MANCHESTER 1824

The University of Manchester

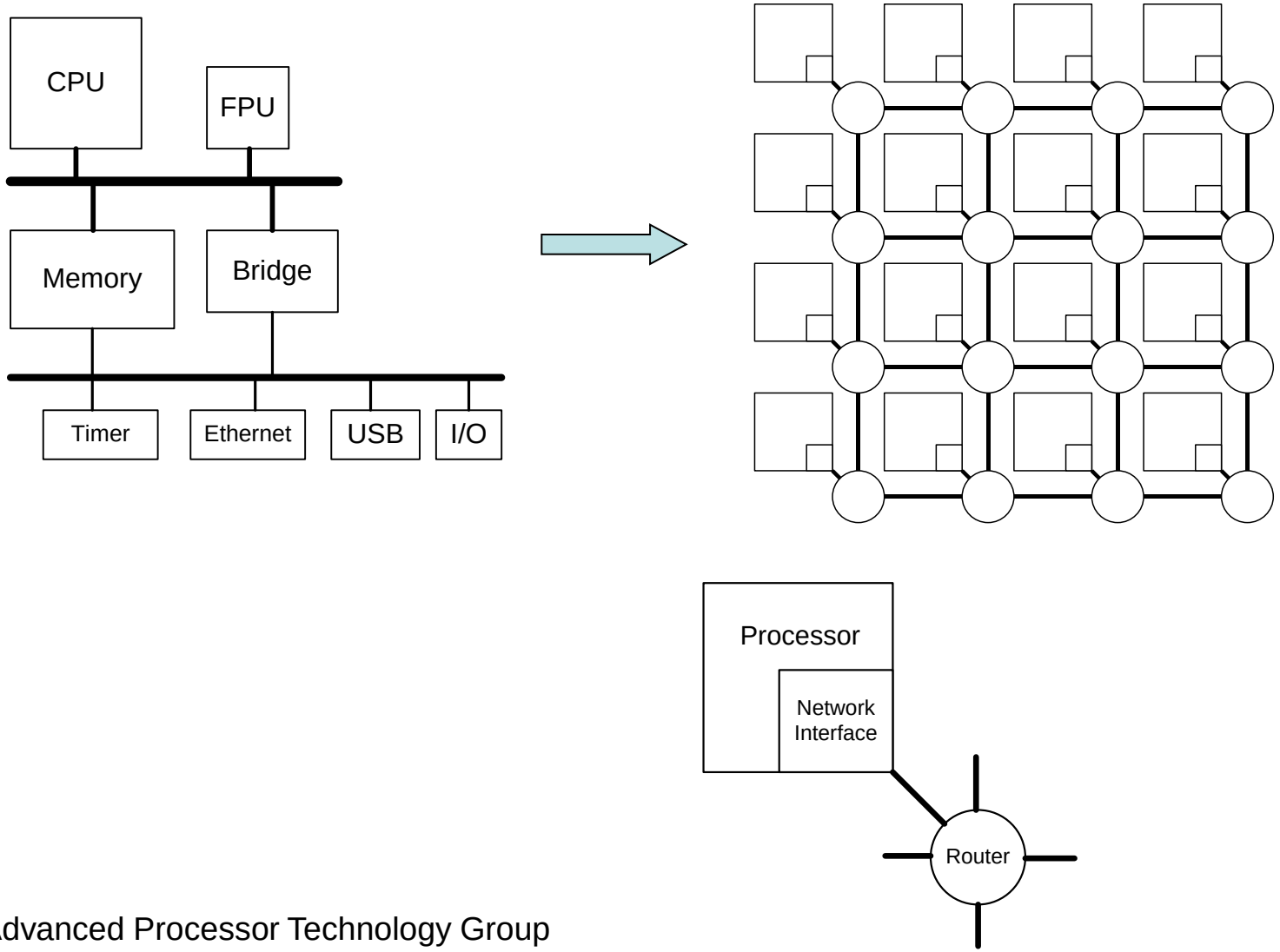
From Channel Slicing to Spatial Division Multiplex for Asynchronous Networks-on-Chip

