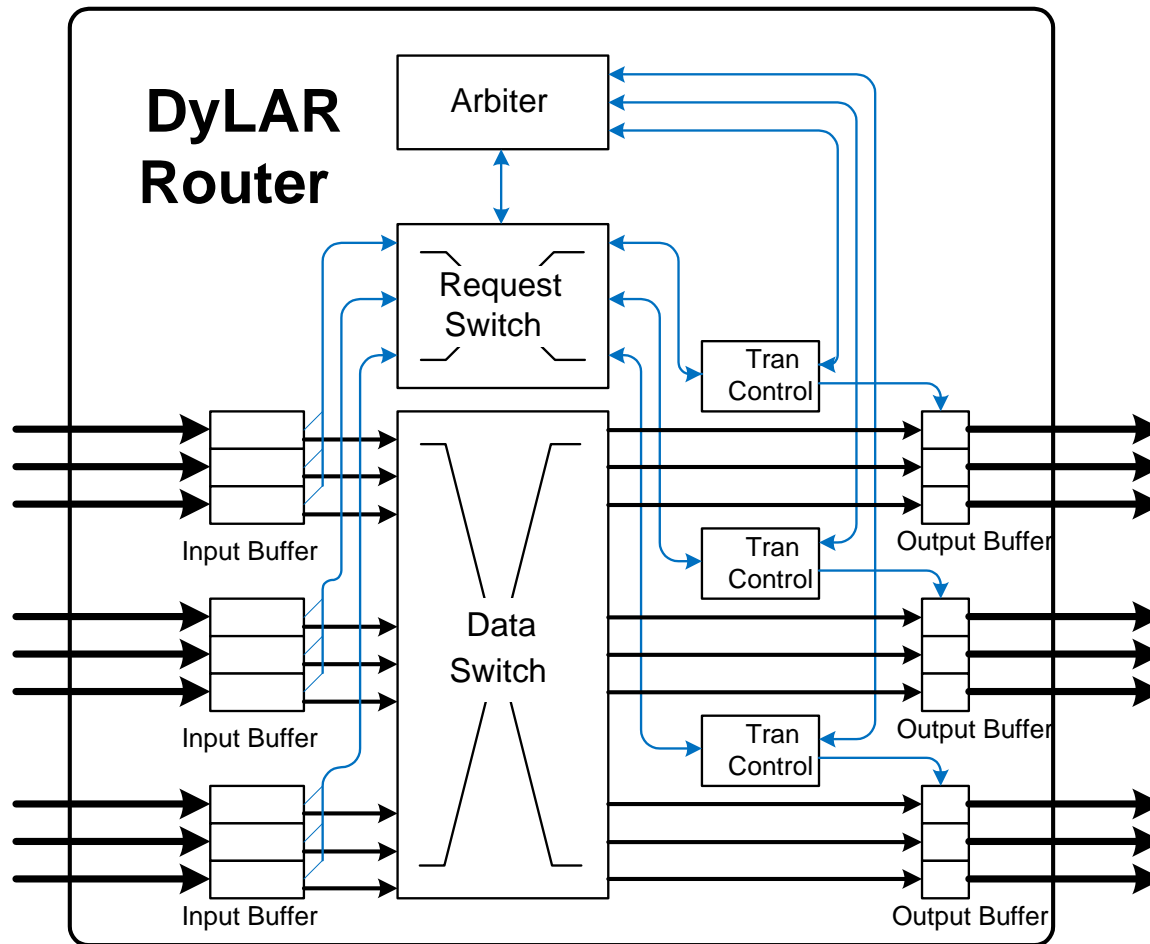
VC Router



SDM Router



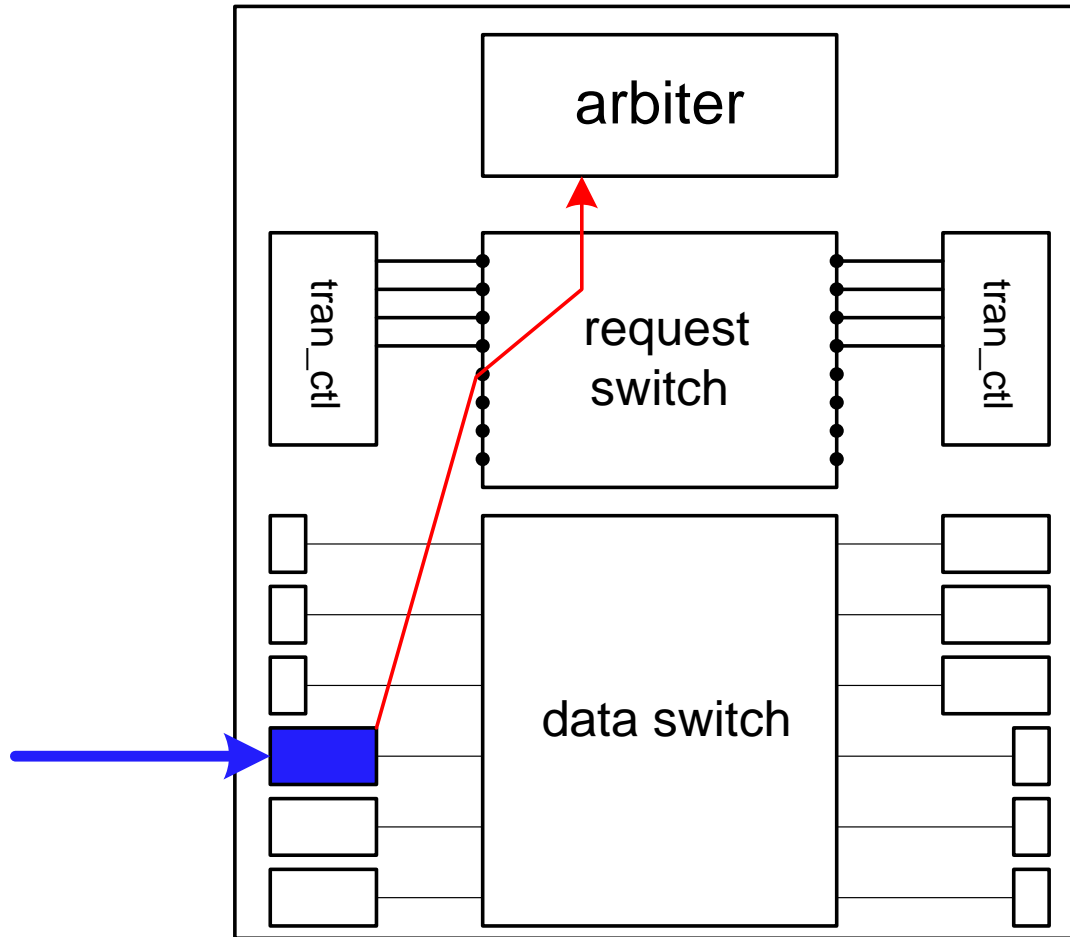
Dynamic Link Allocation Router (DyLAR)



