ROHINI COLLEGE OF ENGINEERING & TECHNOLOGY
(AUTONOMOUS)
Approved by AICTE & Affiliated to Anna university | All Eligible Courses Accredited by NBA
Accredited by NAAC with A+ Grade
KANYAKUMARI, TAMIL NADU

24EC302 DIGITAL LOGIC CIRCUITS AND DESIGN

INNOVATIVE TEACHING METHOD

I YEAR AI DS II SEMESTER

Flash Card

ASIC VS FPGA

ASIC vs FPGA: Choosing the Right Path in VLSI! ⚙️ 💡

In the VLSI world, ASIC (Application Specific Integrated Circuit) and FPGA (Field Programmable Gate Array) are two powerful solutions — but serve very different purposes.

🔍 What's the Difference?

◇ ASIC
✔️ Custom-built for a specific task
✔️ High performance & low power
✔️ Used in smartphones, GPUs, processors
❗ Long development time & costly
💡 Best for mass production and performance-critical applications

◇ FPGA
✔️ Reprogrammable hardware
✔️ Faster time-to-market
✔️ Perfect for prototyping & R&D
❗ Less optimized for power/performance
💡 Ideal for flexible and rapid development cycles

For chip design, physical design, or backend flow, ASIC is the path.
For rapid prototyping, digital logic design, or embedded systems, FPGA is the go-to.

🌐 As the industry evolves with AI/ML, 5G, and automotive tech, both ASIC and FPGA are playing critical roles — and VLSI engineers with expertise in either (or both!) are in massive demand.

ASIC vs FPGA

Choosing the Right Path in VLSI

ASIC

- Custom-built for a specific function
- High performance, low power
- Used in smartphones, GPUs, processors
- Long development cycle
- Best for large-scale, performance-driven products

FPGA

- Reprogrammable hardware
- Fast time-to-market
- Great for prototyyping & R&D
- Less bower/ performance optimized
- Ideal for flexibility & early-stage designs

CAREER FOCUS

ASIC
Physical Design, Backend, Chip Deign

FPGA
Embedded Systems, RTL, Prototyping

Tell us—Have you worked with either? Which one do you prefer?

