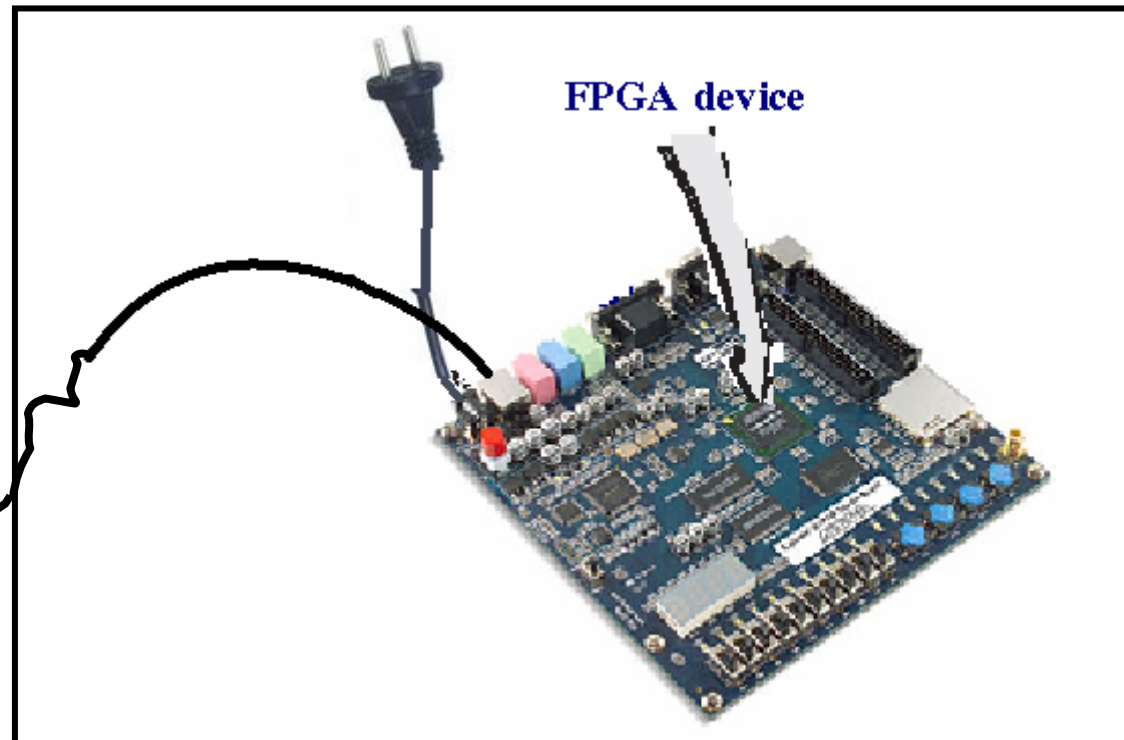
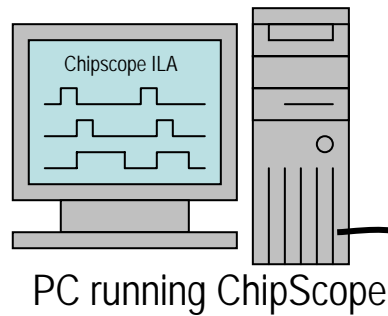


Introduction to FPGA

Prepared by
Eng. Waleed Saad

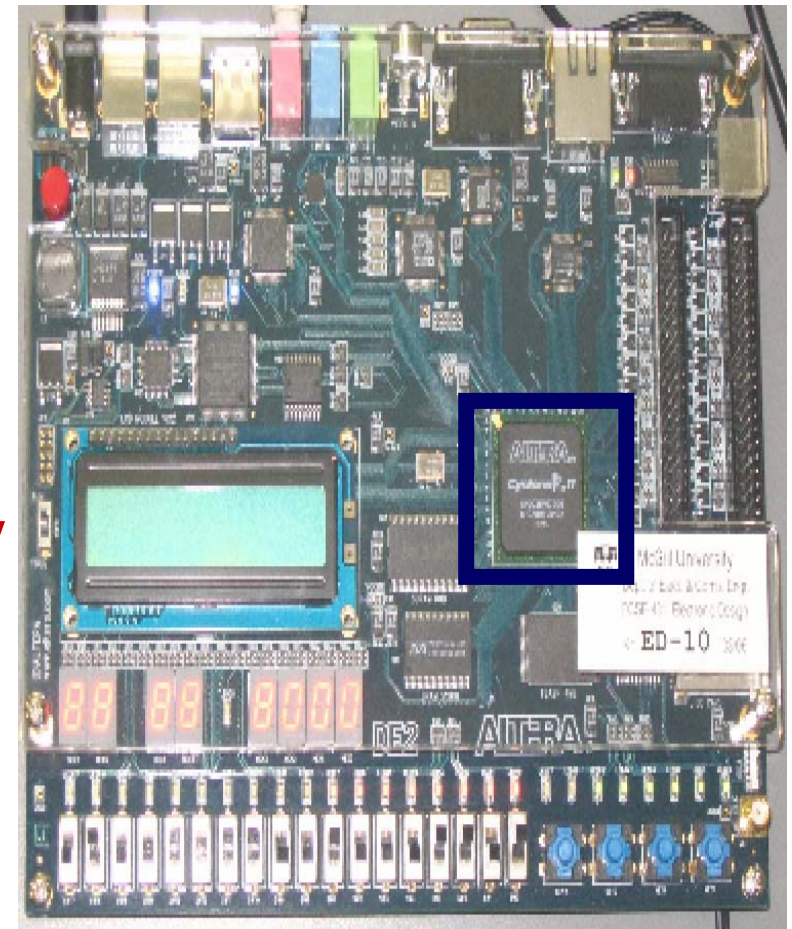


Introduction to FPGA

What's the FPGA?