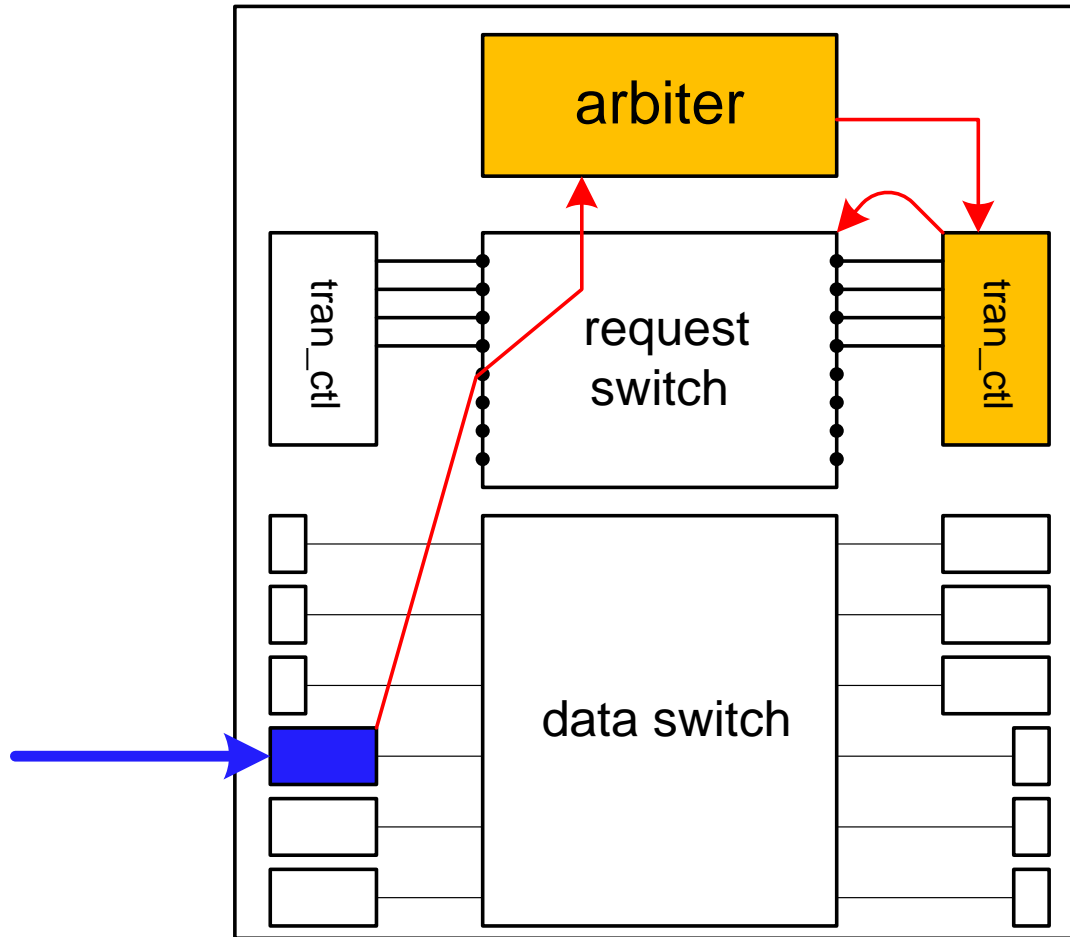
Detailed Procedures

- Request
- Path reserved
- Sending data
- Release path

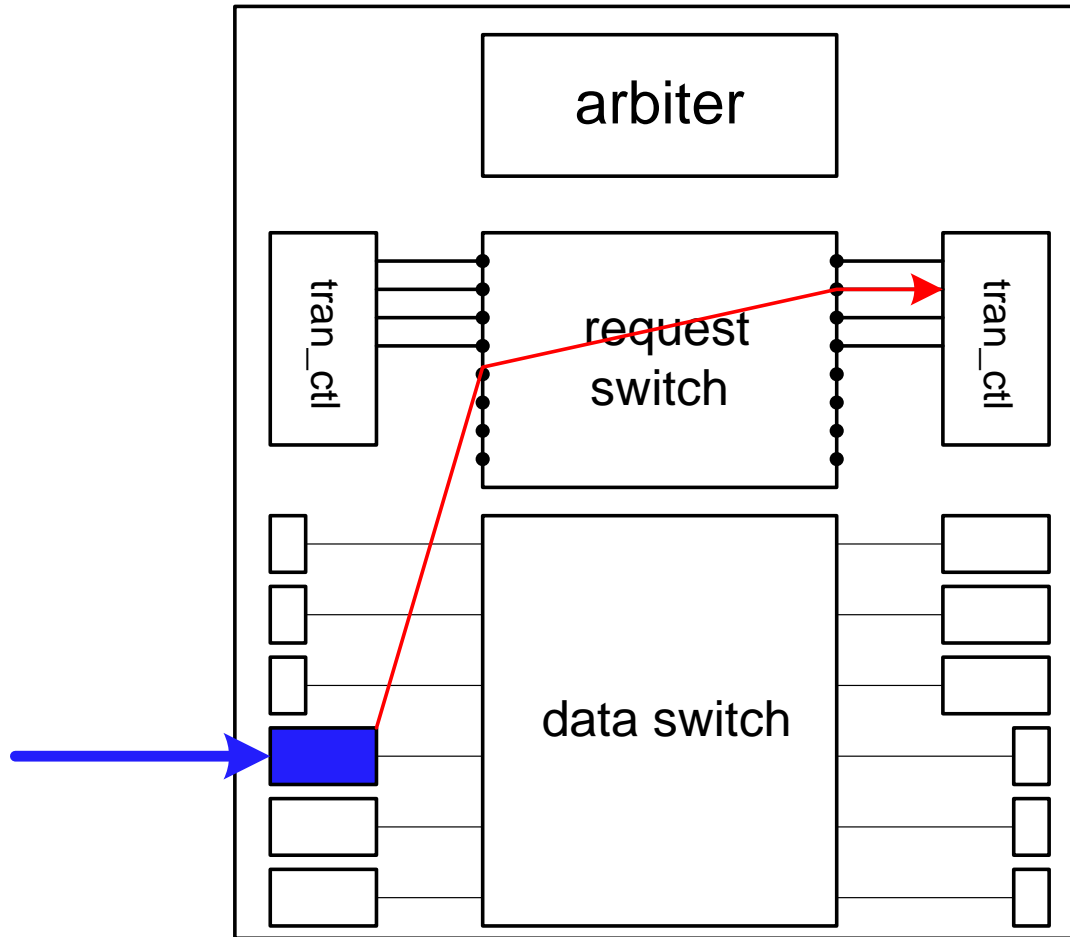
Request Procedure



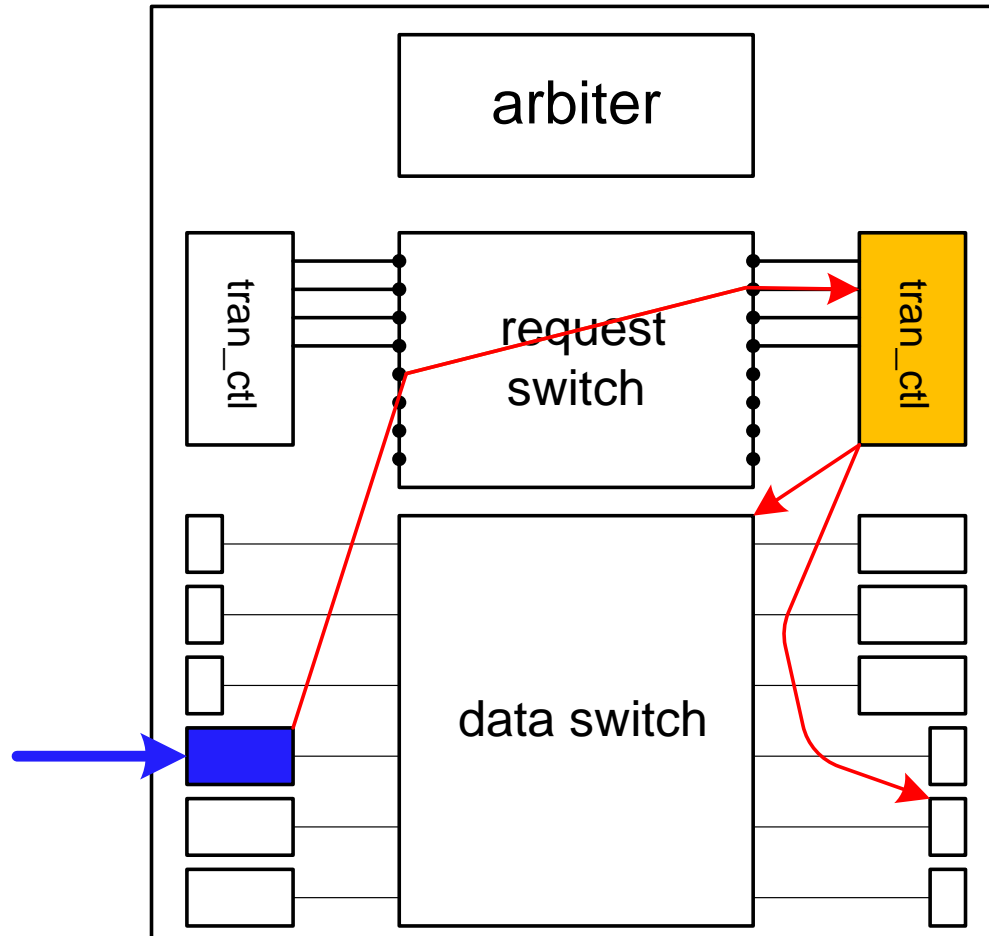
Request Procedure



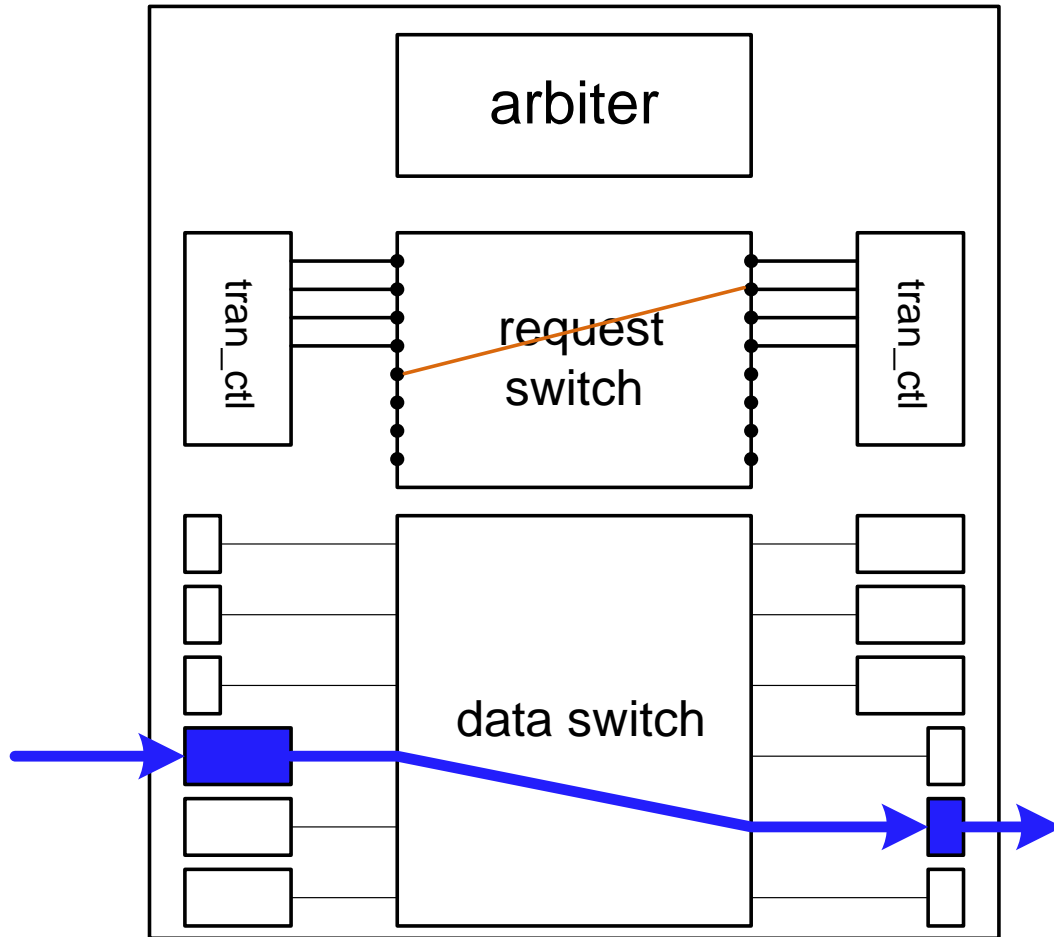