INDUSTRY USE CASES

Auto

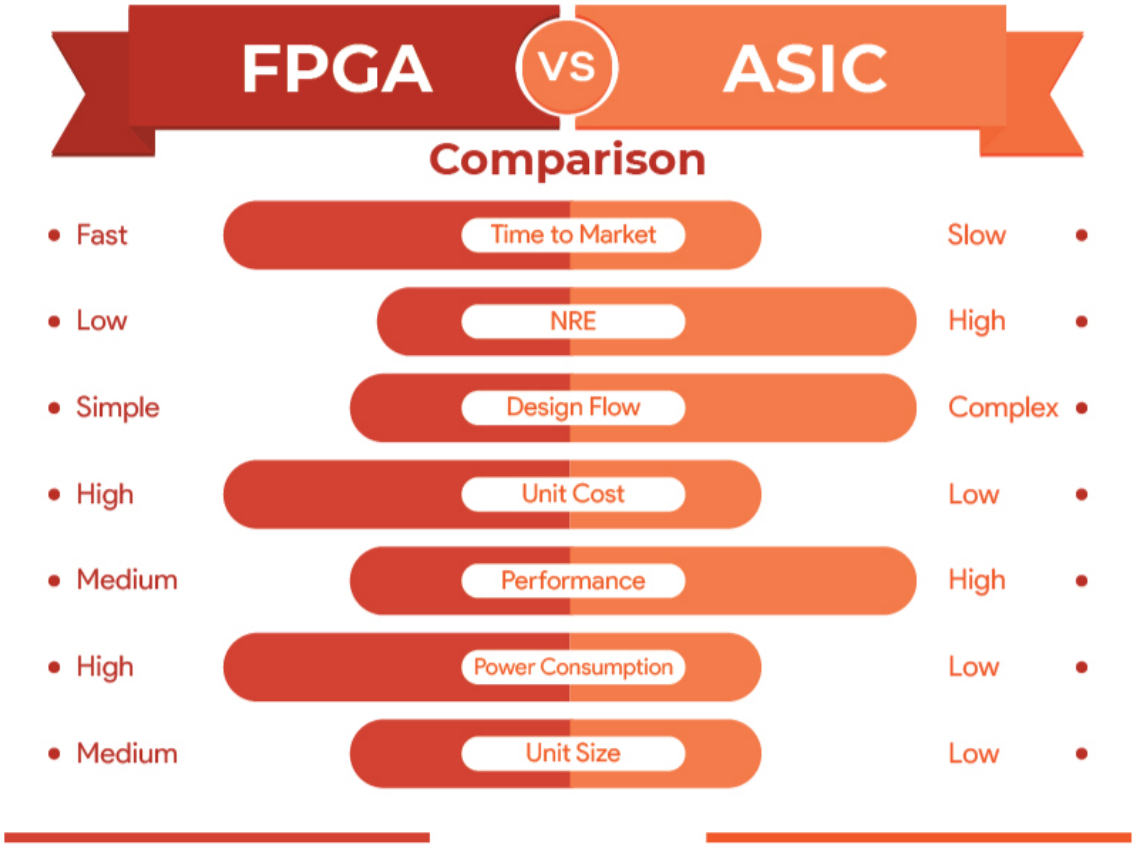
Consumer Electronics

AI & ML

PRO TIP: Learn both!

Hybrid skillsets are in massive demand

56 & Networking



The main differences between **FPGA (Field-Programmable Gate Array)** and **ASIC (Application-Specific Integrated Circuit)** come down to flexibility, performance, cost, and development time. Here's a clear breakdown:

1. Purpose & Flexibility

- **FPGA**: General-purpose, reprogrammable hardware. Ideal for prototyping, low-volume products, or applications needing frequent updates.
- **ASIC**: Custom-built for a specific application. Hardwired logic means no reconfiguration once fabricated.

2. Performance & Power Efficiency

FPGA:

- Slower than ASICs due to programmable interconnects.
- Higher power consumption for the same task.

ASIC:

- Much faster and more power-efficient because it's optimized for a single task.
- Ideal for high-performance and energy-critical applications (e.g., smartphones, routers, data centers).

3. Cost

FPGA:

- High per-unit cost.
- No upfront NRE (Non-Recurring Engineering) costs.
- Cost-effective for small-volume or prototype runs.

ASIC:

- Very high NRE costs due to custom design and tooling.
- Very low per-unit cost at scale, making it economical for mass production.

4. Time to Market

FPGA:

- Faster to develop and deploy since it’s reprogrammable.
- Useful when time-to-market is critical.

ASIC:

- Longer development cycle due to design, validation, and fabrication.
- Once manufactured, changes are expensive or impossible.

5. Design Risk & Debugging

FPGA:

- Easy to iterate and debug during development.
- Can be field-updated after deployment.

ASIC:

- Design bugs are very costly and time-consuming to fix. R
- equires thorough simulation and verification before fabrication.

6. Volume Suitability

FPGA:

- Best for **low to medium volumes**.

ASIC:

- Best for **high volumes** where the NRE cost can be amortized.

FPGA vs. ASIC

FPGA

Advantages:

- Faster time-to-market
- No NRE (Non Recurring Expenses)
- Simpler design cycle
- More predictable project cycle
- Field Re-programability
- Reusability
- Prototyping
- Unlike ASICs, FPGA's have special hardwares such as Block-RAM, DCM modules, MACs, memories and high speed I/O, embedded CPU etc inbuilt
- FPGA synthesis is much more easier than ASIC.

Disadvantages

- Higher unit cost
- Slow... difficult to achieve high frequency
- Power consumption in FPGA is more. You don't have any control over the power optimization. This is where ASIC wins the race !
- You have to use the resources available in the FPGA. Thus FPGA limits the design size.

