Digital Integrated Circuit Design

Module BusIntro

On-chip Buses and Interconnects : Introduction

W. Rhett Davis

Why do we care?

- What is a Bus?
- What is an Interconnect?
- Why do we use them?

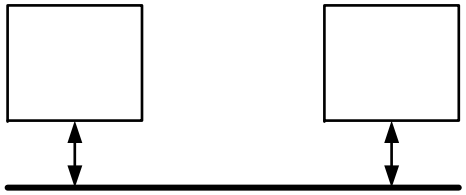
Our Question

- Which bus or interconnect should we use?

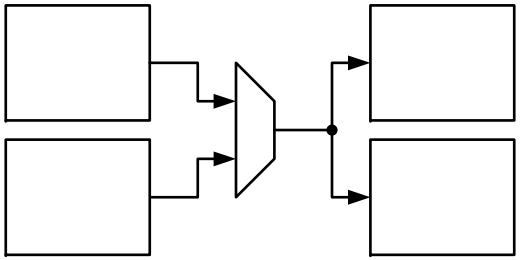
  The answer depends on the following:

  - What IP blocks do we have and what do they work with?
  - How many ports do we need?
  - What kind of overhead can we permit?
    - Throughput
    - Area
    - Power

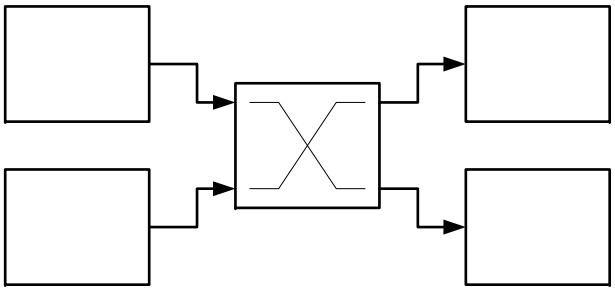
Types of Interconnects



- Shared Wire



- Central Mux



- Crossbar
- Other Issues:
  Queueing, Pipelining

Bus & Interconnect Standards

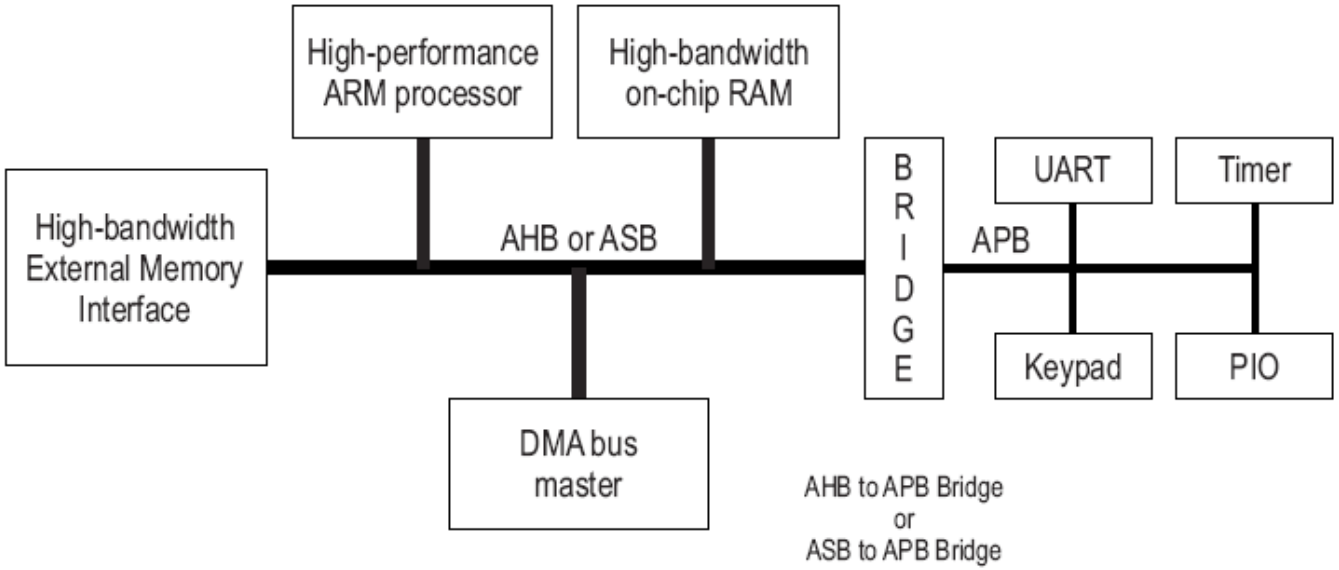
- AMBA from ARM
- Wishbone from OpenCores.org
- CoreConnect from IBM
- Sonics “Silicon Backplane”

We’ll focus on AMBA in this class, because it's the most commonly used

AMBA Introduction

- Advanced Microcontroller Bus Architecture (AMBA), created by ARM as an interface for their microprocessors.
- Easy to obtain documentation (free download) and can be used without royalties.
- Very common in commercial SoC's (e.g. Qualcomm Multimedia Cellphone SoC)
- History:
  - AMBA 2 released in 1999, includes APB and AHB
  - AMBA 3 released in 2003, includes AXI and AHB-Lite
  - AMBA 4 released in 2010, includes AXI4-Stream

AMBA 2.0 System-Level View



AMBA AHB

* High performance
* Pipelined operation
* Multiple bus masters
* Burst transfers
* Split transactions

AMBA ASB

* High performance
* Pipelined operation
* Multiple bus masters

AMBA APB

* Low power
* Latched address and control
* Simple interface
* Suitable for many peripherals

Source: AMBA Specification, Rev. 2.0

Comparison of AMBA Bus Types

	APB	AHB	AHB-Lite	AXI / PL300
Processors	all	ARM7,9,10	ARM Cortex	ARM11
Control Signals	4	27	12	77
No. of Masters	1	1-15	1	1-16
No. of Slaves	1-15	1-15	1-15	1-16
Interconnect Type	Central MUX	Central MUX	Central MUX	Crossbar w/ 5 channels
Phases	Setup, Enable	Bus request, Address, Data	Address, Data	Address, Data, Response
Xact. Depth	1	2	2	16
Burst Ops.	no	yes	yes	yes
Simultaneous Read & Write	no	no	no	yes

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Thanks for watching