Wei Song

Supervisor: Doug Edwards

Advisor: Christopher Harrison

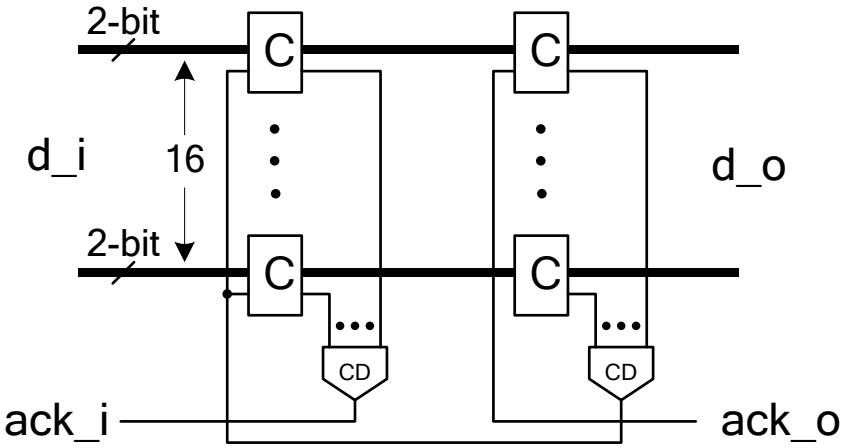
Background: Networks-on-Chip

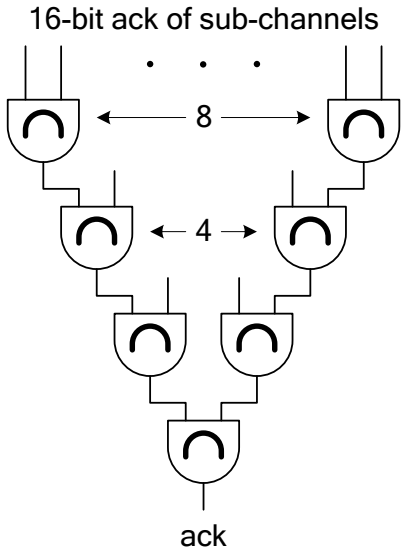


Synchronous/Asynchronous

- Synchronous
  - Clock triggered
  - Fast
  - Small
  - Power Consuming
  - Sensitive to variation
  - Complex clock tree
- Asynchronous
  - Handshake
  - Slow !!
  - Large
  - Power Efficient
  - Tolerance to variation
  - No clock tree

Why asynchronous is slow?

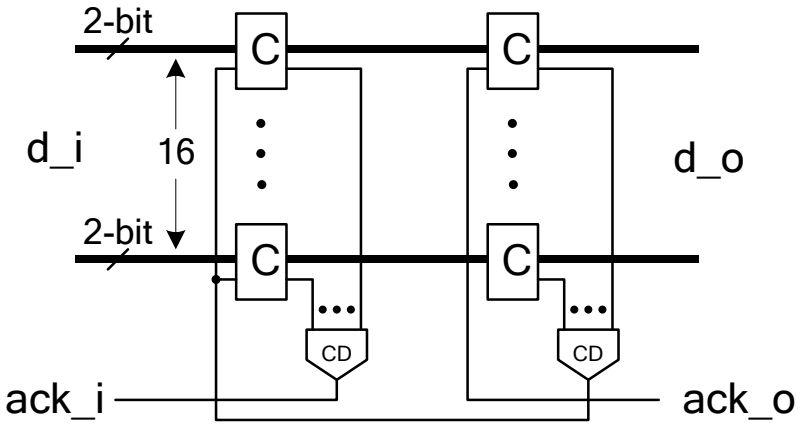


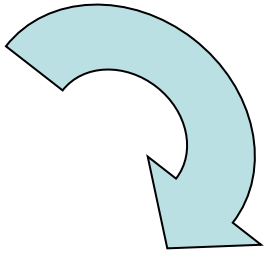


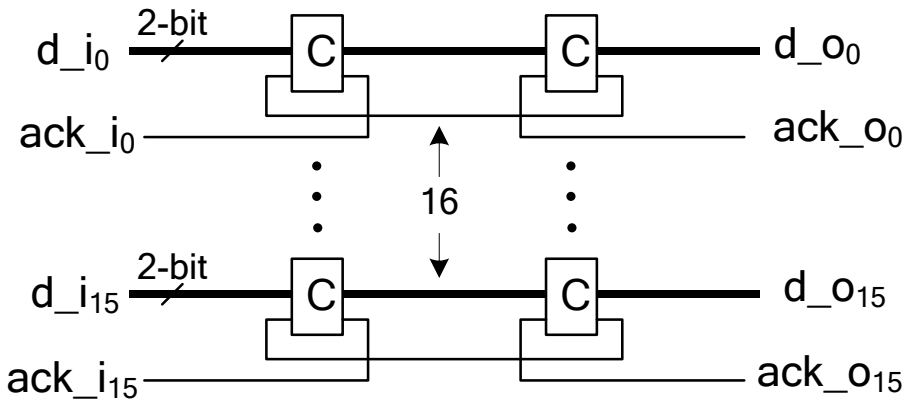
Advantages: data on all sub-channels are synchronized, ease the time division multiple access (TDMA) techniques, such as virtual channel and TDMA