FPGA

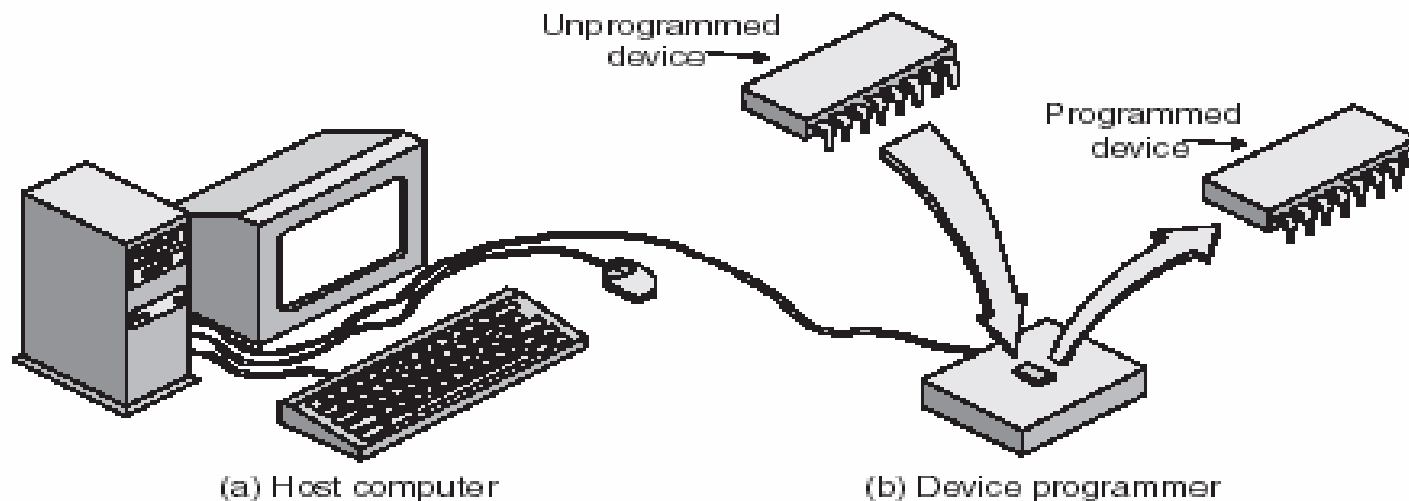
Field Programmable Gate Array



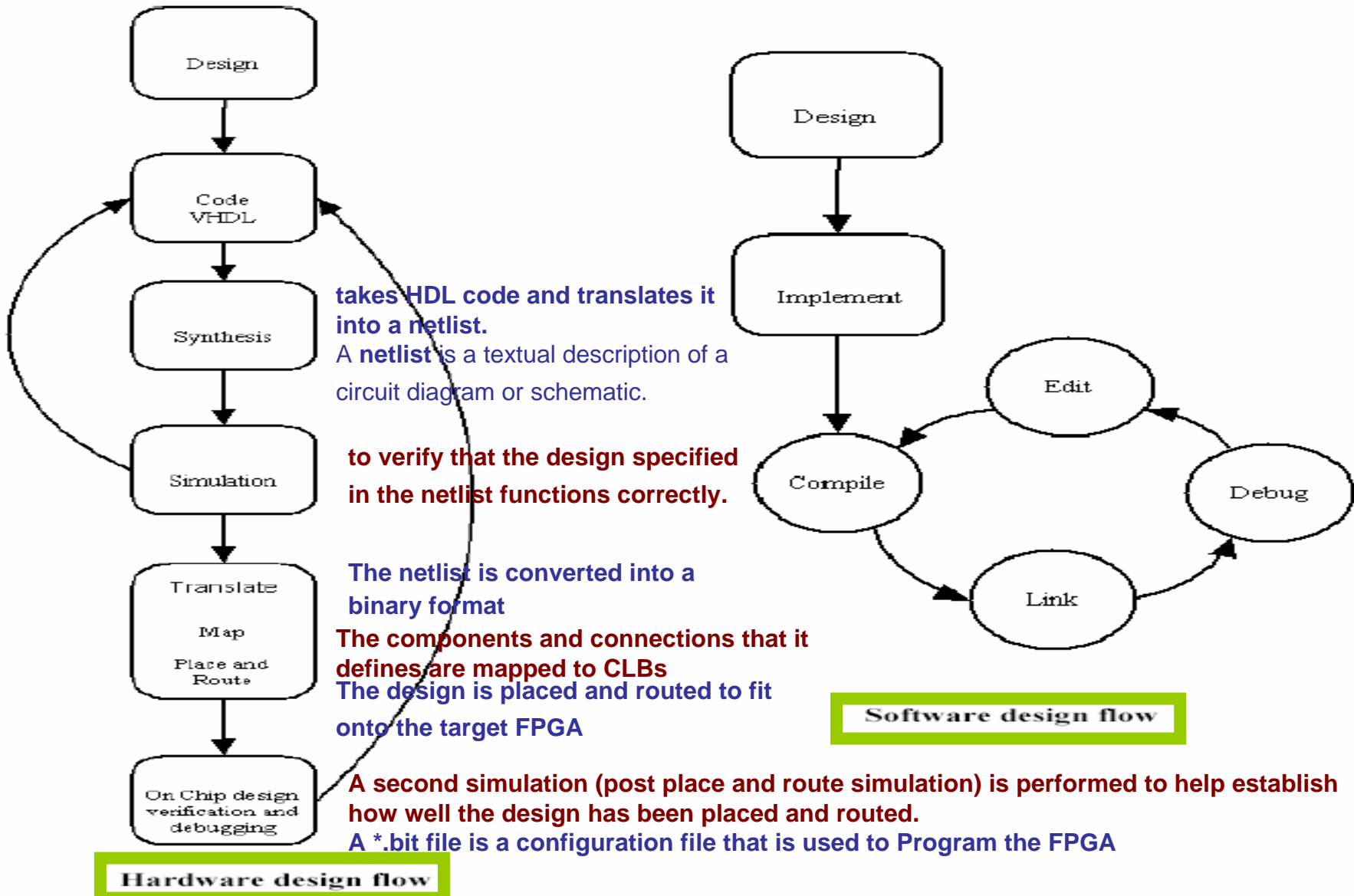
Introduction to FPGA

What's the FPGA?

- **FPGA is a device that can be programmed to many different kinds of logic functions and its structure is an array of resources that can be configured.**
- **VHDL, VERILOG are the most famous programming languages.**