Request Procedure



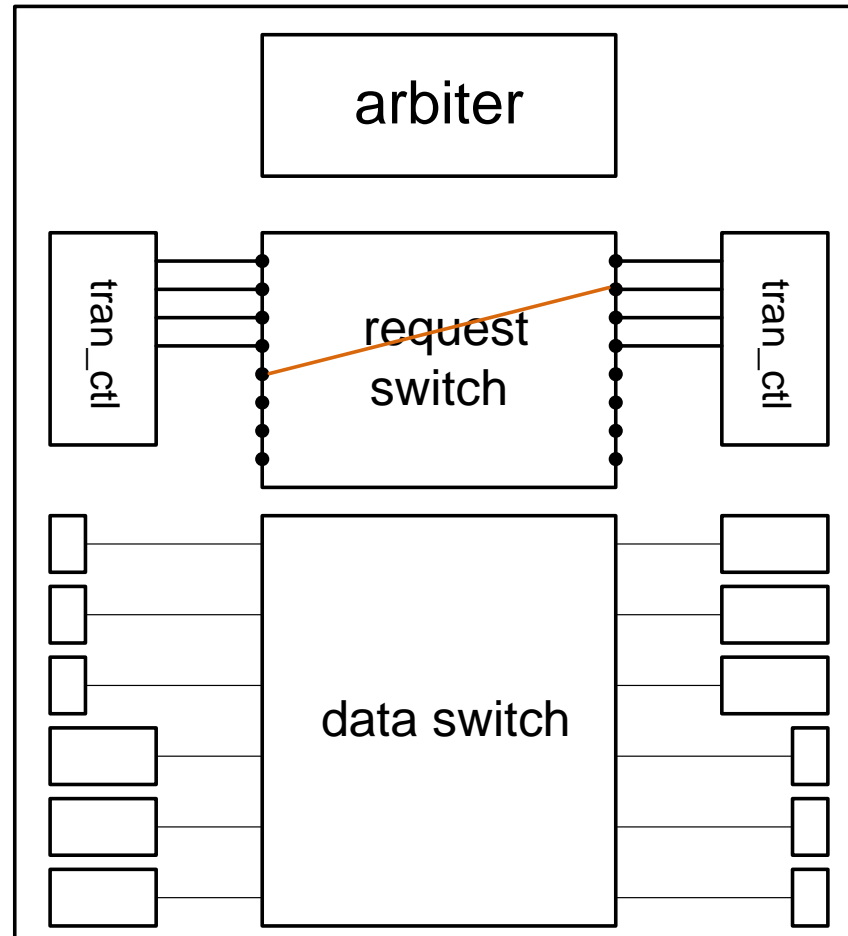
Request Procedure



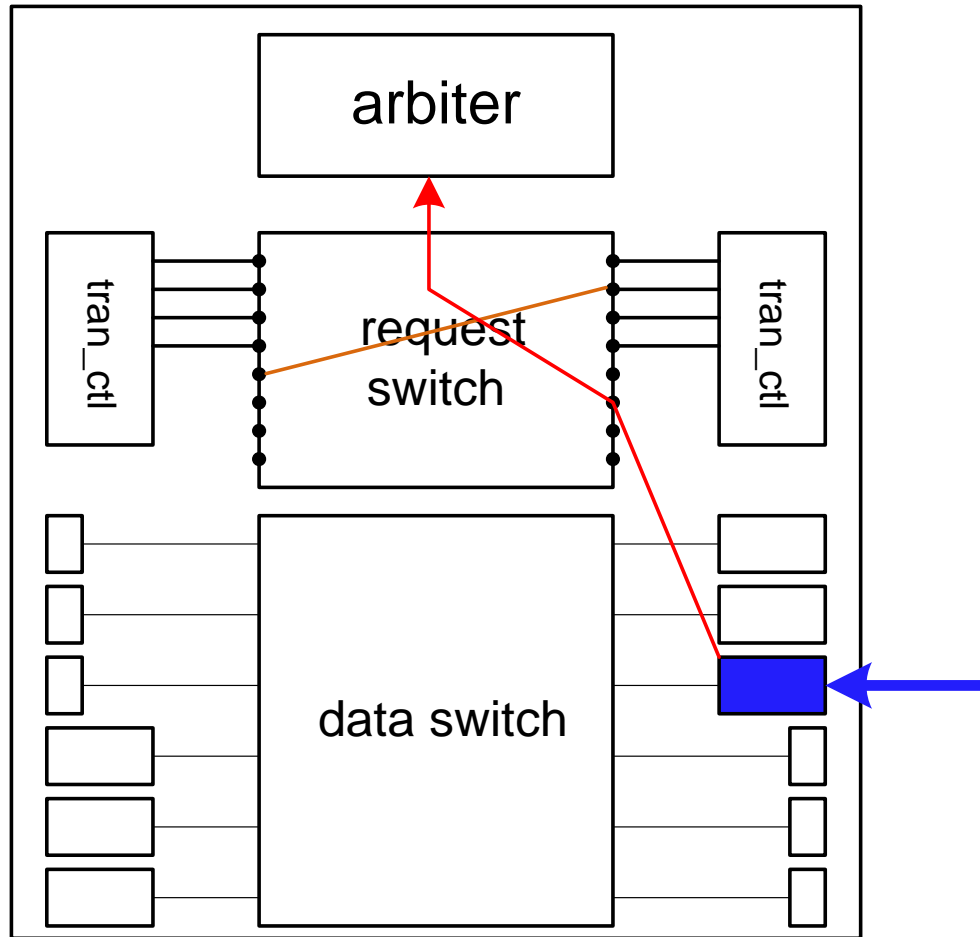
Request Procedure



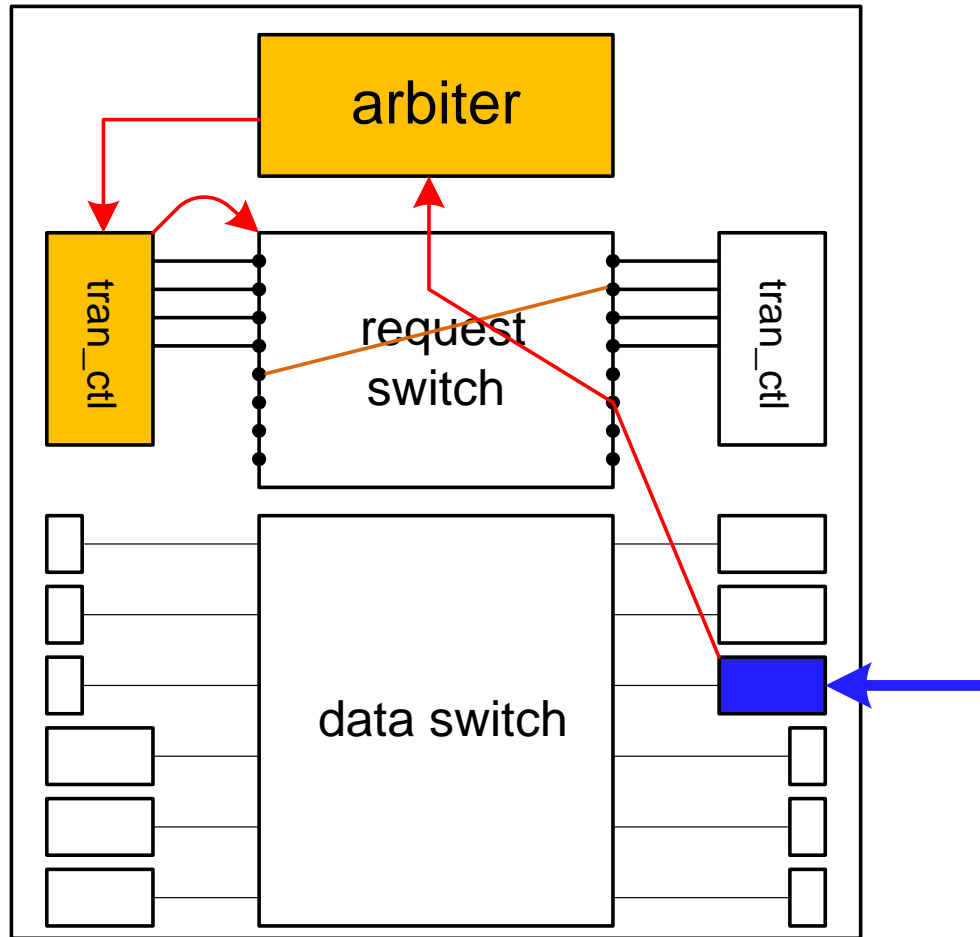
Request Procedure



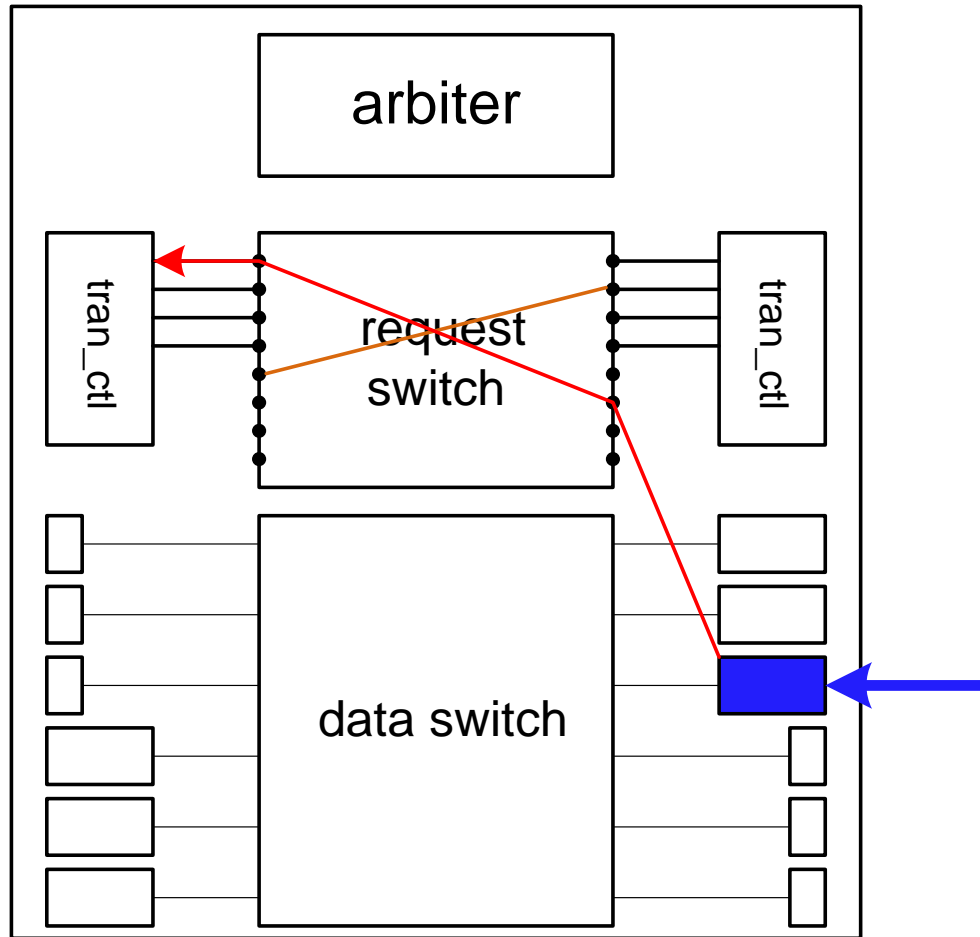