Drawbacks: low speed (66% on CD)

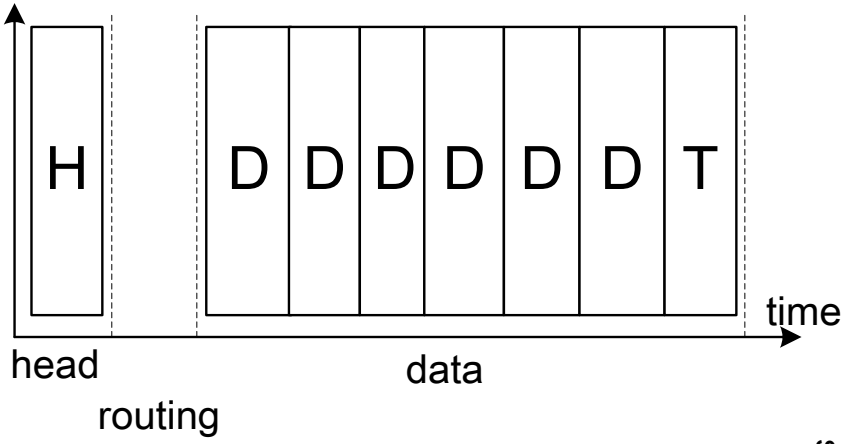
ChSlice: implementation

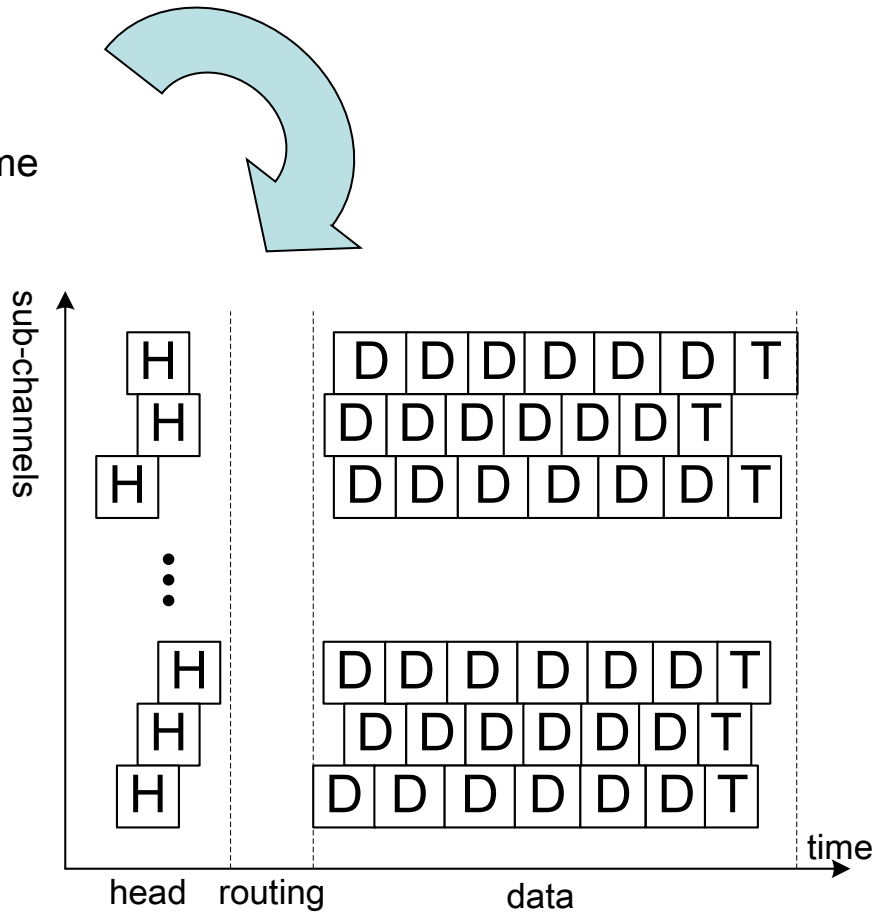






Flow control

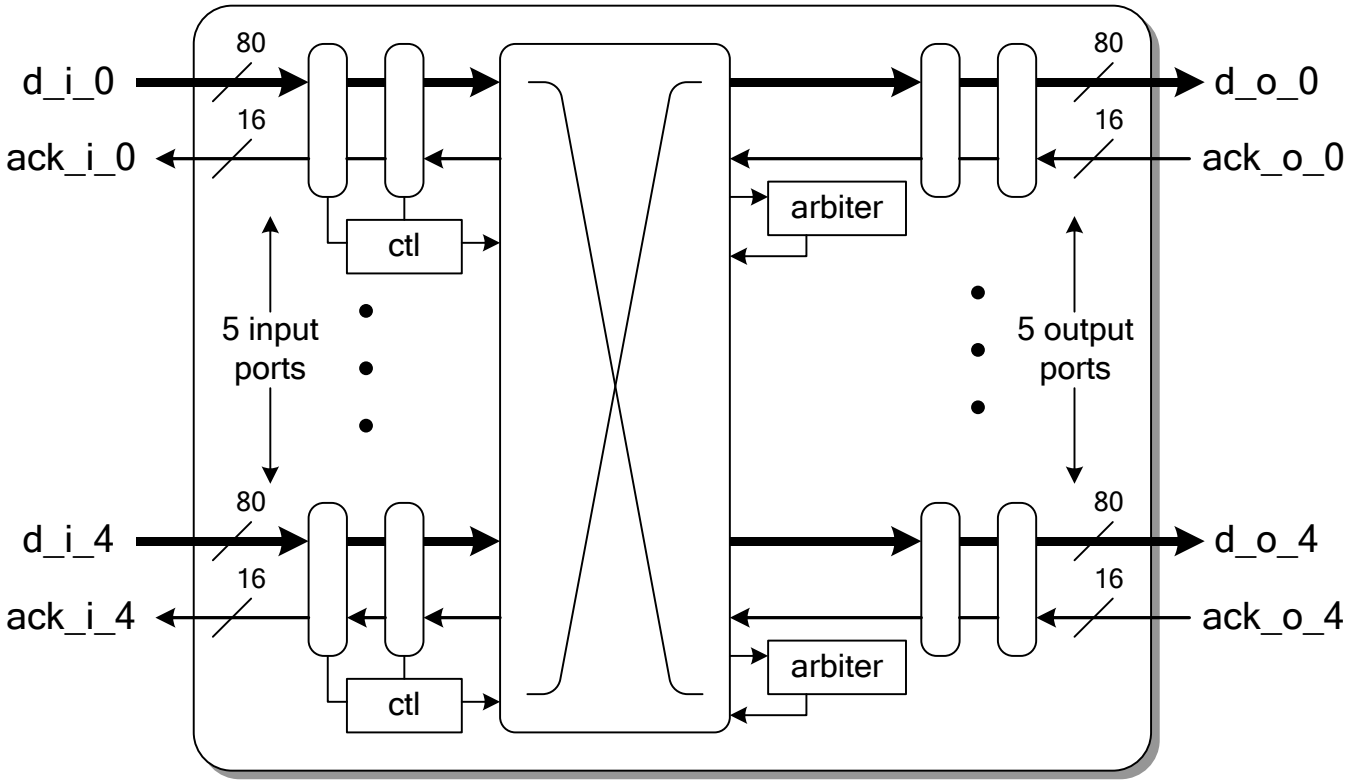




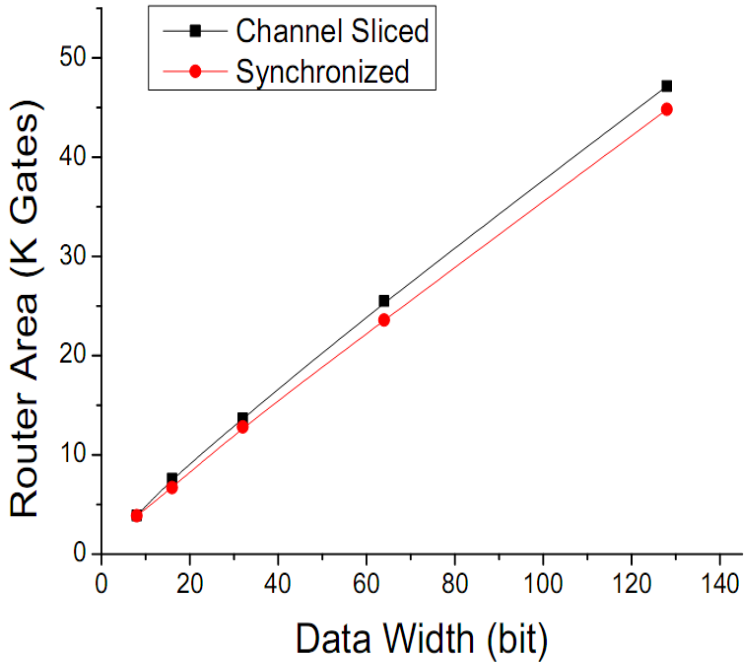
MANCHESTER 1824

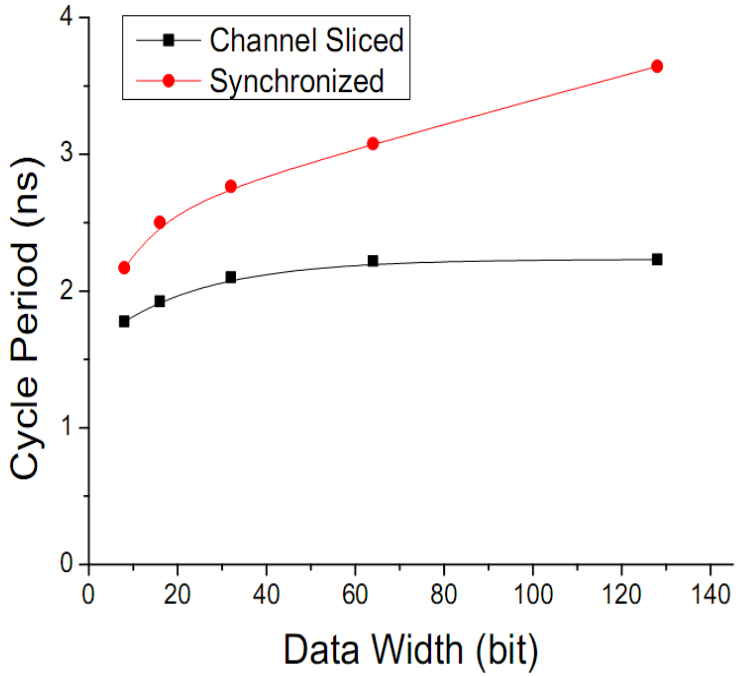
The University of Manchester

Router: structure



Speed and Area





Future Work

- Implementation of a Spatial Division Multiplex (SDM) router (under test)
  - Switch structure
    - Clos Switch Networks
  - Path scheduling algorithm
    - random round-robin -> random arbitration
- Quality of Services support
  - Two switch structure in one router

MANCHESTER 1824