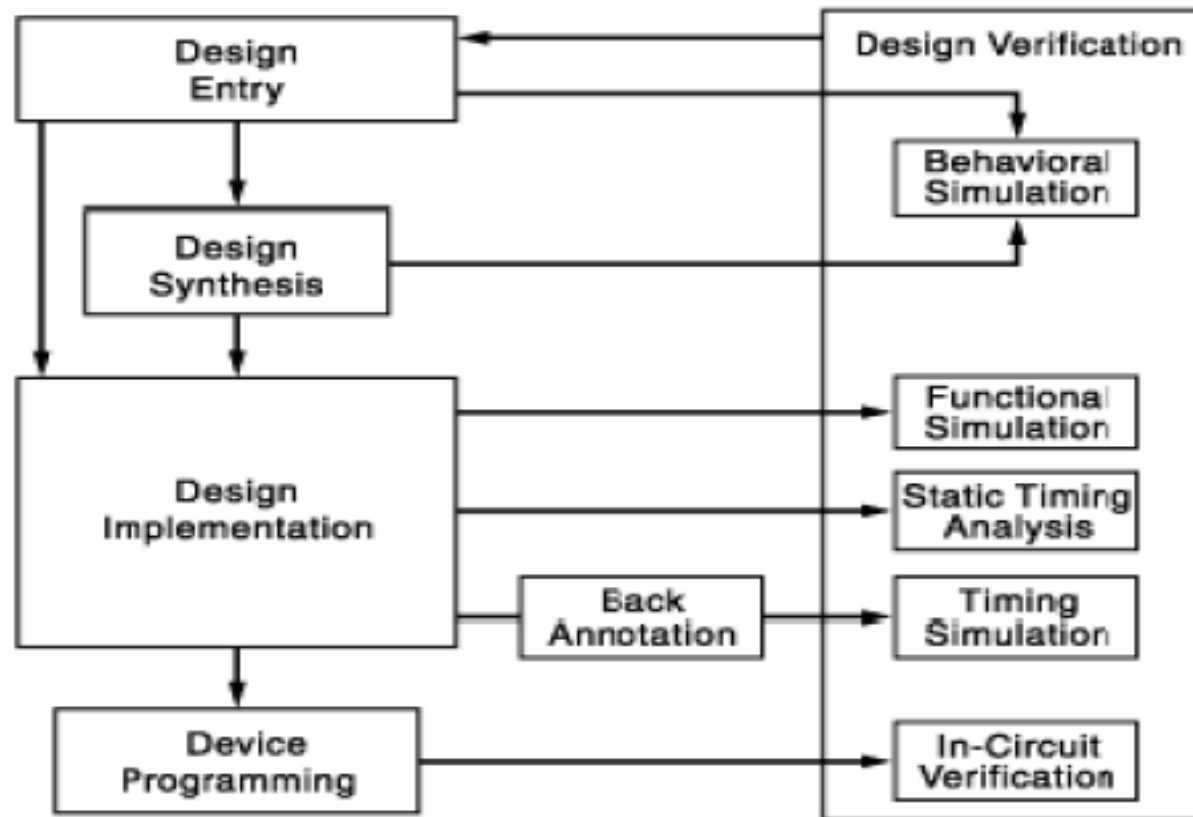


Introduction to FPGA

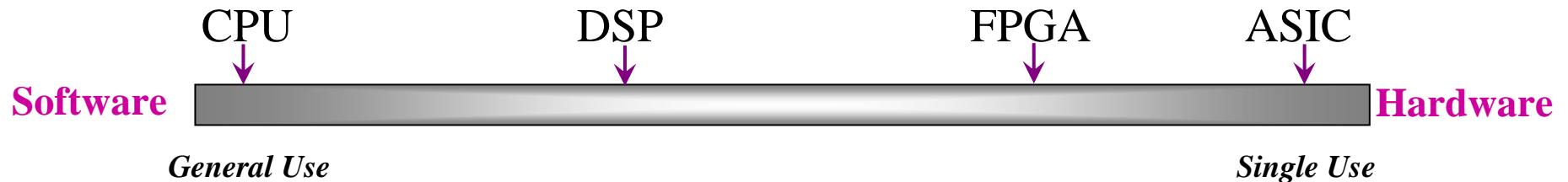


Introduction to FPGA

FPGA Design flow



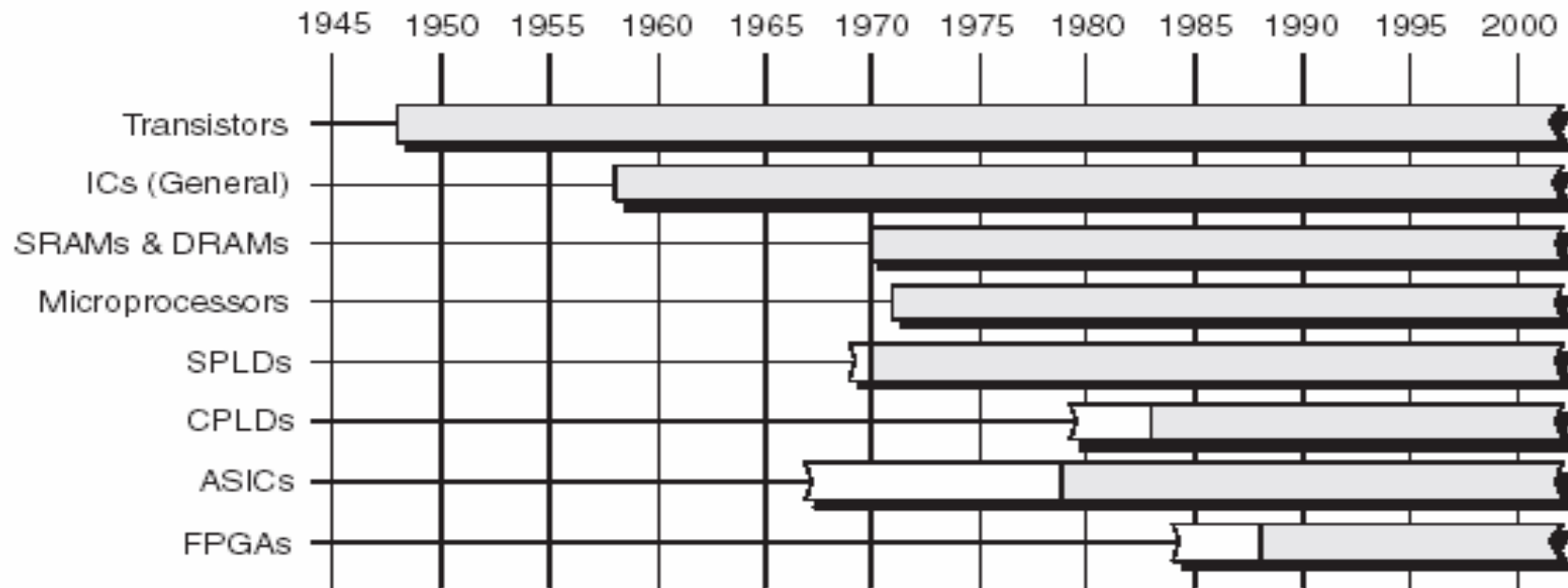
Introduction to FPGA



FPGA one from hardware tools and in the same times has the facilities of software, hence it has the ability of reprogramming and the speed of hardware in the other hand the hardware tools used for once.

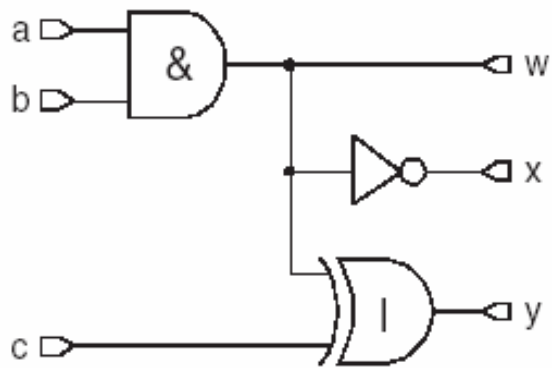
Introduction to FPGA

FPGA history

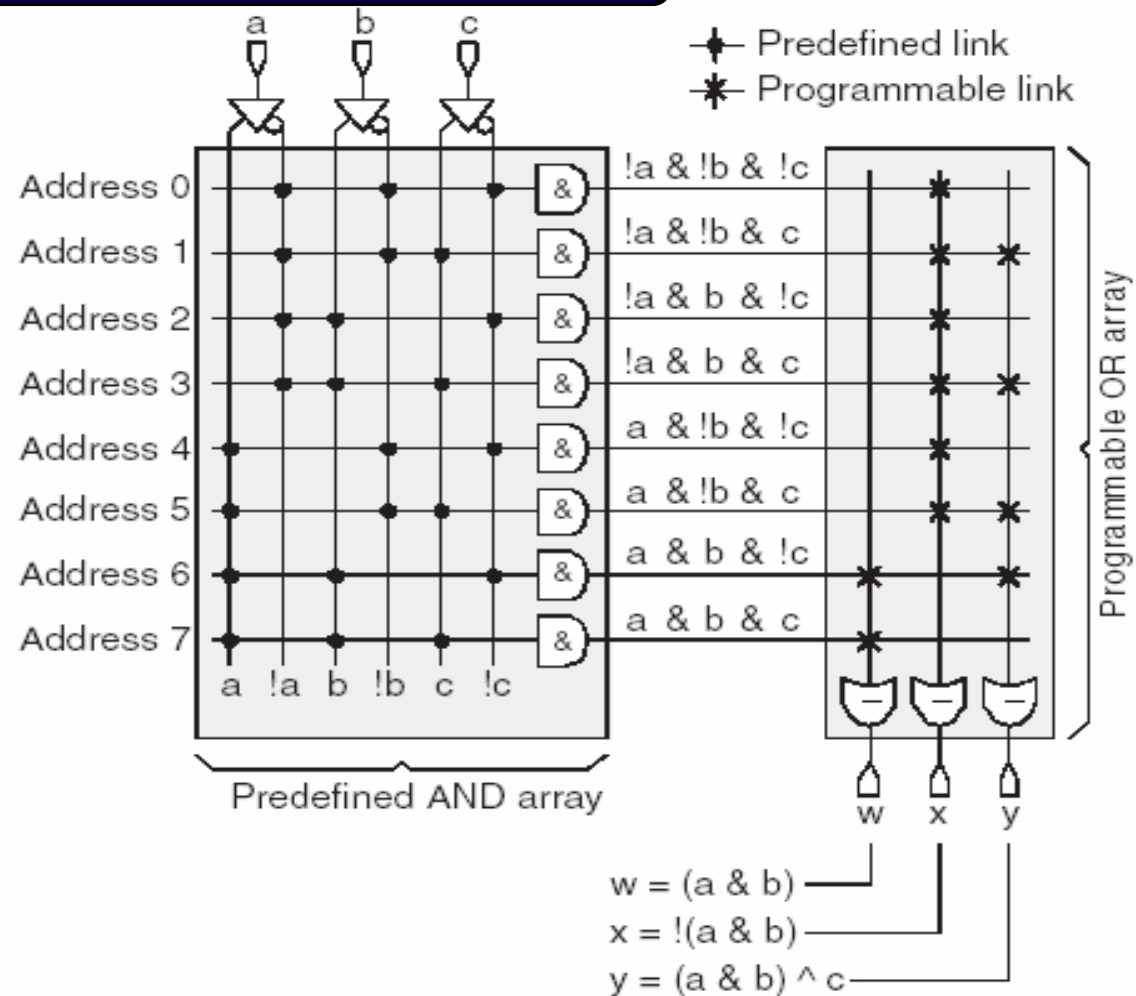


Introduction to FPGA

PROM (SPLD)

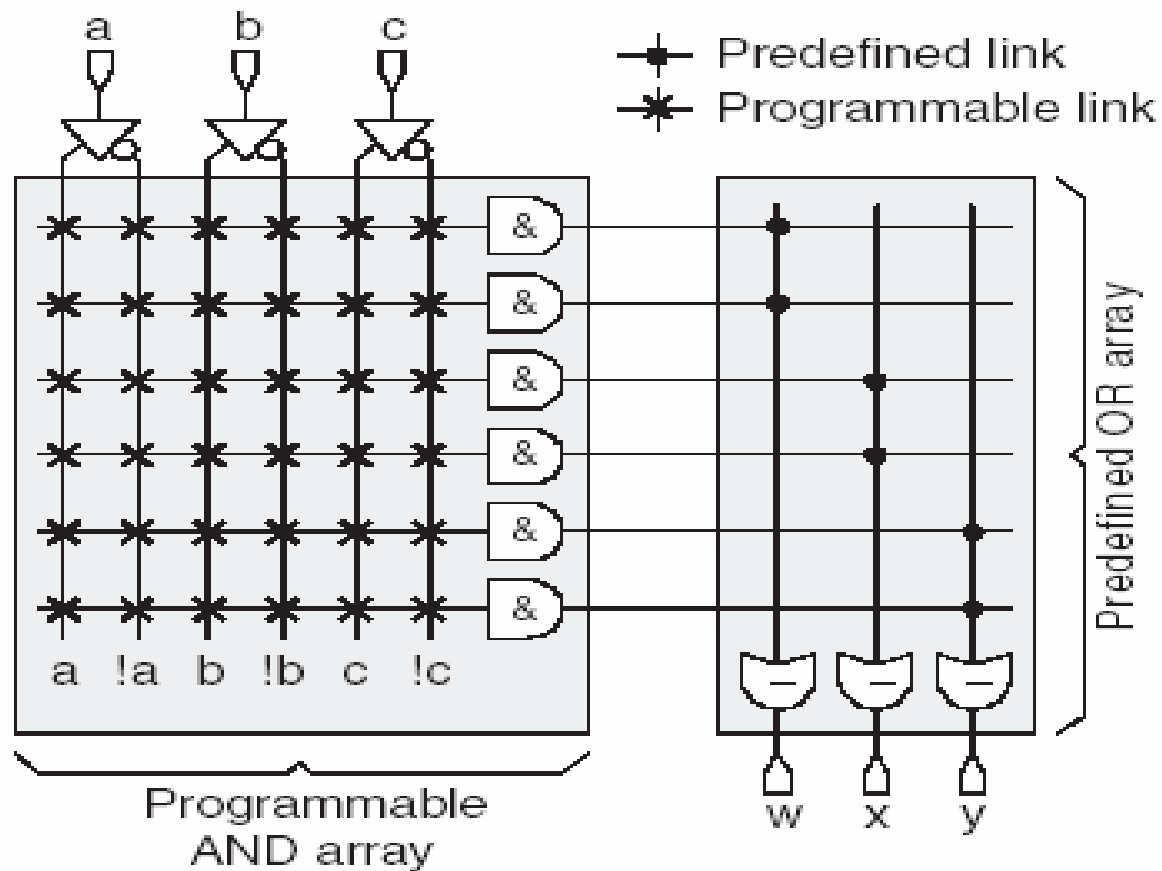


a	b	c	w	x	y
0	0	0	0	1	0
0	0	1	0	1	1
0	1	0	0	1	0
0	1	1	0	1	1
1	0	0	0	1	0
1	0	1	0	1	1
1	1	0	1	0	1
1	1	1	1	0	0