ASIC

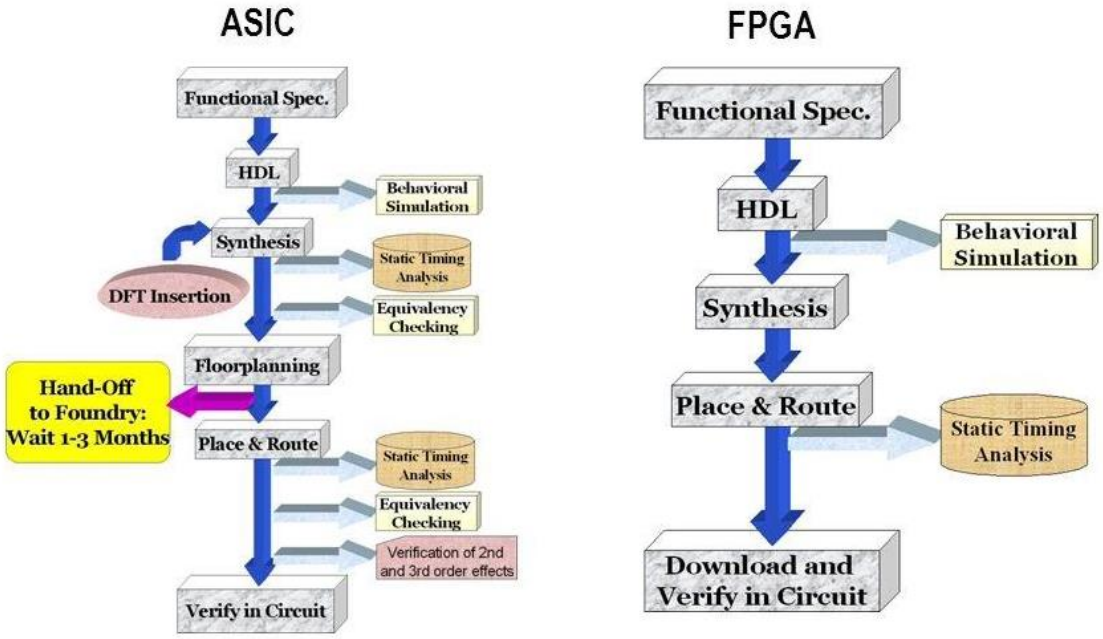
Advantages

- Cost....cost....cost....Lower unit costs
- Speed...speed...speed....ASICs are faster than FPGA
- Low power....Low power....Low power
- In ASIC you can implement analog circuit, mixed signal designs. This is generally not possible in FPGA.
- In ASIC DFT (Design For Test) is inserted. In FPGA DFT is not carried out (rather for FPGA no need of DFT !) .

Disadvantages

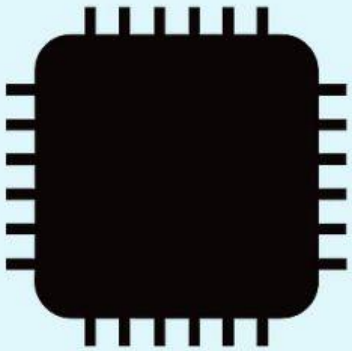
- Longer Time-to-market
- High NRE
- Design Issues such as DFM, SI
- In FPGA you don't have all these because ASIC designer takes care of all these. (Don't forget FPGA is an IC and designed by ASIC design engineer !!)
- Expensive Tools: ASIC design tools are very much expensive. You spend a huge amount of NRE.