The University of Manchester

Publications

1. Wei Song and Doug Edwards. **Channel Slicing: a way to build fast routers for asynchronous NoCs**. *Proceedings of the UK Asynchronous Forum*, Sep. 2009.
2. Wei Song and Doug Edwards. **A low latency wormhole router for asynchronous on-chip networks**. ASP-DAC, 2010, in submission.
3. Wei Song and Doug Edwards. **Building asynchronous routers with independent sub-channels**. *Proc. of international Symposium on SOC*, Oct. 2009.
4. Wei Song, Doug Edwards, Jose Nunez-Yanez, and Sohini Dasgupta. **Adaptive stochastic routing in fault-tolerant on-chip networks**. *NOCS*, Pages 32-37, 2009.
5. Wei Song and Doug Edwards. **A dynamic link allocation router**. *Proceedings of the UK Asynchronous Forum*, Sep. 2008.

Question?

MANCHESTER 1824

The University of Manchester

Compare with other routers

	Tech (nm)	Period (ns)	Period (Hz)	Pipeline Style	Other
Sliced Wormhole	130	2.2	450M	4-phase 1-of-4	Standard cell
Synchronized Wormhole	130	2.8	360M	4-phase 1-of-4	Standard cell
ANoC	130	4.0	250M	4-phase 1-of-4	Customized Cell Lib
ASPIN	90	0.88	1.13G	Dual-Rail / Bundled-Data	Customized Cell Lib
QNoC	180	4.8	208M	Bundled-data	Delay line
MANGO	120	1.26	790M	Bundled-data	Delay line
DSPIN	130	2.45	408M	Synchronous circuit	

MANCHESTER 1824

The University of Manchester

Crossbar, Benes, Clos