

NoC Design: Case Study

COE838: Systems-on-Chip Design
<http://www.ee.ryerson.ca/~courses/COE838/>

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Overview

- Application Core Graph
- NoC Mapping of MPEG-4, MWD, AV Benchmark
- NOC Topology Generation and Analysis
- Coregraph and 2D-NoC Mapping
- Determining NoC Traffic and VC Channels

Some papers to be identified in the class

NoC Design Problems

- **Application Mapping – Hardware Software Codesign/Cosynthesis (map tasks to cores)**
- **NoC Topology Selection**
- **Floorplaning/Placement (within the NoC)**
- **Routing -Wormhole Virtual Channels etc. (of messages)**
- **Buffer Sizing – (size of FIFO queues in the routers)**
- **Simulation- Using SystemC or some other environment (Network simulation for traffic, delay, power modeling)**
- **Testing ... Combined with problems of designing NOC itself (topology synthesis, switching, virtual channels, arbitration, flow control,.....)**

Topology Generation and Analysis

Aim:

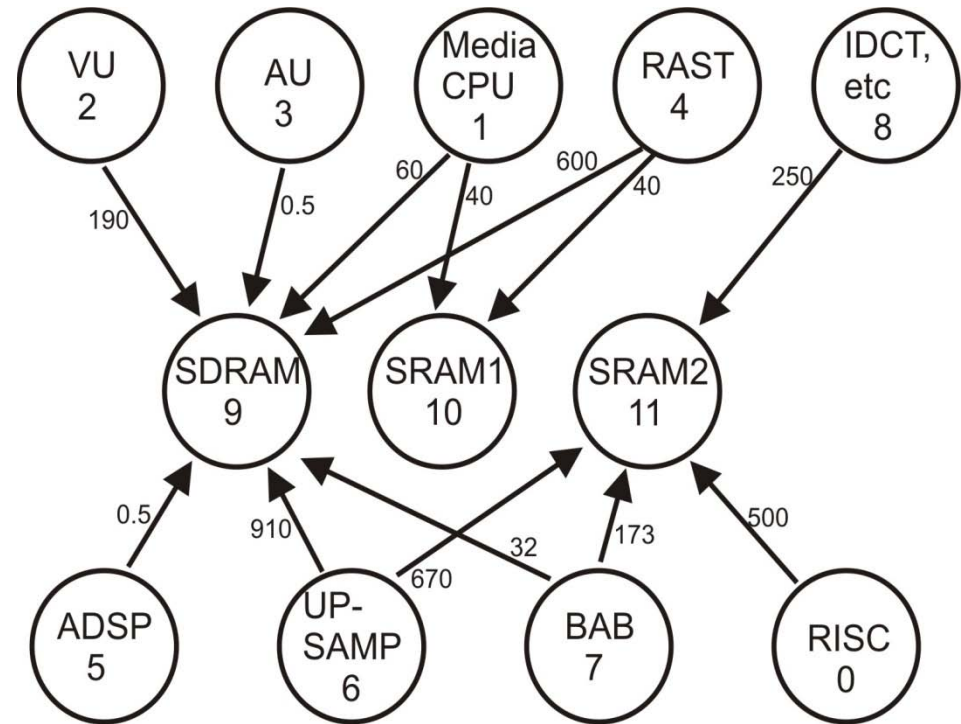
- Generate a viable network topology.
- Analyze the generated topology.

Targeted Network:

- Best-effort, wormhole switched.
- Lookup table based source routing.
- No virtual channel support.
- Round Robin switch output arbitration.
- One NI per component master or slave interface.
- All transactions converted to packets of the same length (flit count).
- Burst beats converted to separate packets.

