Multiplier (H.1)

20151130

References

Some Figures from the following sites

[1] http://pages.hmc.edu/harris/cmosvlsi/4e/index.html
Weste & Harris Book Site

[2] en.wikipedia.org

[3] Digital Integrated Circuits : A Design Perspective,
Jan M. Rabaey,
(http://bwrcs.eecs.berkeley.edu/Classes/IcBook/)

[4] Digital Electronics and Design with VHDL
Pedroni

Multiplication

- Example:

```
1100 : 12₁₀    multiplicand
0101 : 5₁₀     multiplier
```

$1100 : 12_{10}$ multiplicand

$\underline{0101} : 5_{10}$ multiplier

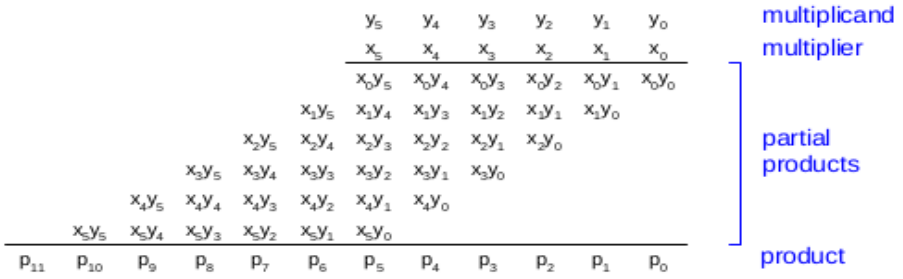
partial products

product

- M x N-bit multiplication
  - Produce N M-bit partial products
  - Sum these to produce M+N-bit product

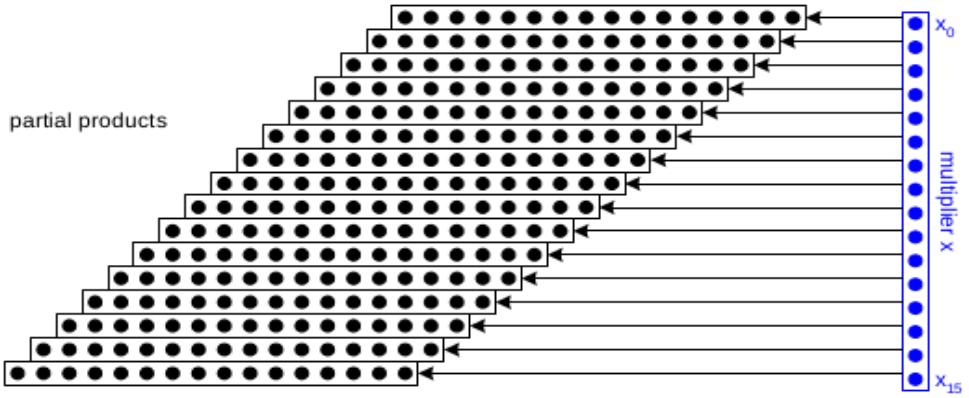
General Form

- Multiplicand: $Y = (y_{M-1}, y_{M-2}, \ldots, y_1, y_0)$
- Multiplier: $X = (x_{N-1}, x_{N-2}, \ldots, x_1, x_0)$
- Product: $$P = \left(\sum_{j=0}^{M-1} y_j 2^j \right) \left(\sum_{i=0}^{N-1} x_i 2^i \right) = \sum_{i=0}^{N-1} \sum_{j=0}^{M-1} x_i y_j 2^{i+j}$$

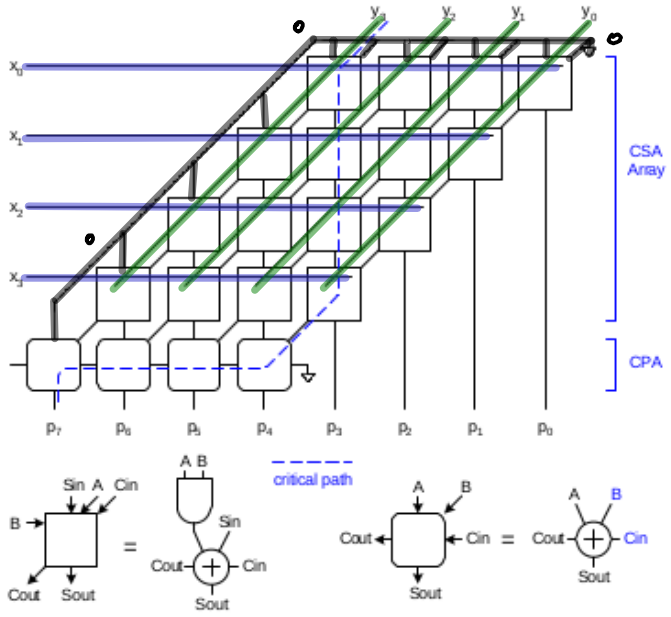


Dot Diagram

- Each dot represents a bit



Array Multiplier



Rectangular Array

- Squash array to fit rectangular floorplan