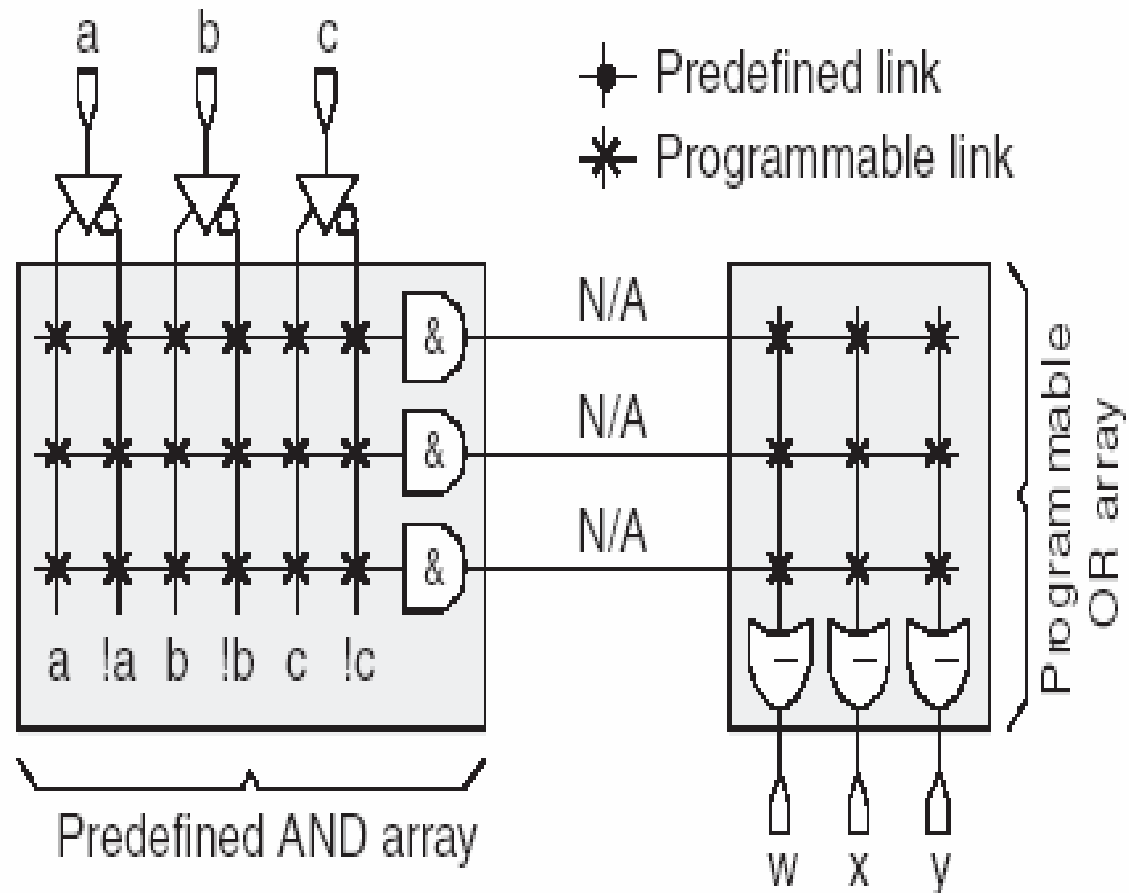
Introduction to FPGA

PAL (SPLD)



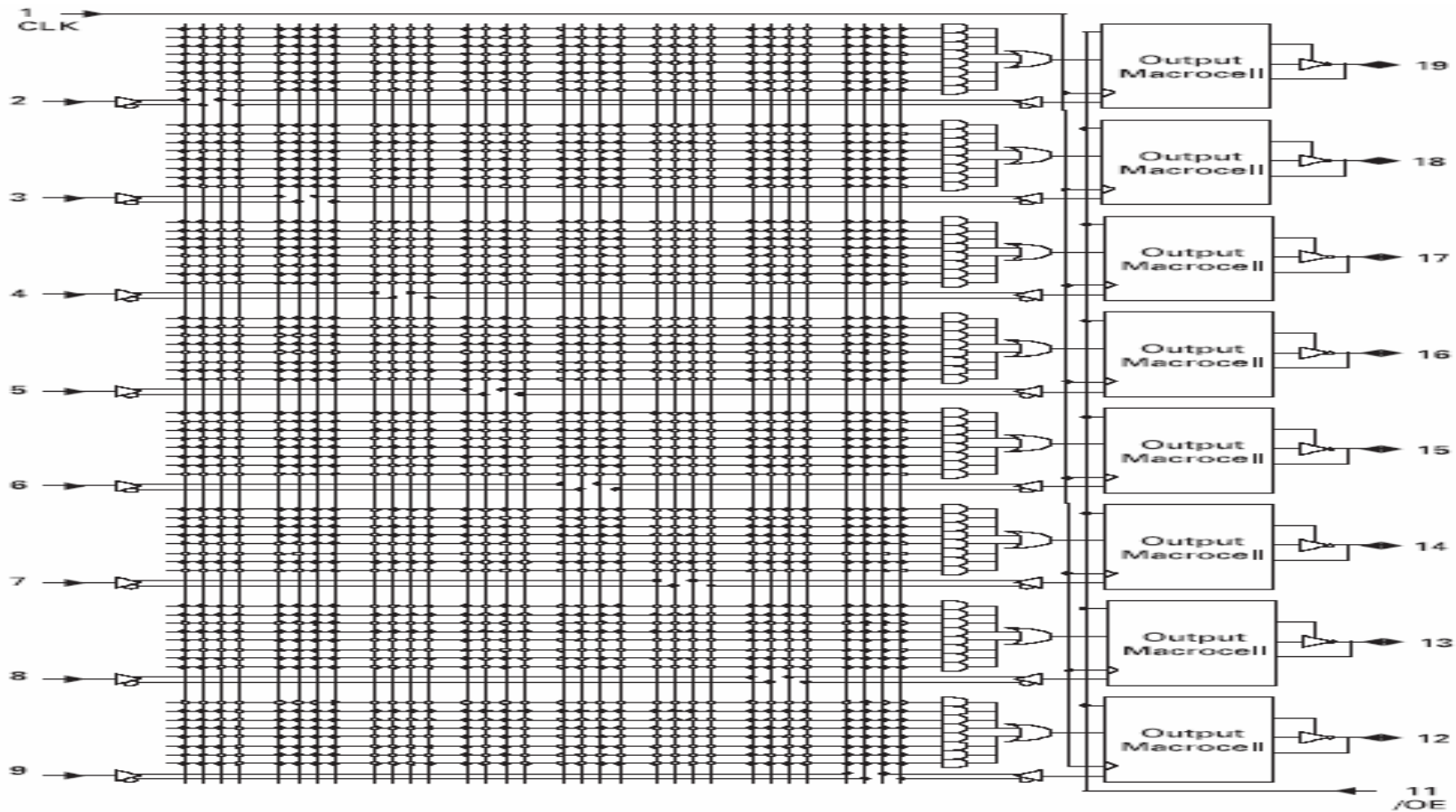
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PLA (SPLD)