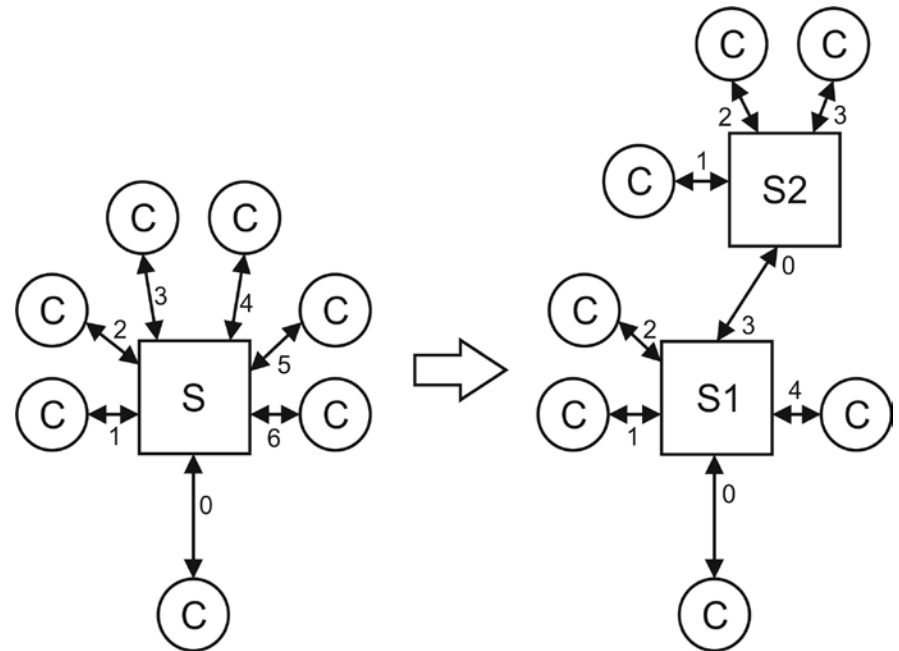
MPEG-4 Core-Graph

- Input:
 - Core Graph
 - Network Parameters
- Output:
 - Topology Graph
 - Route tables
 - Recommended Operating Clock Frequency