Design Flow Comparison

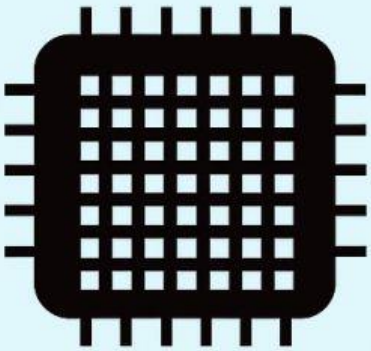


ASIC vs FPGA

Custom Chips vs Reconfigurable Chips



ASIC



FPGA

ASIC

- High performance
- Lower power
- Fixed functionality

FPGA

- Flexible and reprogramnable
- Faster time to market
- Great for prototyping

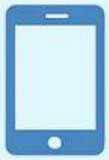
APPLICATIONS

Common uses for both

Automotive electronics

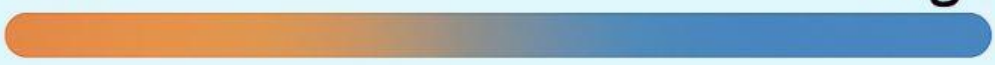
Telecom-munications

AI accele-ration

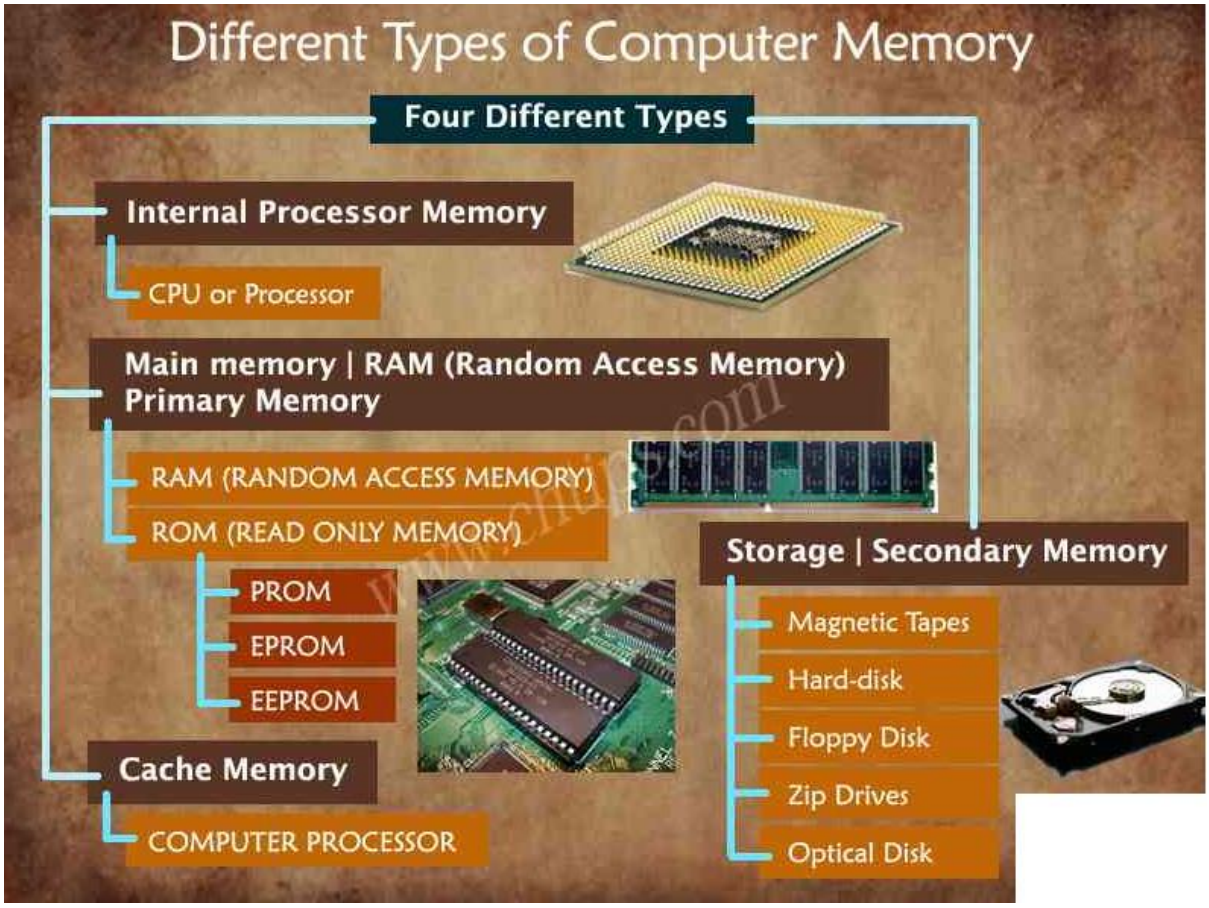


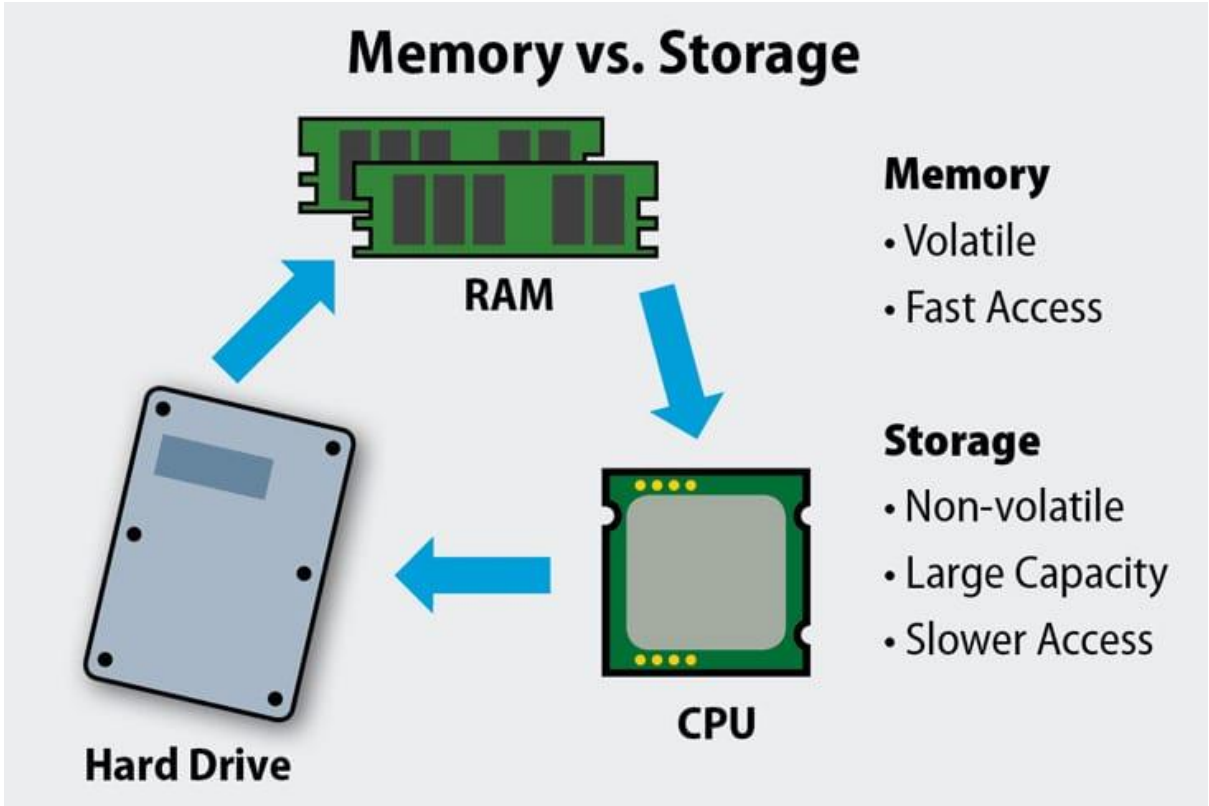
Consumer electronics

Low **High**



Cost


Different Types of Computer Memory
Four Different Types
Internal Processor Memory
CPU or Processor
Main memory | RAM (Random Access Memory)
Primary Memory
RAM (RANDOM ACCESS MEMORY)
ROM (READ ONLY MEMORY)
PROM
EPROM
EEPROM
Cache Memory
COMPUTER PROCESSOR
Storage | Secondary Memory
Magnetic Tapes
Hard-disk
Floppy Disk
Zip Drives
Optical Disk


Memory vs. Storage
RAM
CPU
Hard Drive
Memory
• Volatile
• Fast Access
Storage
• Non-volatile
• Large Capacity
• Slower Access