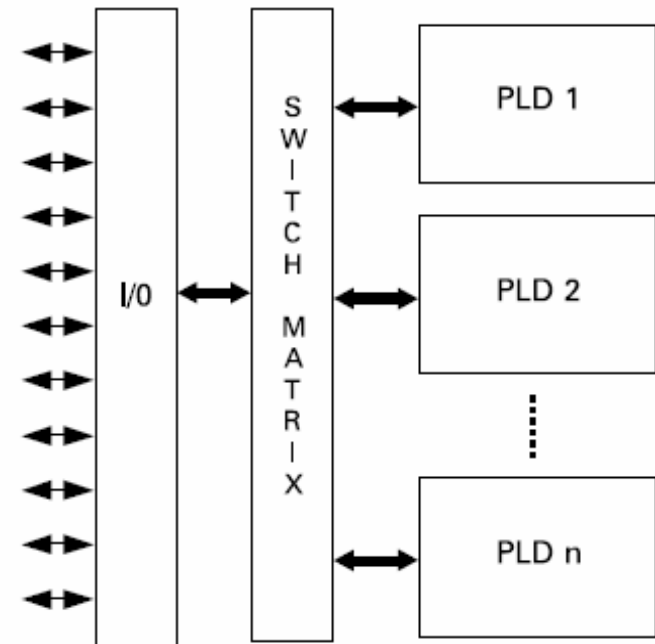
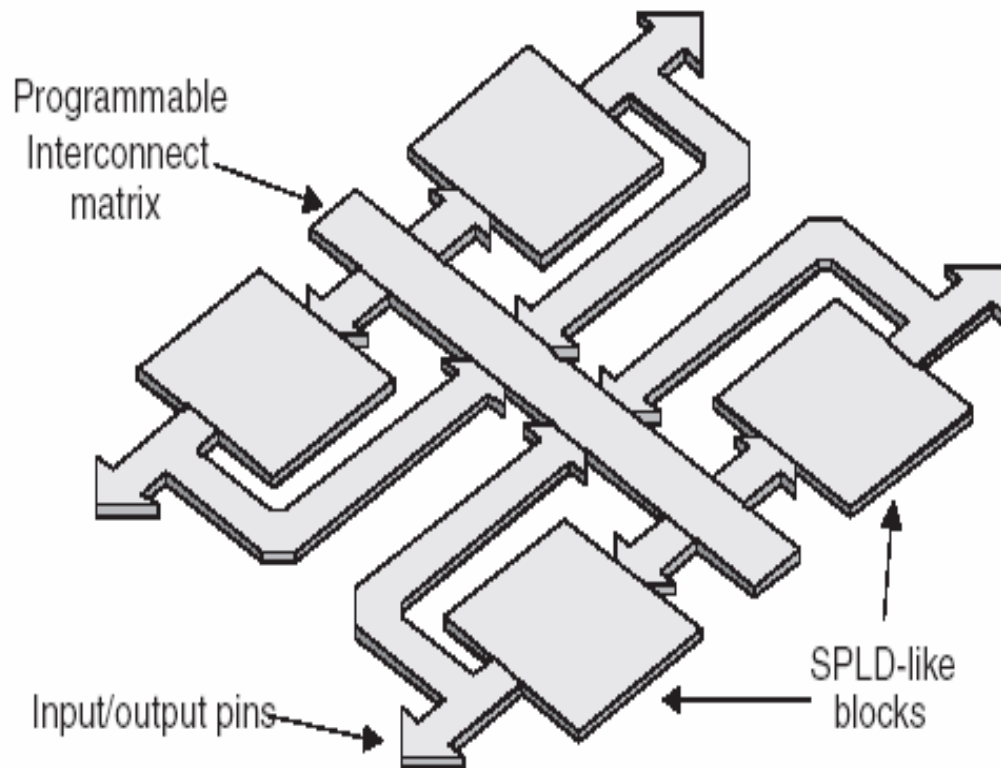
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GAL (Generic PAL) (SPLD)



Introduction to FPGA

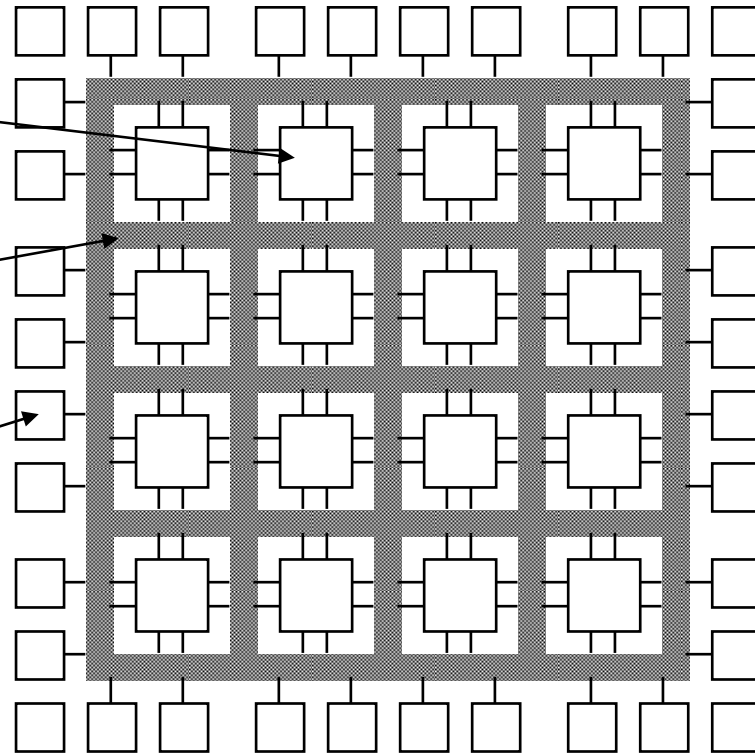
CPLD



Introduction to FPGA

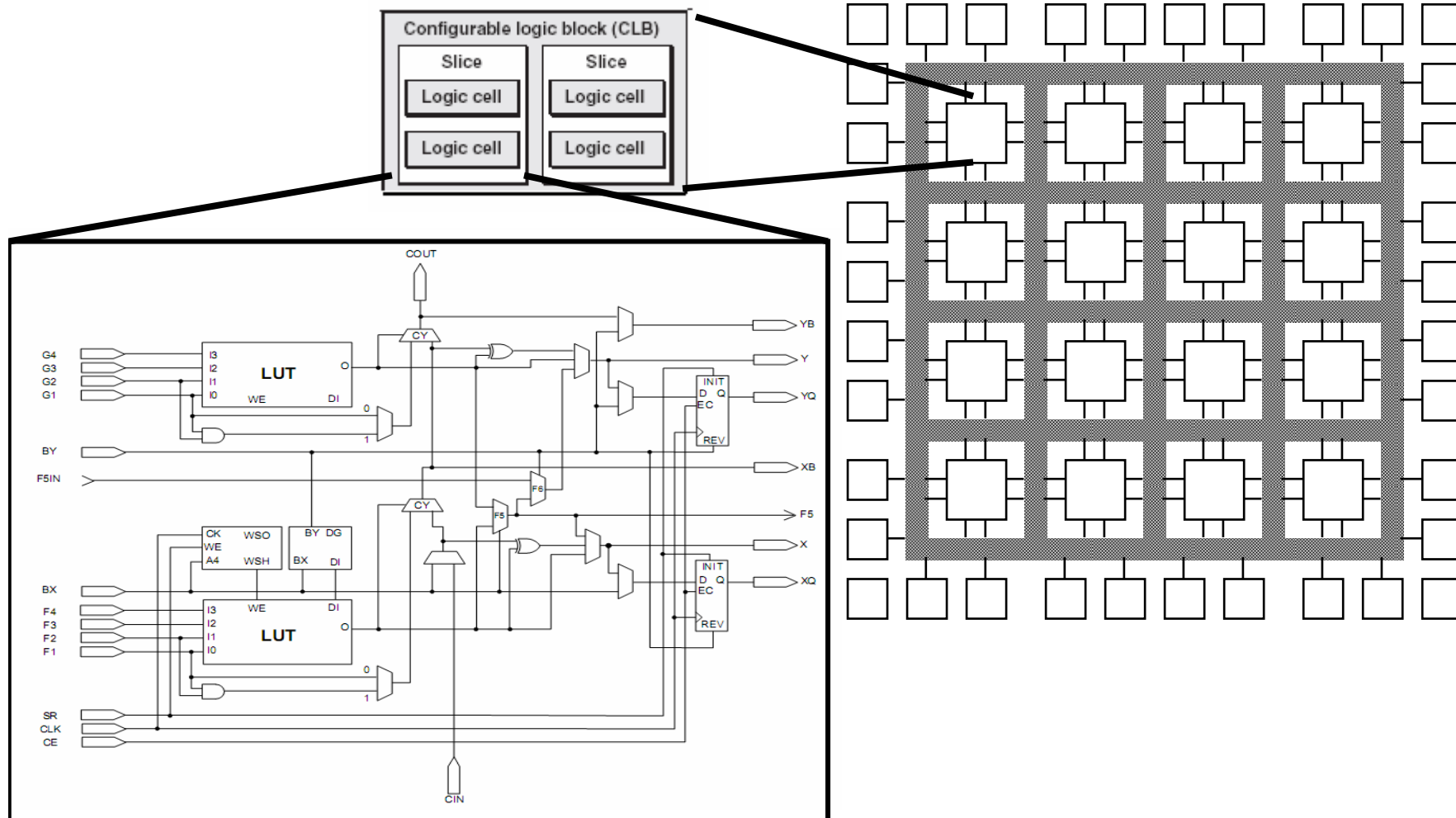
FPGA structure

- **Logic blocks**
 - To implement combinational and sequential logic
- **Interconnect**
 - Wires to connect inputs and outputs to logic blocks
- **I/O blocks**
 - Special logic blocks at periphery of device for external connections