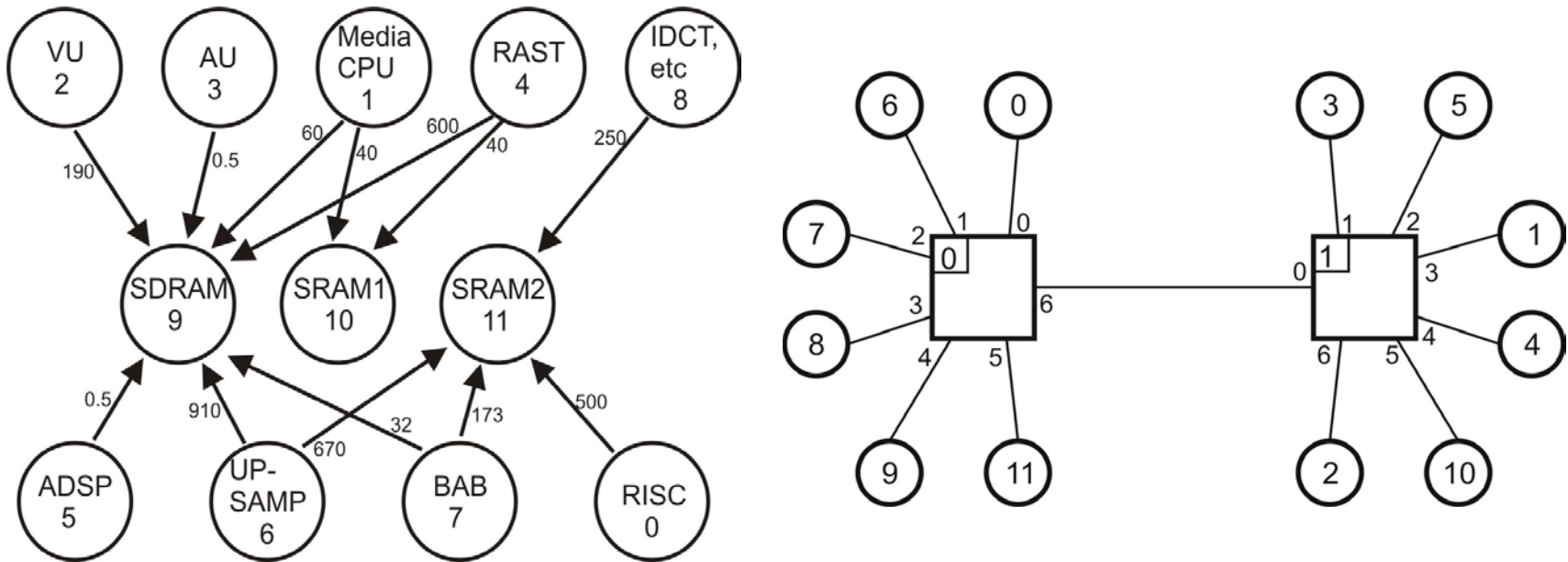
Partitioned Crossbar Topologies

- Initial topology: Fully-Connected Crossbar (single switch).
- Ideal latency situation.
- May violate maximum port requirement.
- Partitioning process.



MPEG-4 Decoder

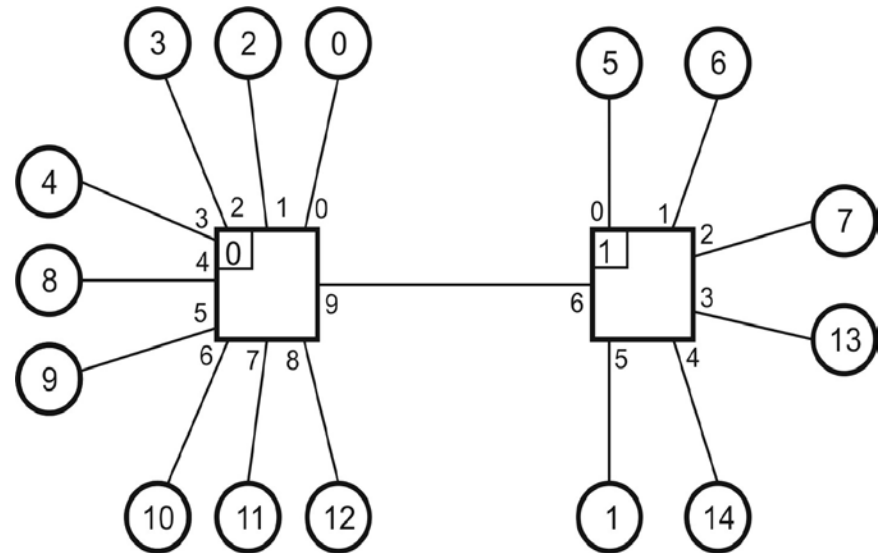
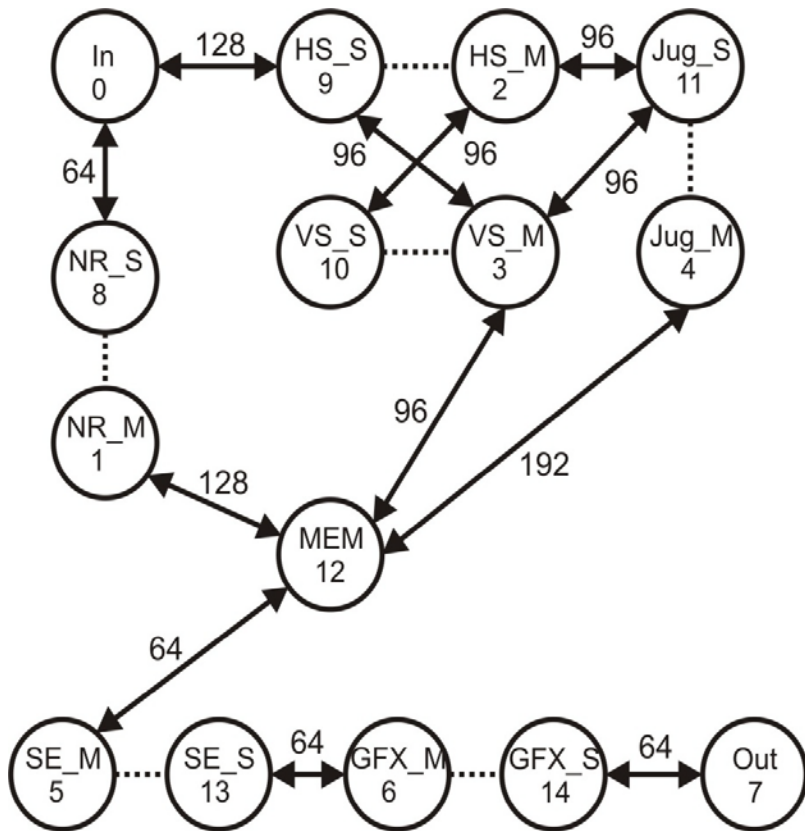
Core-graph to Application Specific NoC