OK Ack



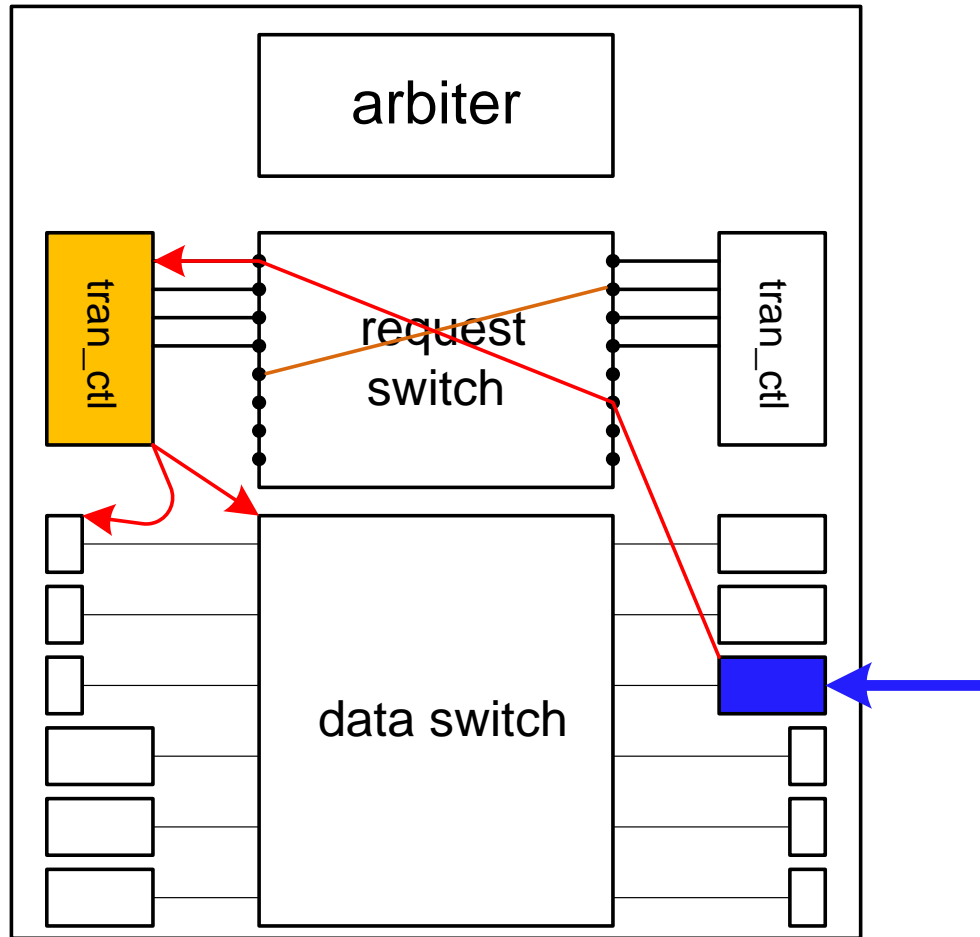
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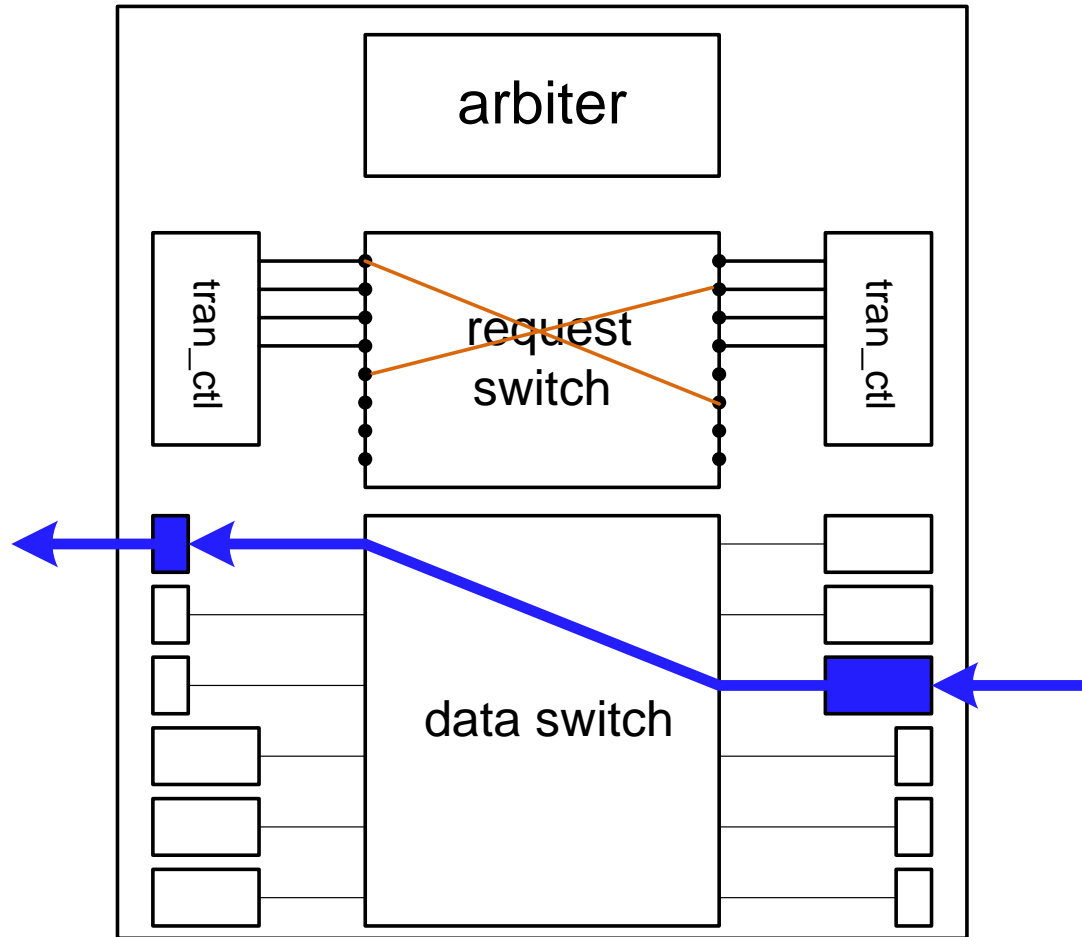
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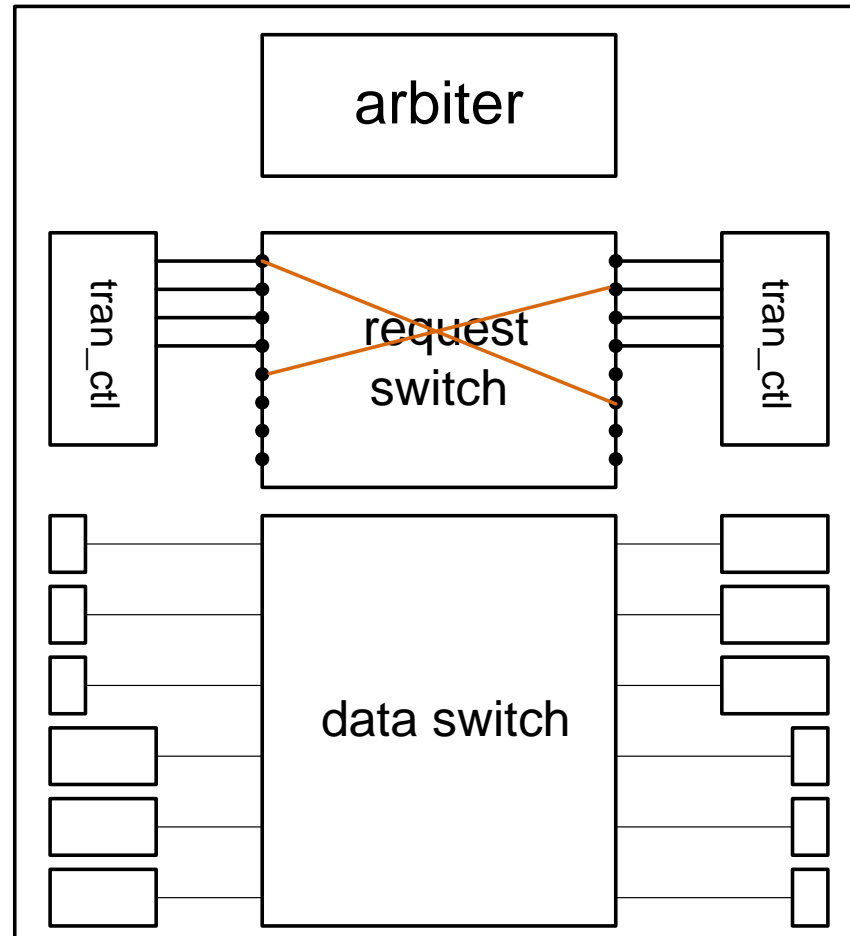