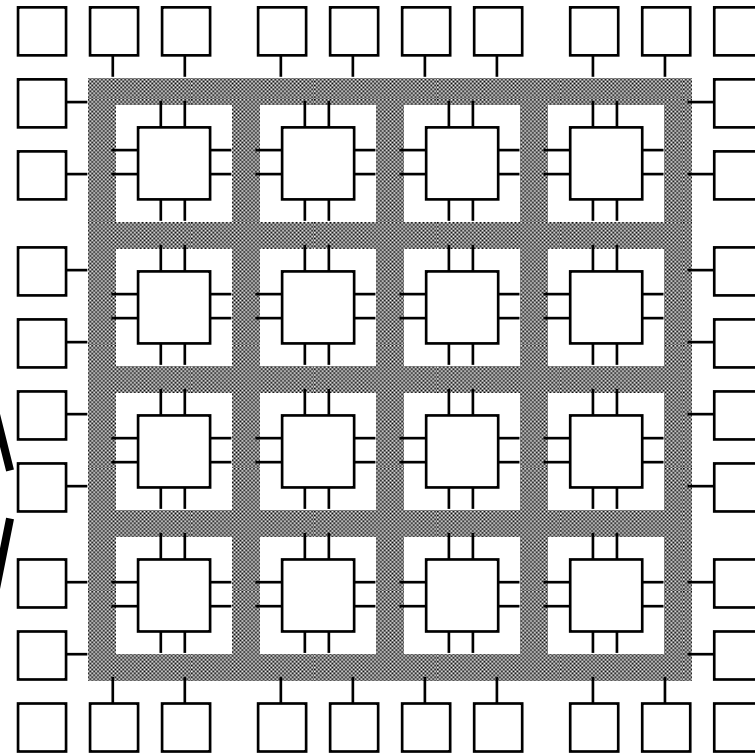
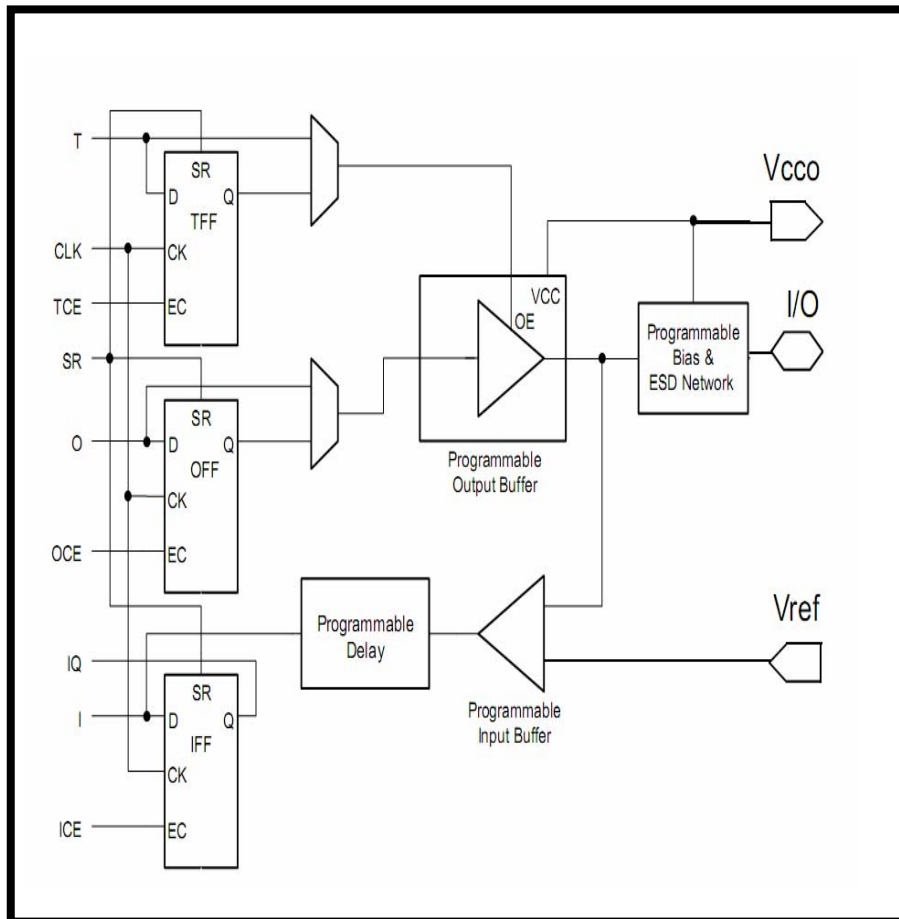
Introduction to FPGA

FPGA structure



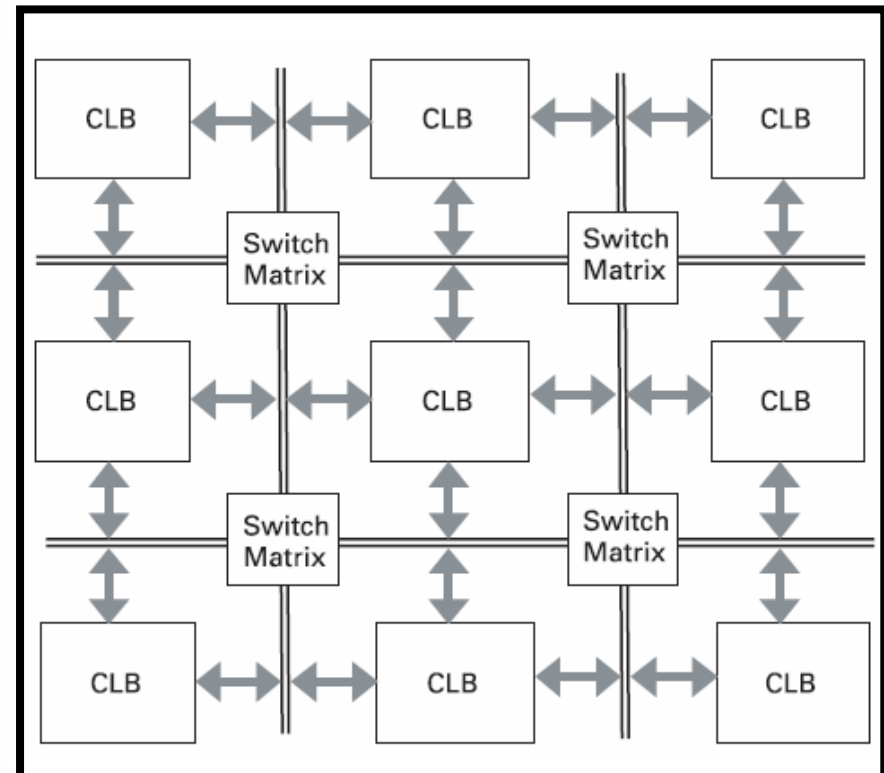
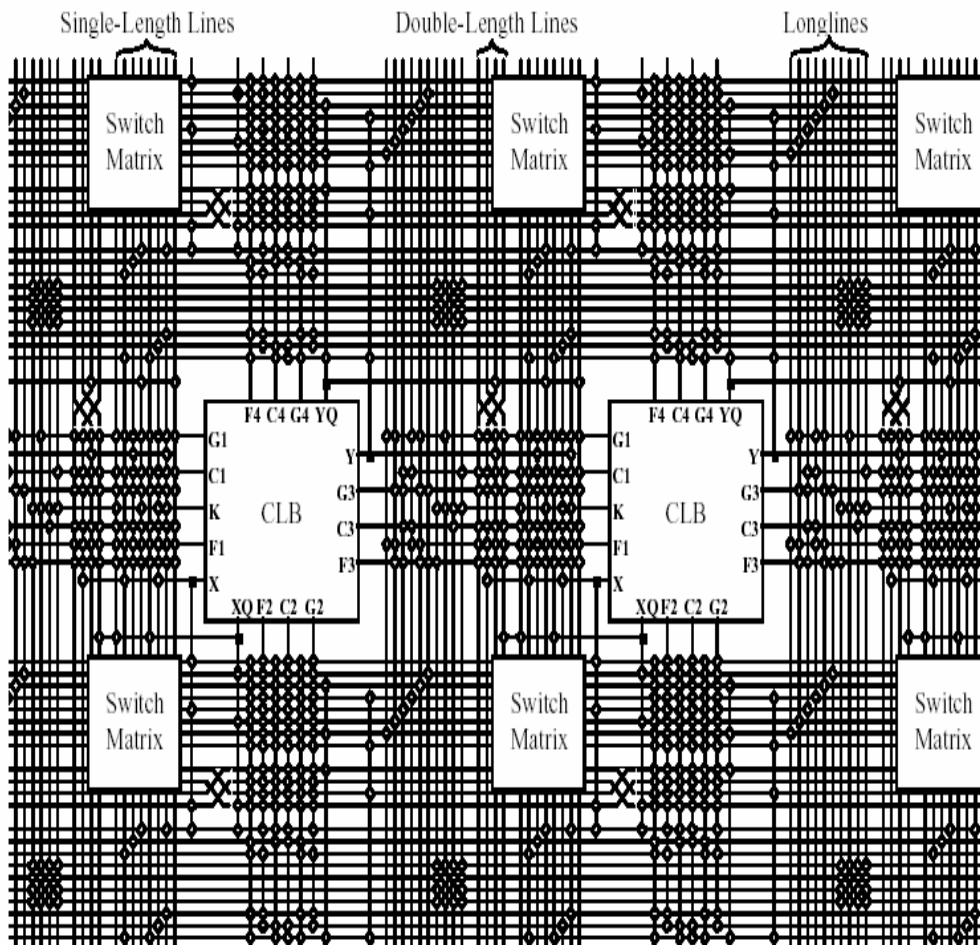
Introduction to FPGA