- The optimal Application-specific NoC has two routers with 7 ports.
- Message require at the most require 1 hop e.g. from Core 3 to 9

MWD Application

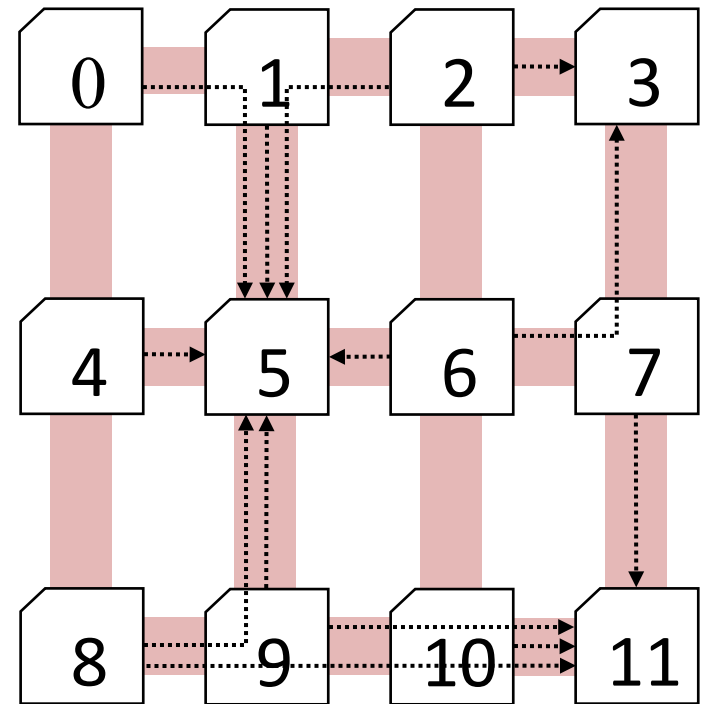
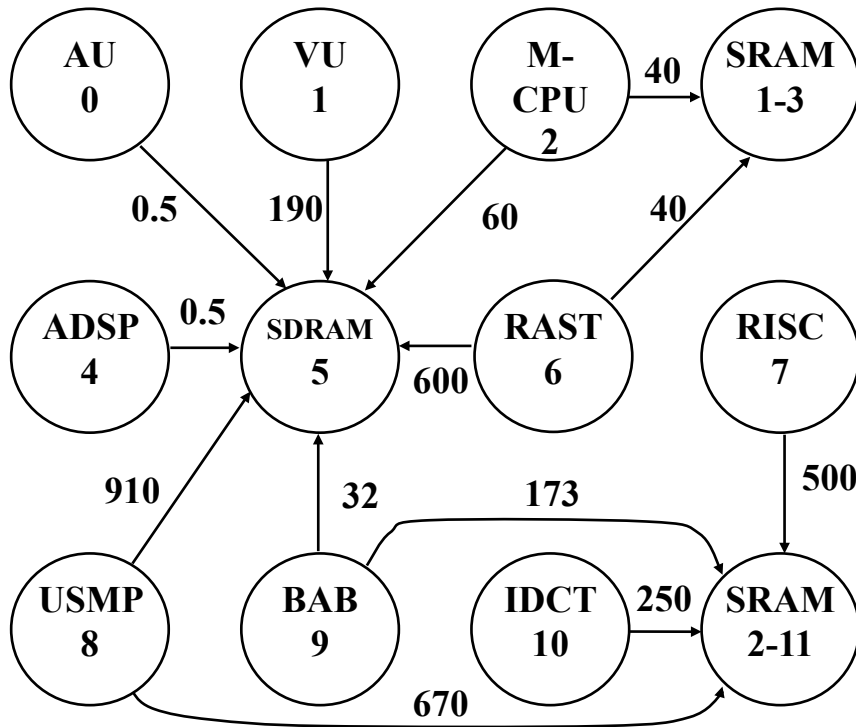
Core-graph to Application Specific NoC