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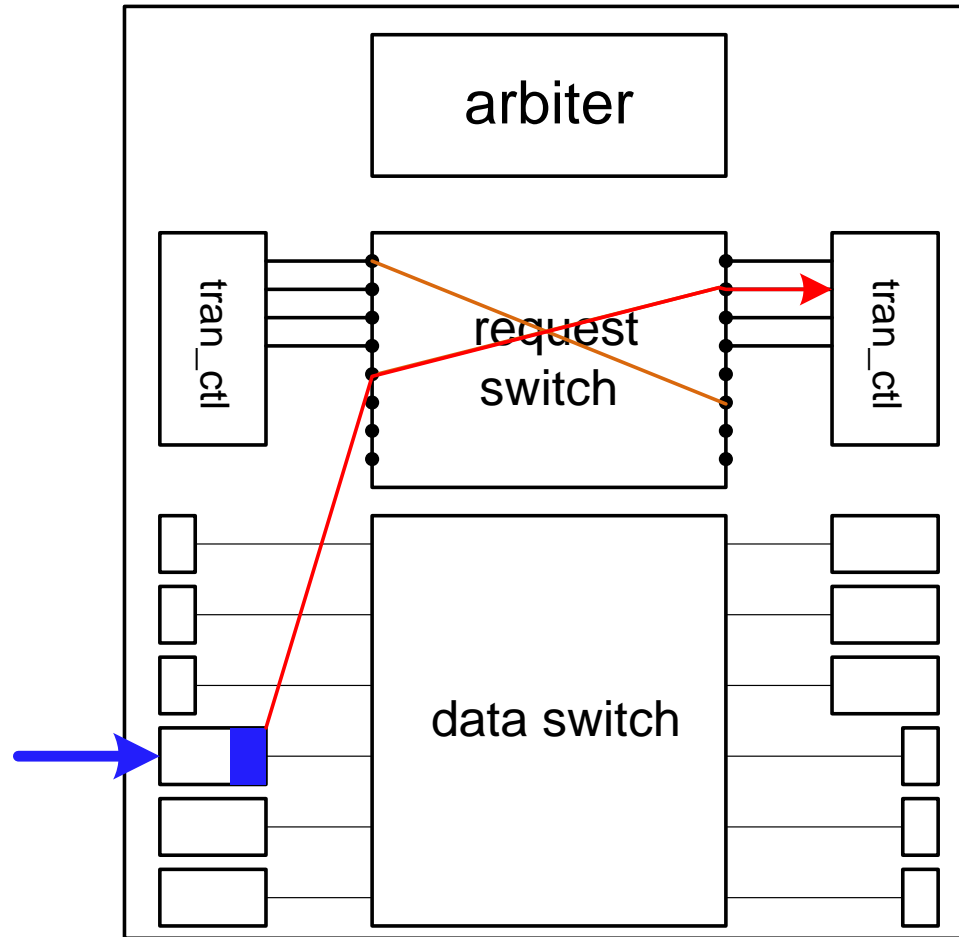
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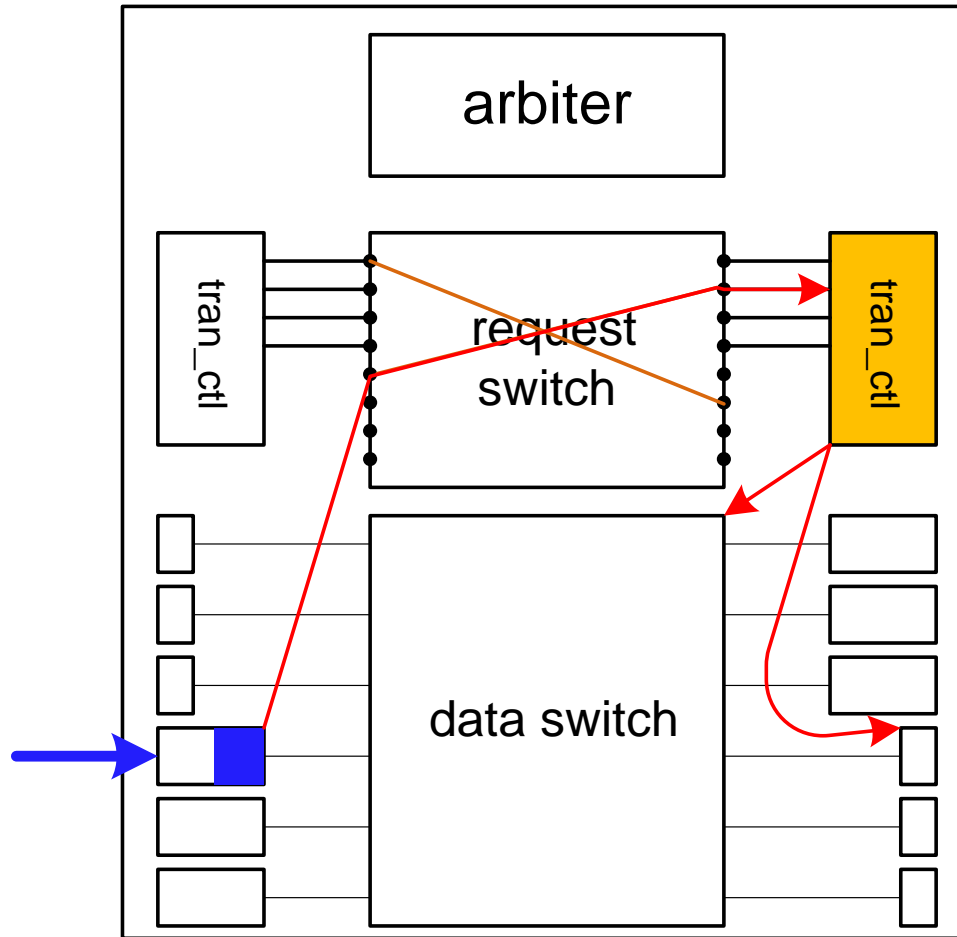
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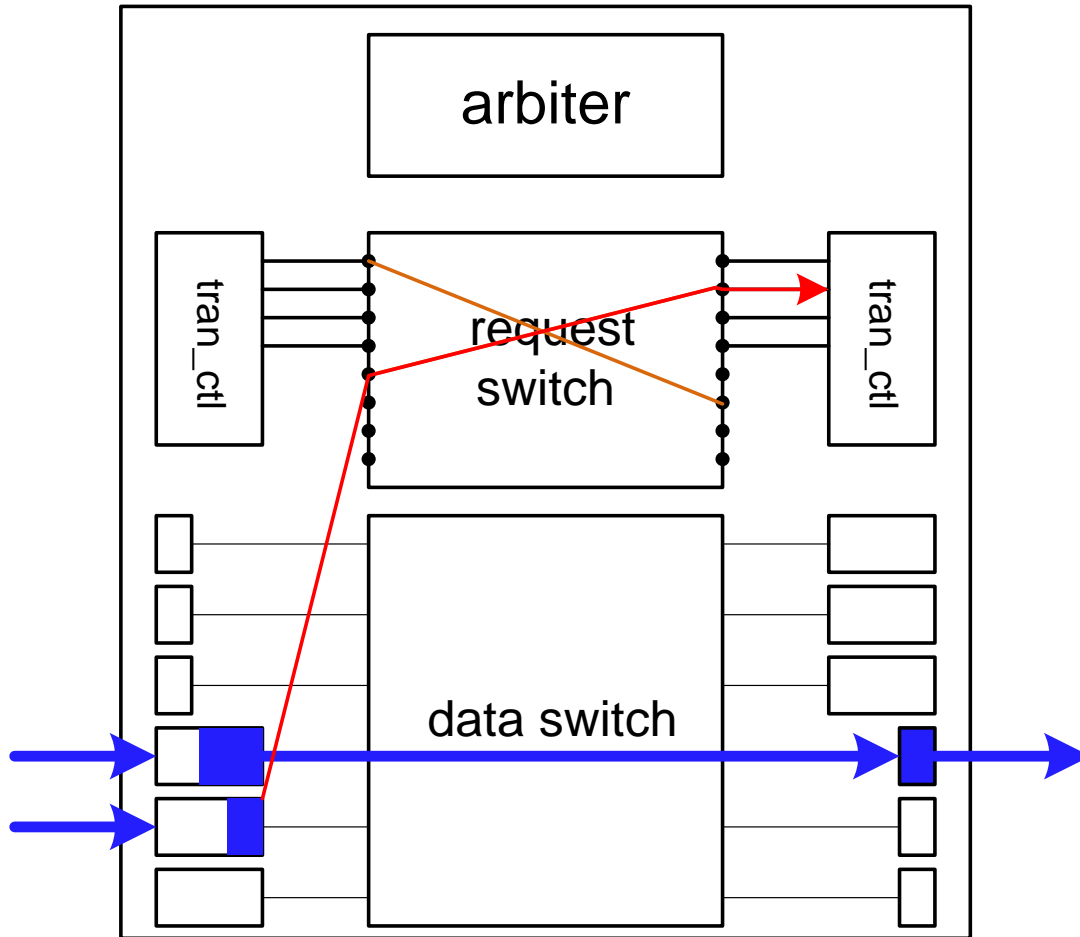
Data Flits