FPGA structure



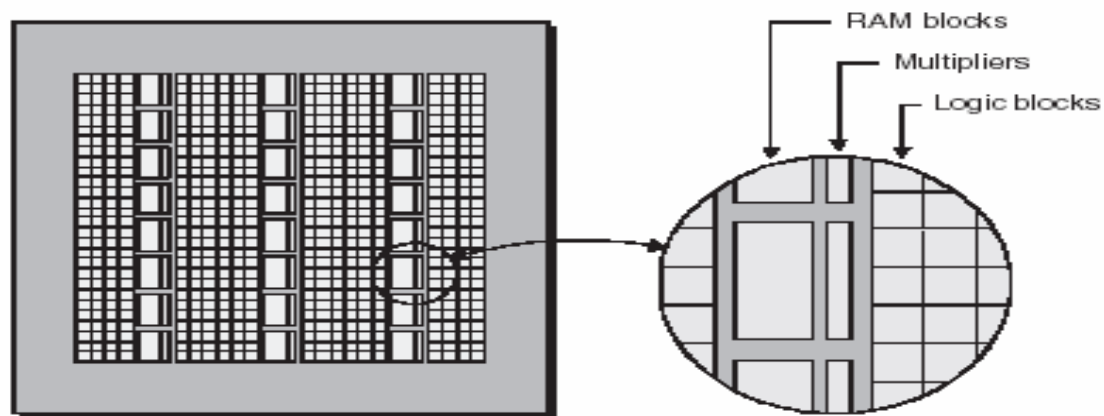
Introduction to FPGA

FPGA structure

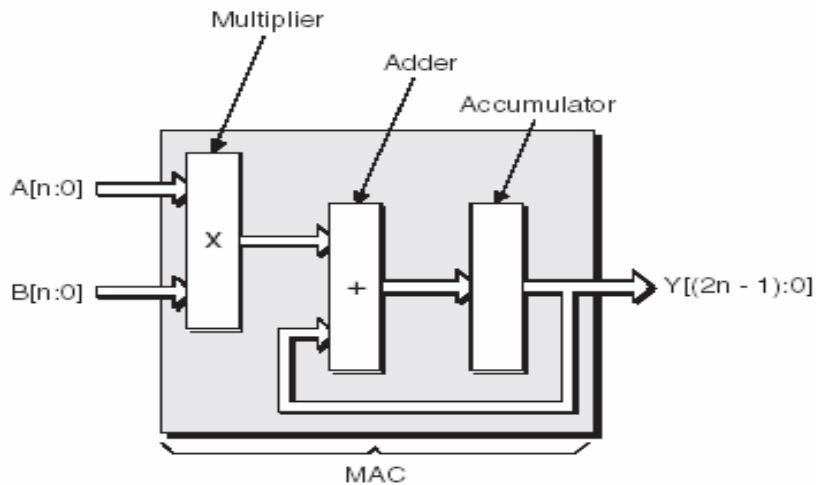


Introduction to FPGA

FPGA structure



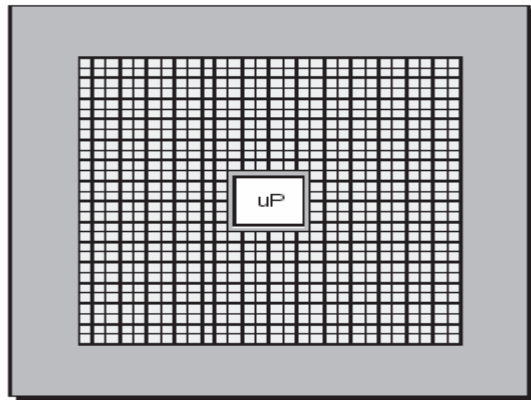
**Embedded
SRAMs and Multipliers**



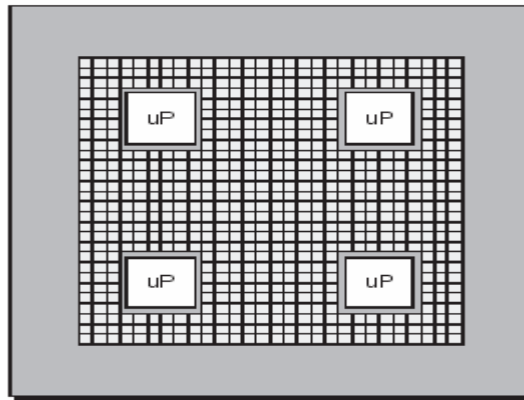
**Embedded
MAC/DSP**

Introduction to FPGA

FPGA structure

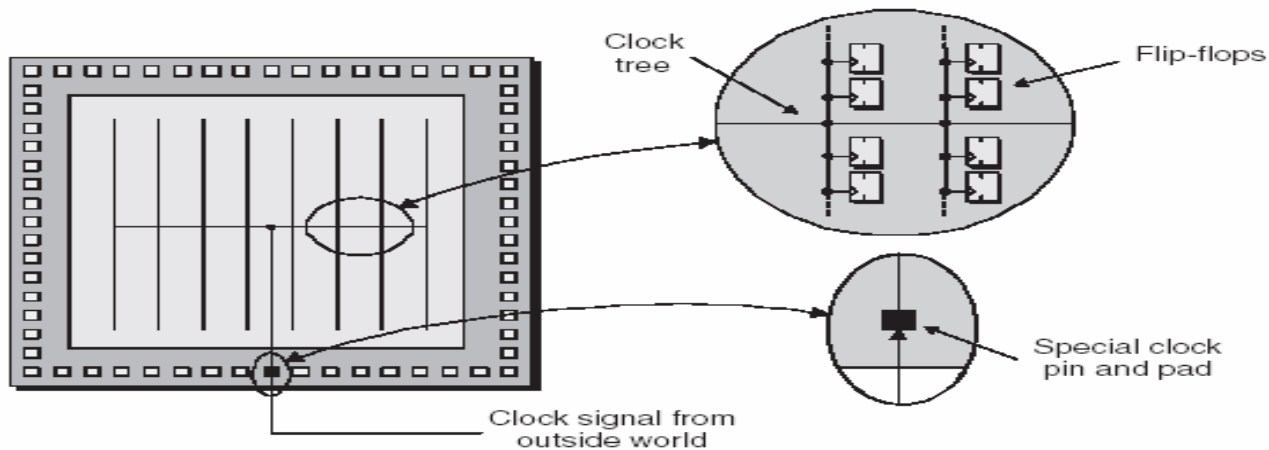


(a) One embedded core



(b) Four embedded cores

**Embedded
Processor cores**

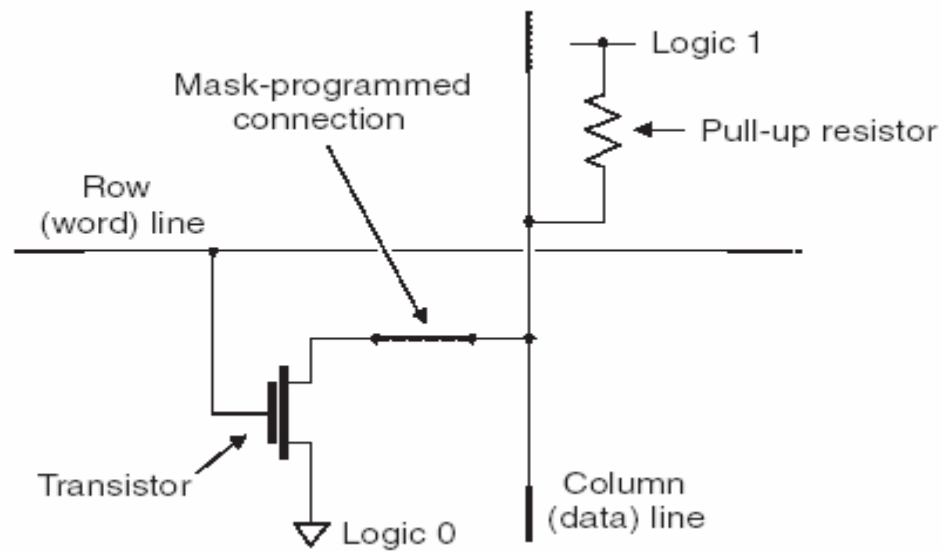


Clock trees

Introduction to FPGA

Programming technologies

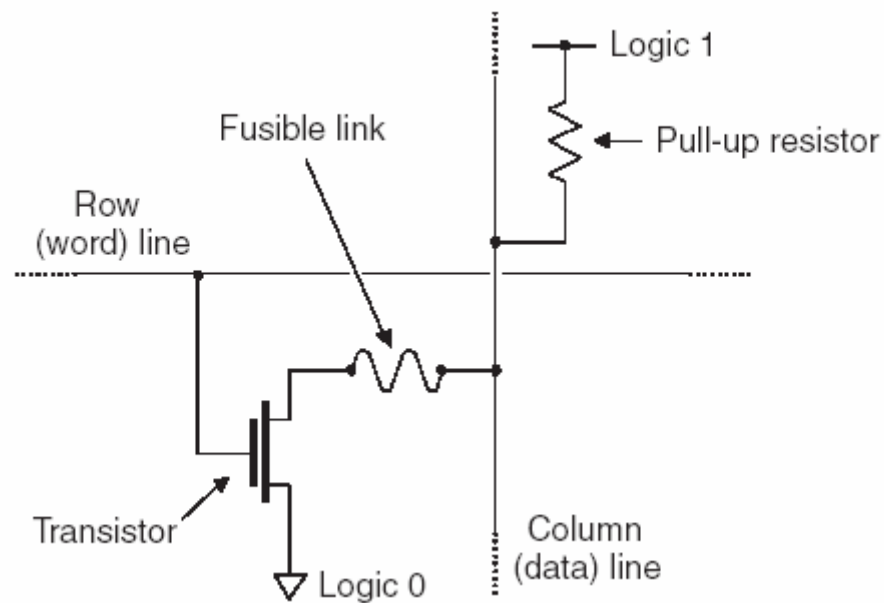
Antifuse technology



Introduction to FPGA

Programming technologies

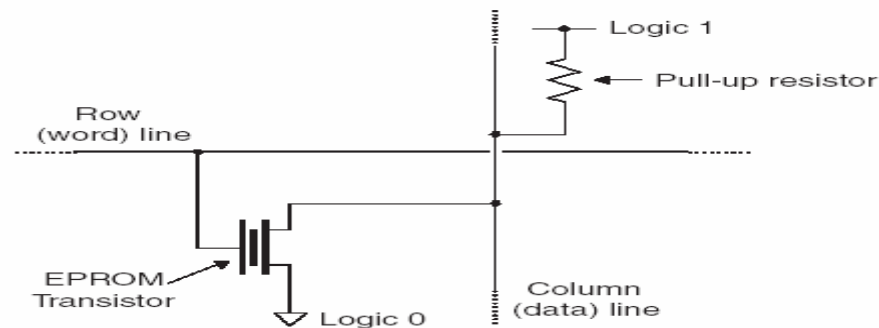
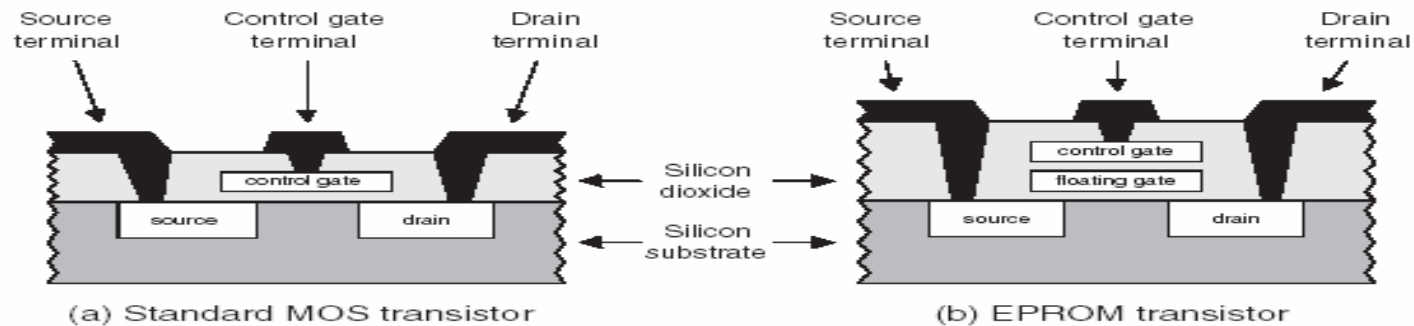
Fusible technology



Introduction to FPGA

Programming technologies

Erasable PROM (EPROM) technology

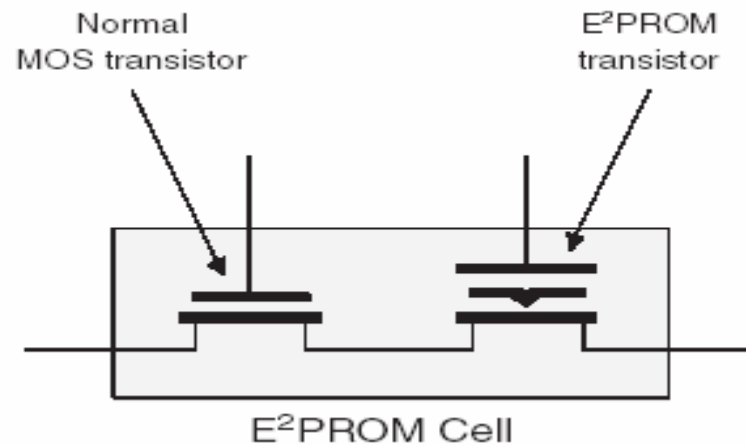


- UV radiation is used to discharge the electrons
- Quartz window is uncovered inside UV container source within 20 min. (cost & time)

Introduction to FPGA

Programming technologies

Electrically EPROM (EEPROM) technology

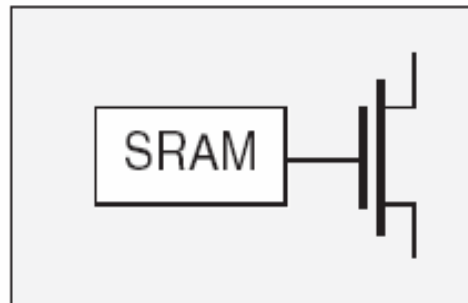


- 2.5 times larger than EPROM
- The normal transistor is used to erase the charges electrically