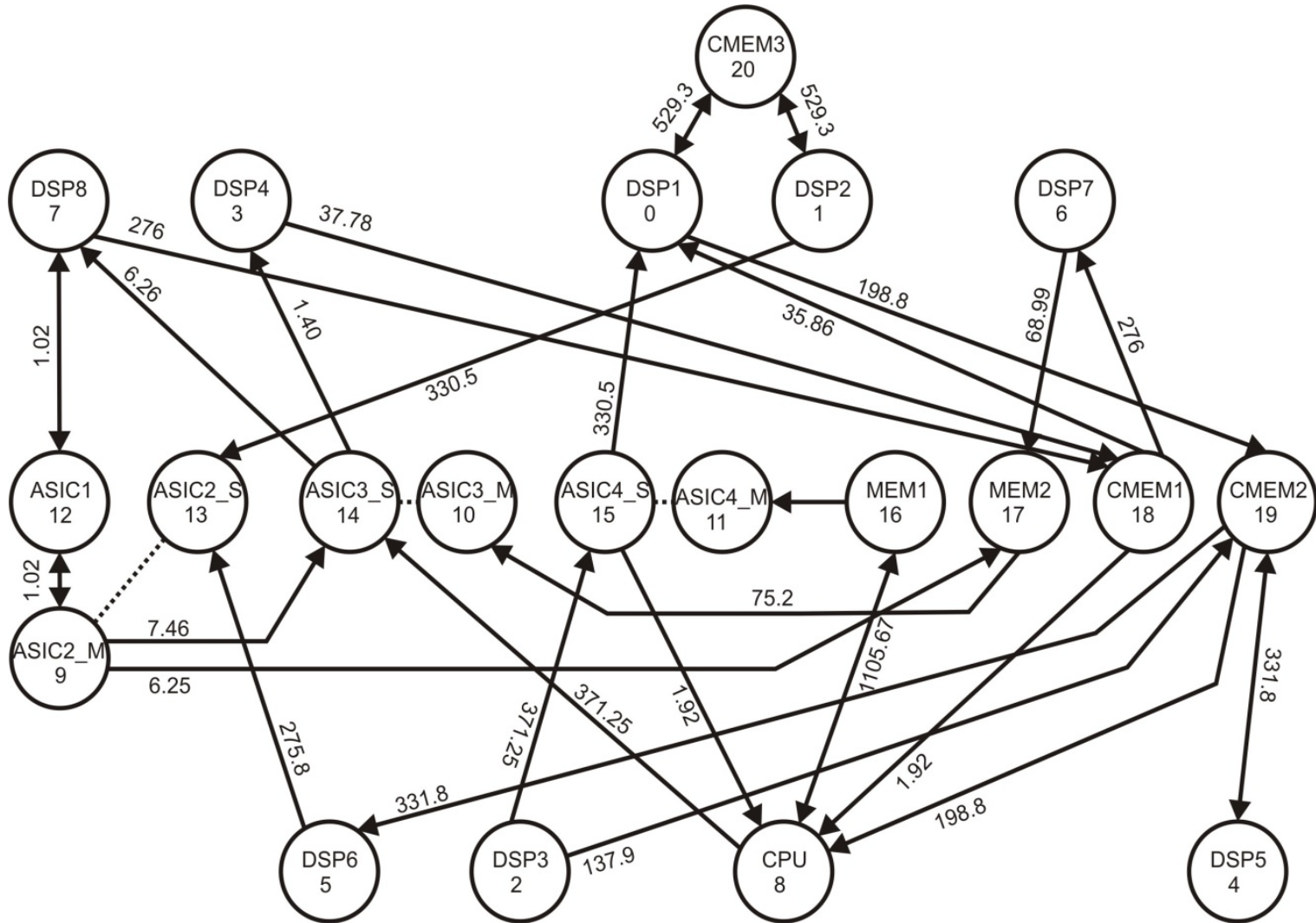
- The optimal Application-specific NoC has two routers with 10 and 7 ports.