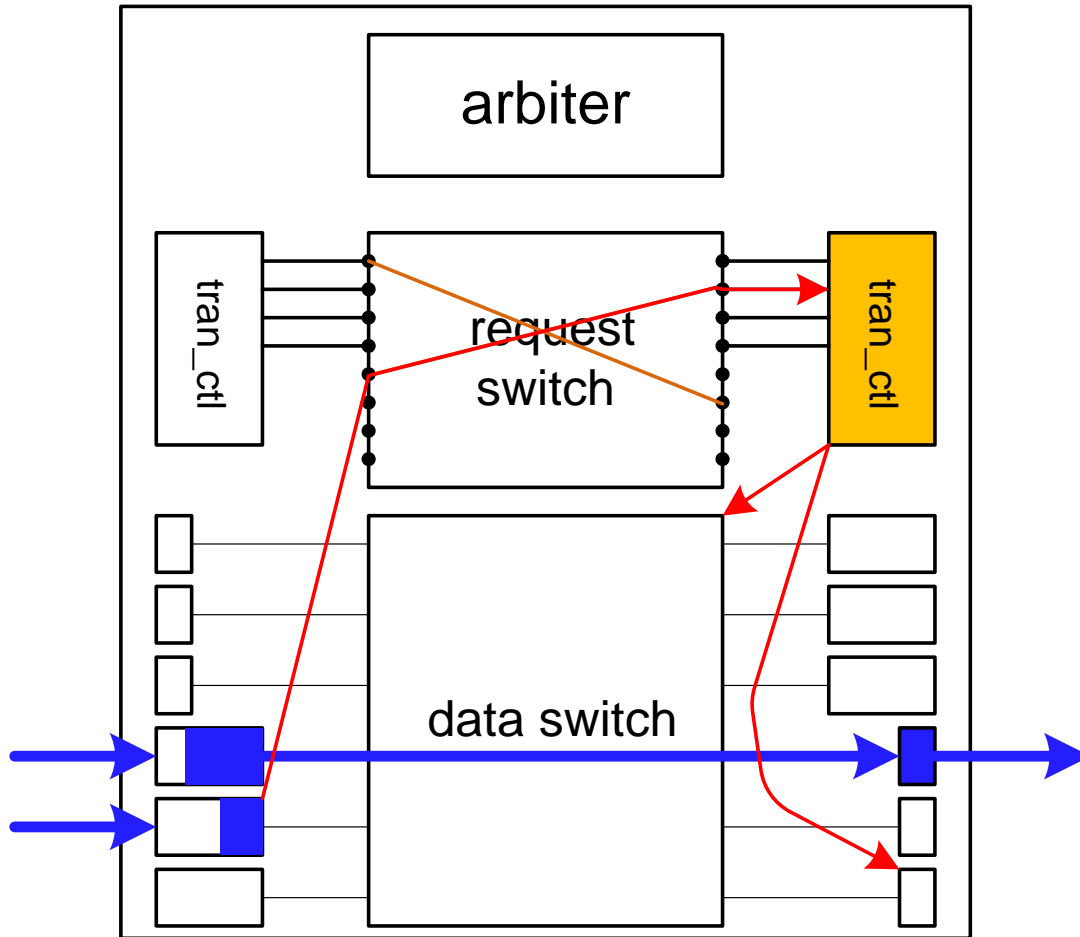
Data Flits



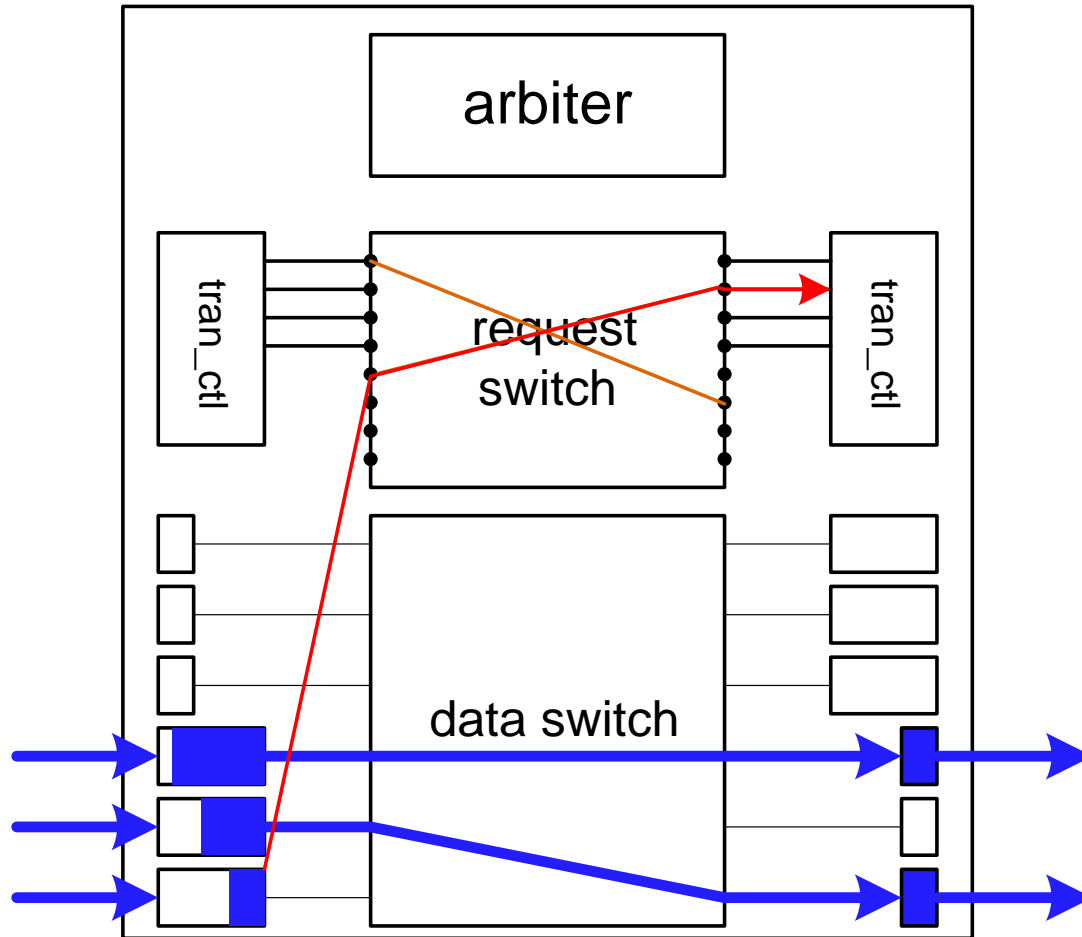
Data Flits



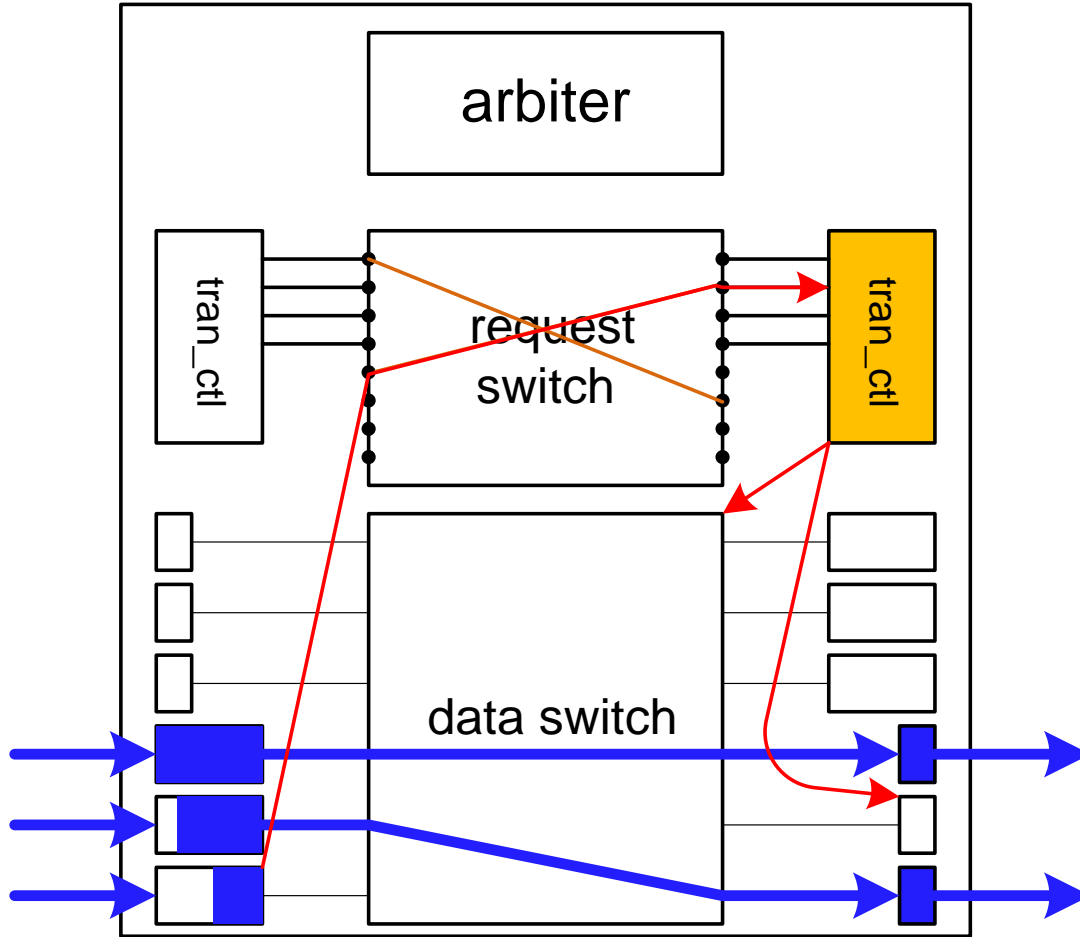
Data Flits



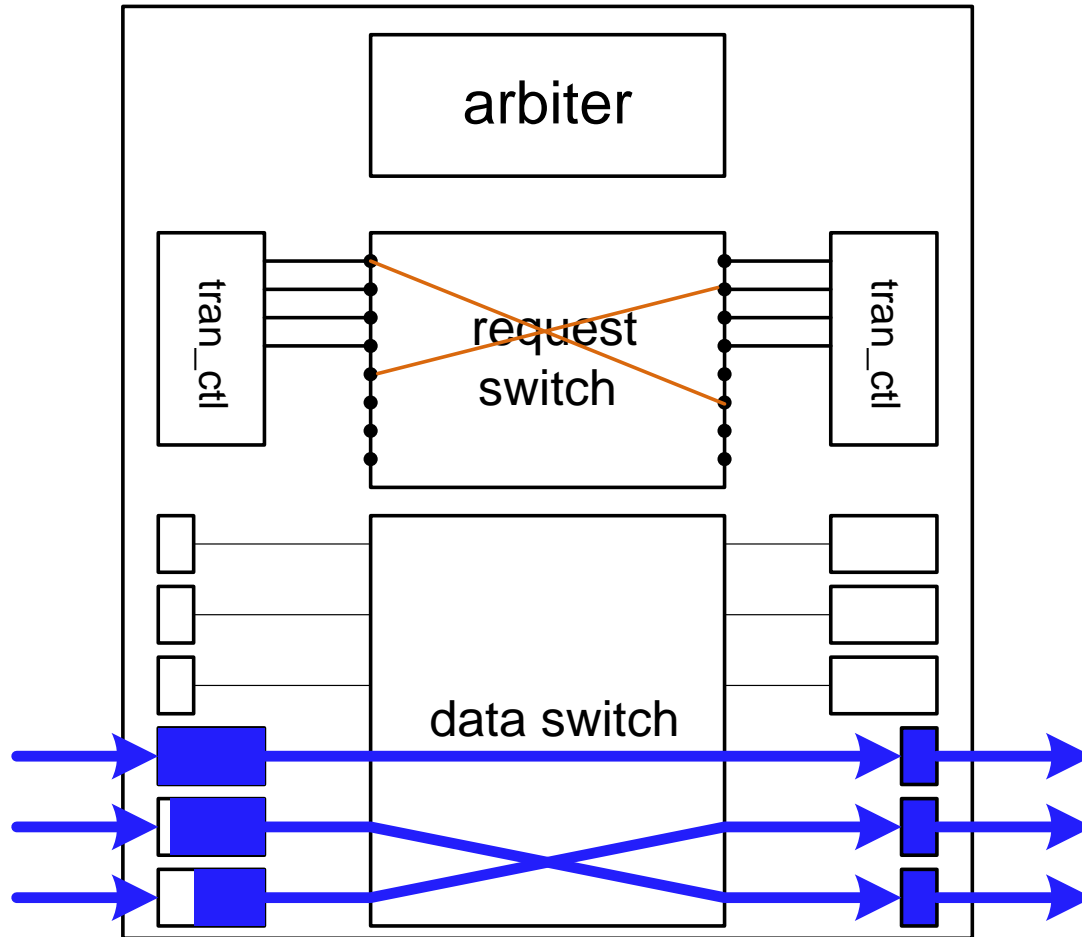
Data Flits



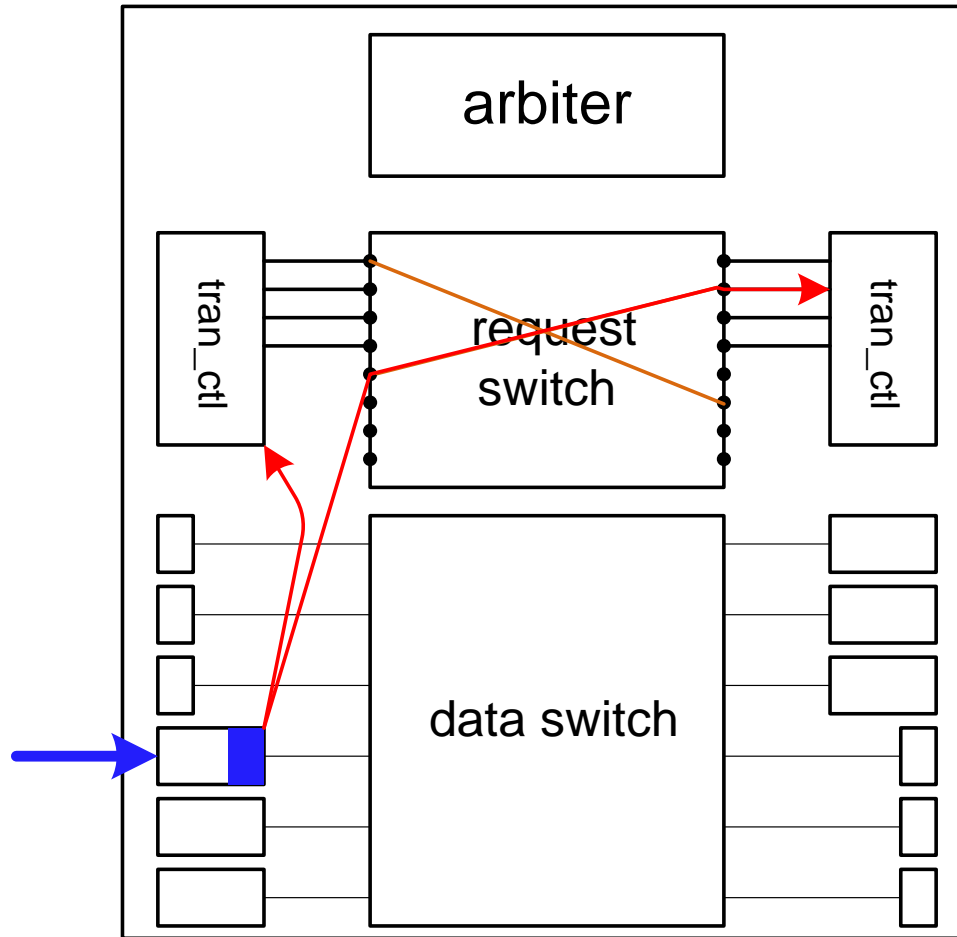
Data Flits



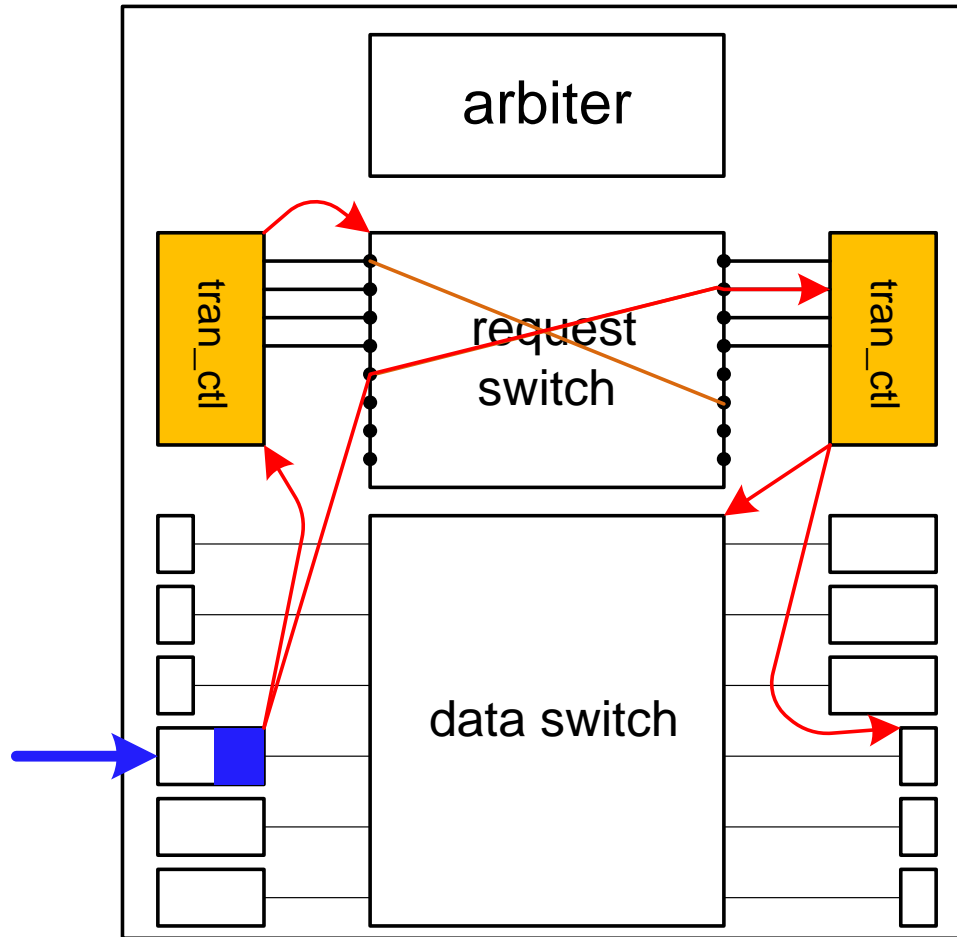
Data Flits



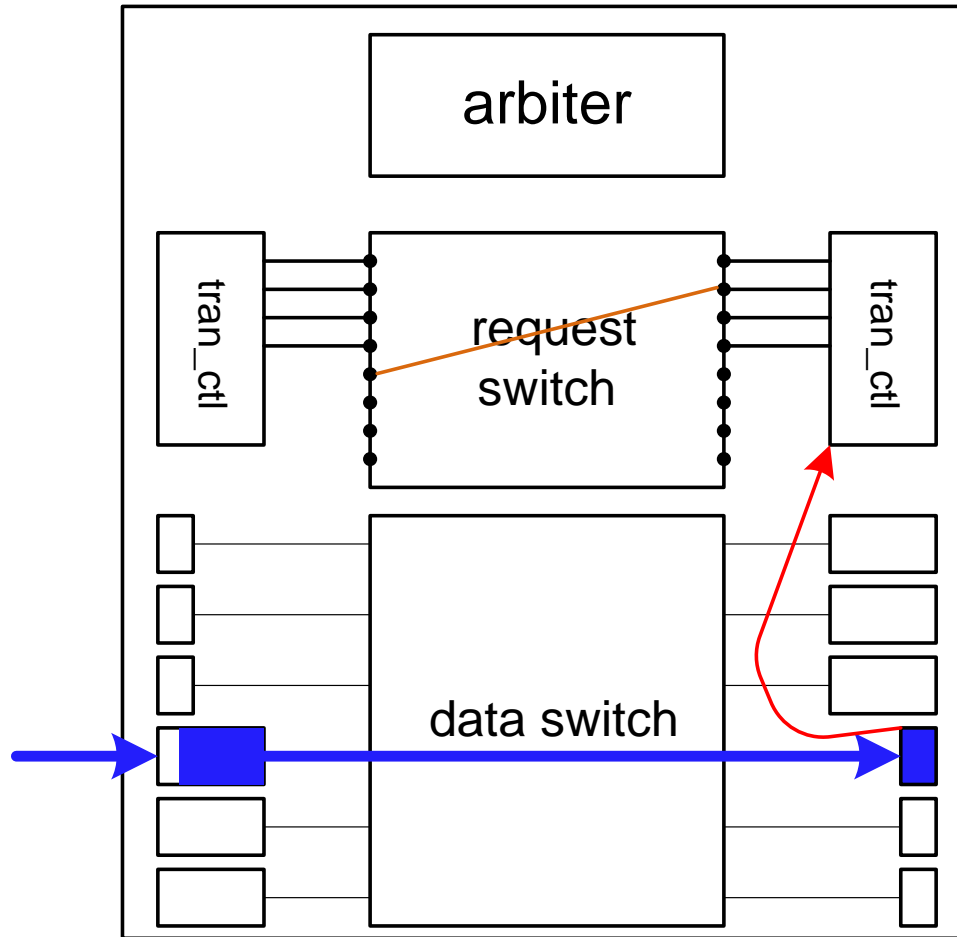