Introduction to FPGA

Programming
technologies

SRAM technology



Introduction to FPGA

CPLD

Yes

Coarse-grain
contain relatively
few (a few 100's max)
large blocks

EEPROM based,
active at power-up

Faster
Because one block of
logic can hold a big
equation "microprocessor
decoding"

Non efficient

FPGA

Yes

Fine-grain
contain a lot
(up to 100 000)
of tiny blocks

SRAM based, need
to be configured at
each power-up

Slower

Efficient
"arithmetic functions (binary
counters, adders, comparators..

programmable digital
logic chips

The no. of blocks of
logic with flip-flops

Technology

input-to-output timings

Routing resources

Introduction to FPGA

uC

FPGA

Implementation of
programmable logic
elements functions

in a sequential manner

in a parallel fashion

ASIC

FPGA

Adv.

Low power
Single chip
Live at power up
Non volatile
Secure
Low unit cost
Low total system cost

Disadv.

Long design times
Incredibly expensive

Introduction to FPGA

Which companies make FPGAs?

Xilinx



Altera



Lattice



Actel



Introduction to FPGA

What can I use FPGA for?

- Many different kinds of logic functions
- Industrial control
- Medical diagnostic
- Telecommunications
- Data processing
- Automotive
- Aerospace
- Gaming systems
-