Mapping to 2D-Mesh NoC

- 3x4 Mesh NoC has 12 routers with 5 ports each.
- We need VCs from router 1 to 5, 9 to 5 and 10 to 11.

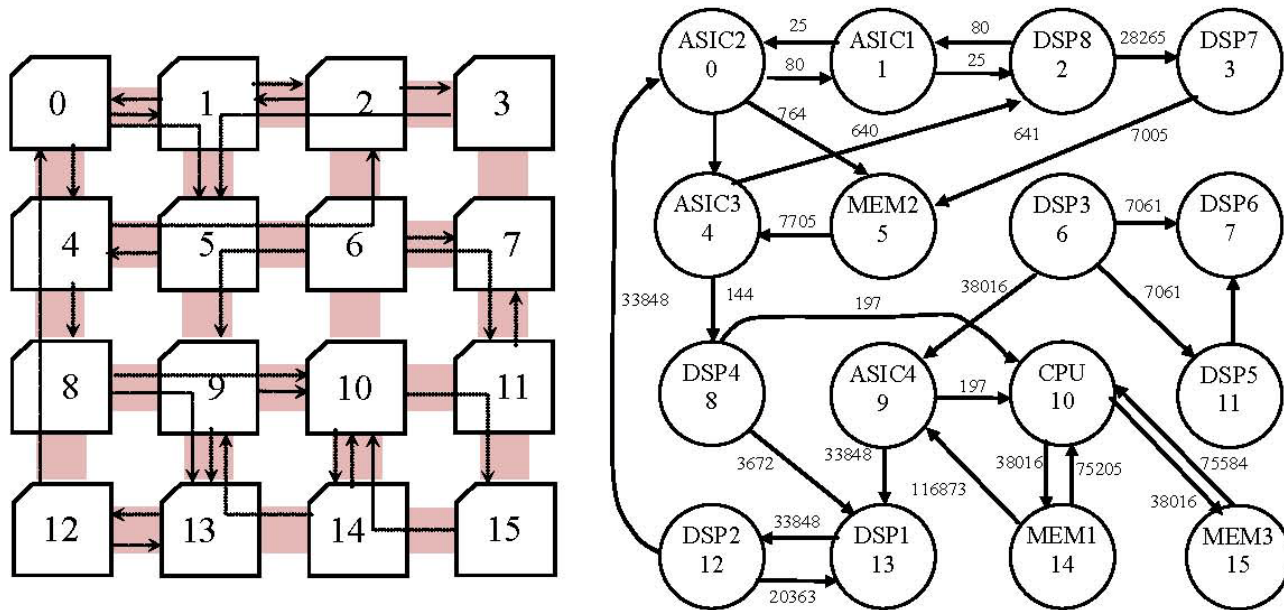


AV Benchmark



Mapping to 2D-Mesh NoC

AV Benchmark



- 4x4 Mesh NoC has 16 routers with 5 ports each.
- We need multiple VCs for some routers.