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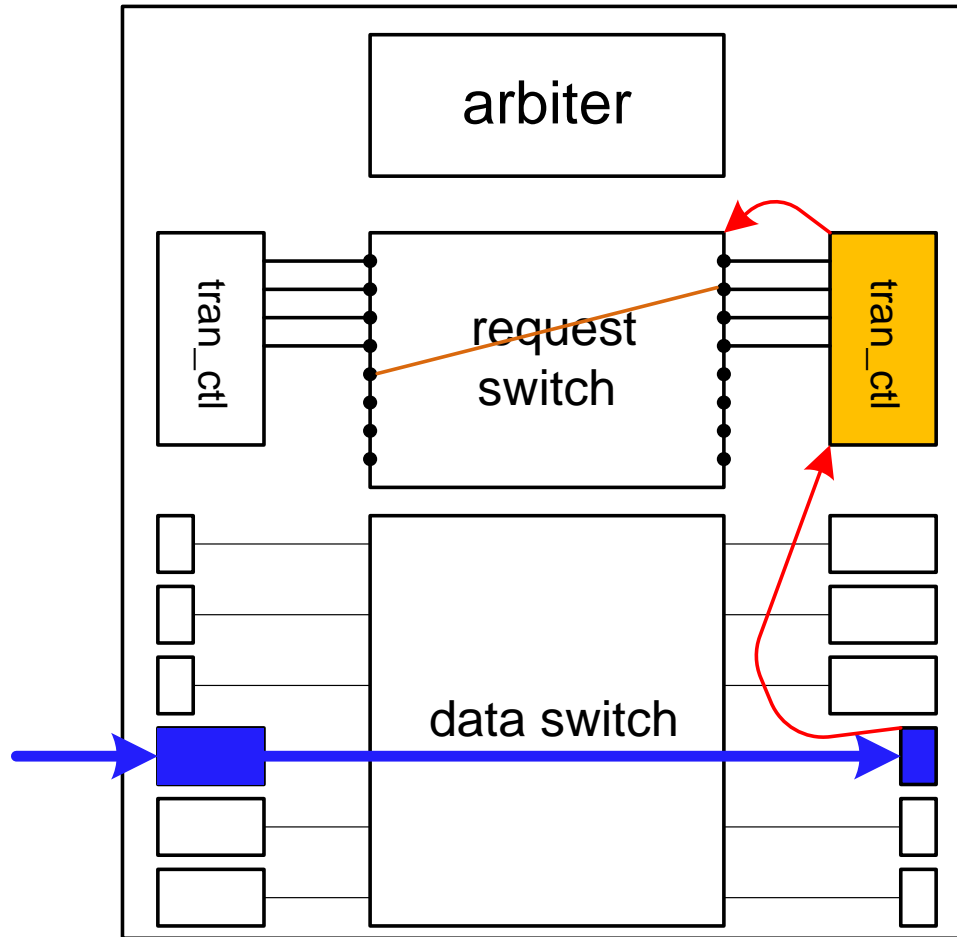
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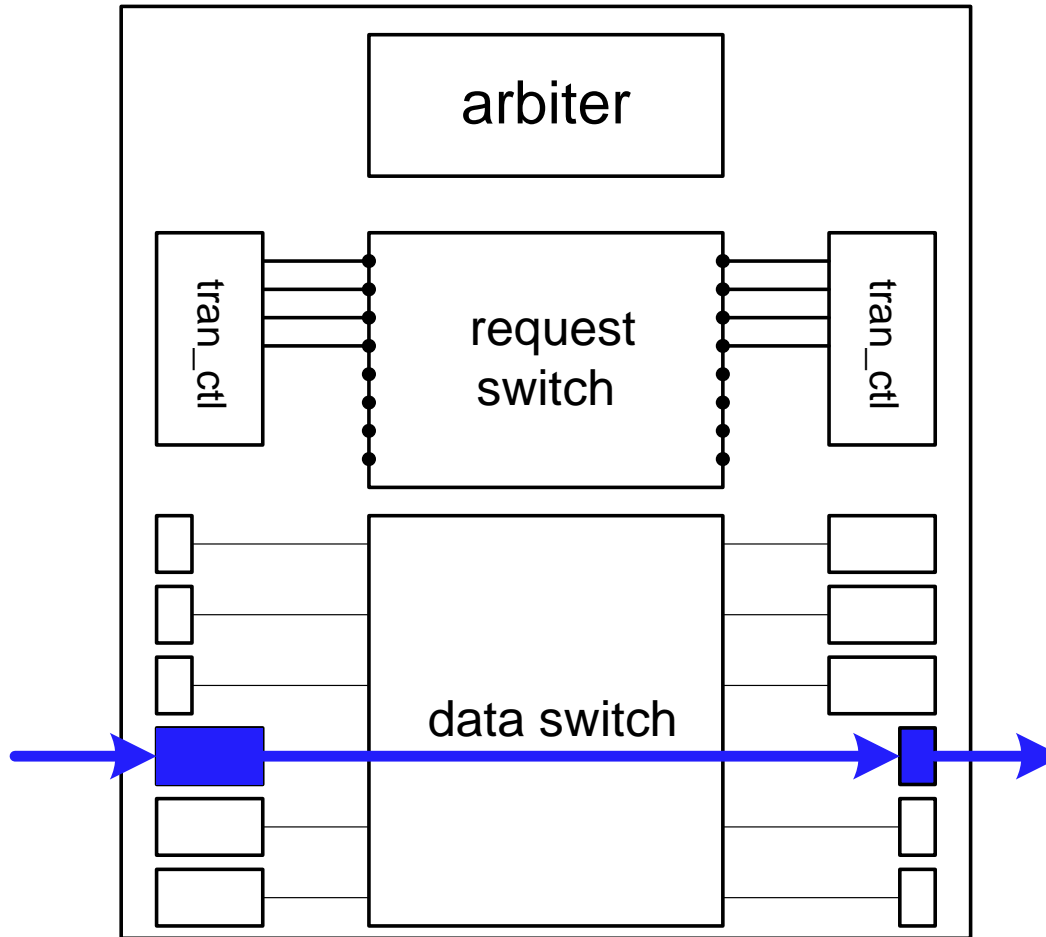
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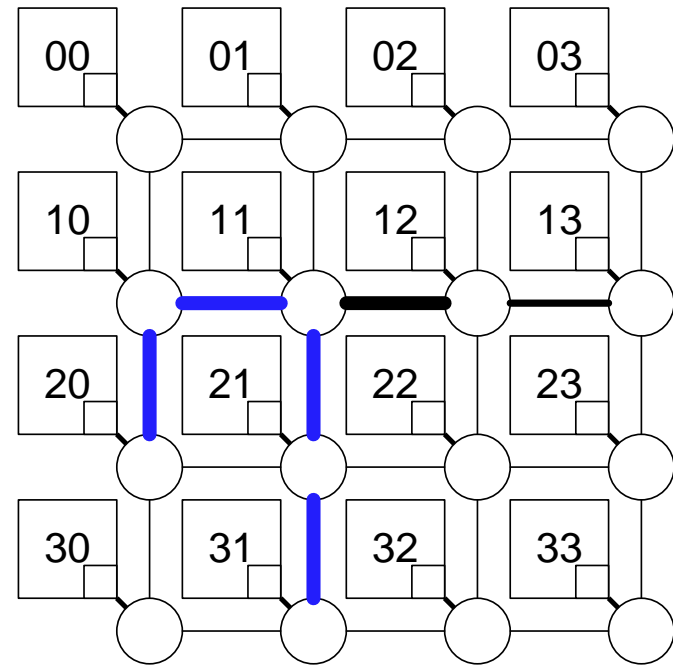
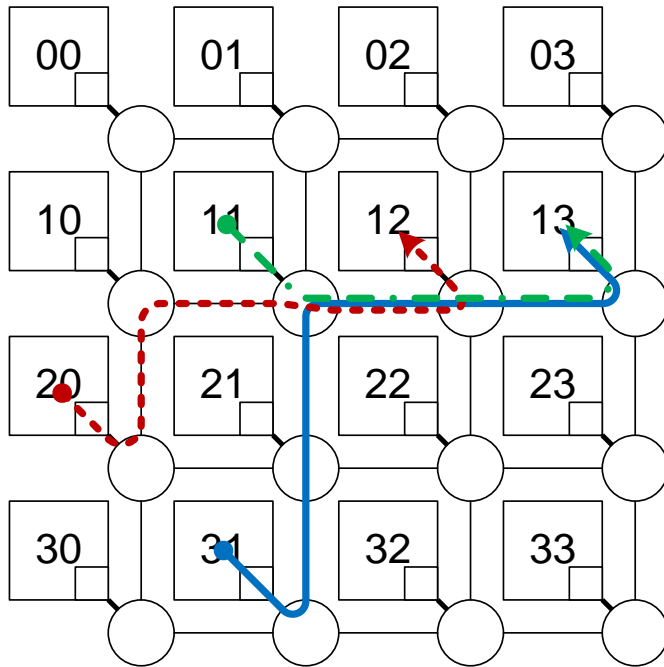
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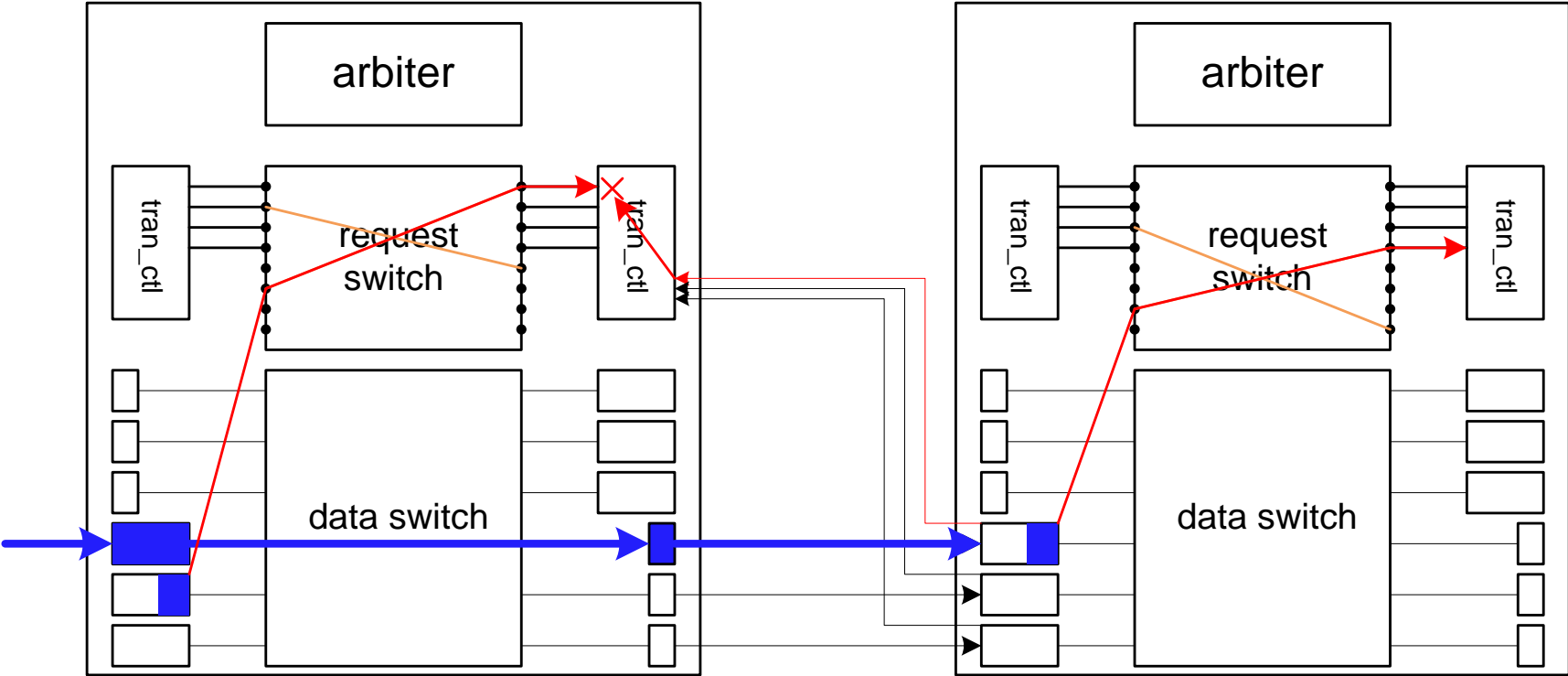
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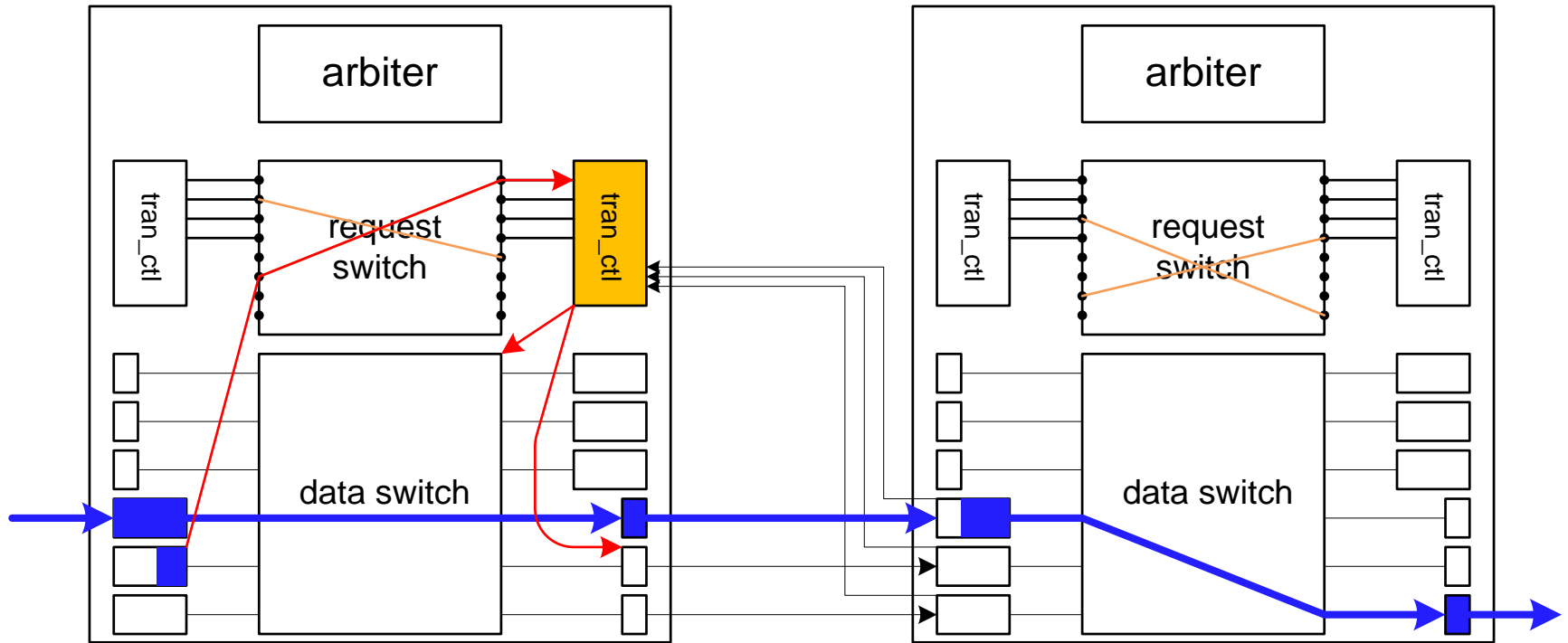
Head-of-line (HOL) Problem



Backpressure



Backpressure



Expected Performance

Table 3.1: The expected performance comparisons

| | Latency | Throughput | Power | Area |
|-------|---------|------------|--------|--------|
| SDM | worst | worst | best | best |
| DyLAR | medium | medium | medium | medium |
| VC | best | best | worst | worst |

Questions?