Idea (1A)

- Time Multiplexed Architecture
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Please send corrections (or suggestions) to youngwlim@hotmail.com.

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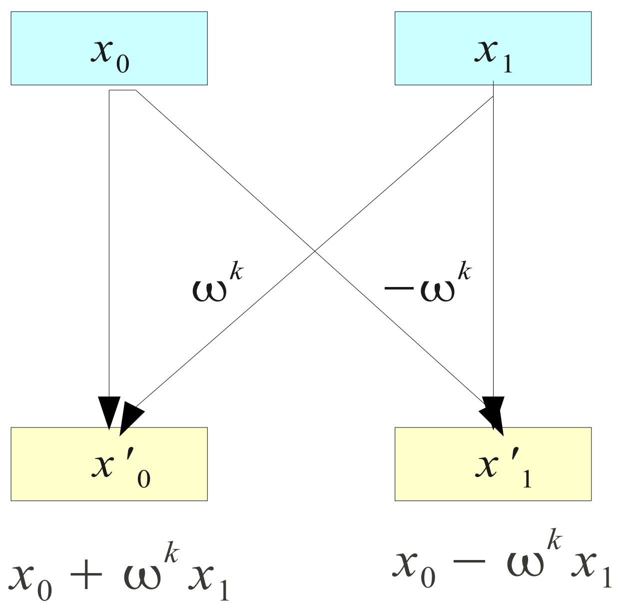
The Butterfly Operations

$$x'_0 = x_0 + \boxed{\omega^k x_1}$$

$$x'_1 = x_0 - \boxed{\omega^k x_1}$$



The Butterfly Time Multiplexed Operations (1)

$$\begin{cases} x'_0 = x_0 + \omega^k x_1 \\ x'_1 = x_0 - \omega^k x_1 \end{cases}$$

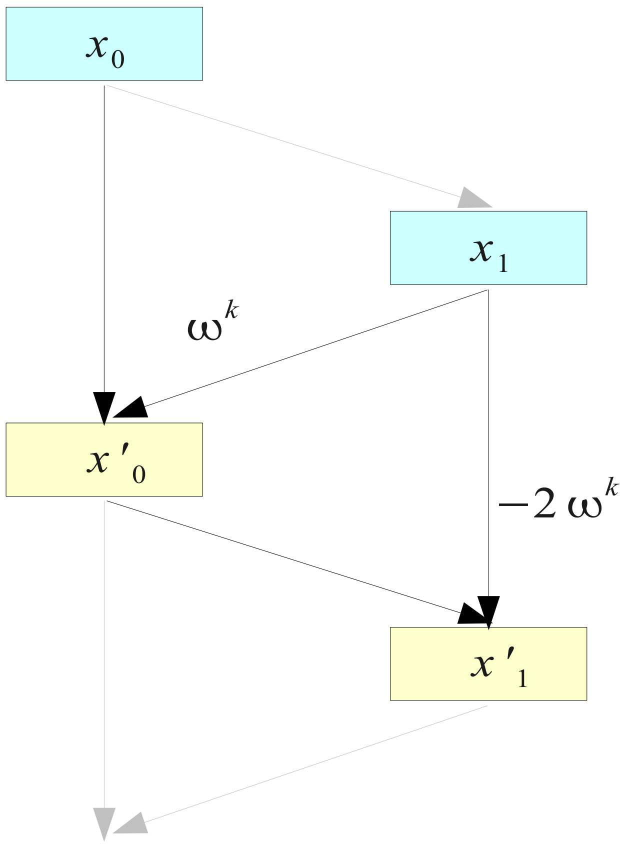
$$x'_0 = x_0 + \omega^k x_1$$

$$x_0 = x'_0 - \omega^k x_1$$

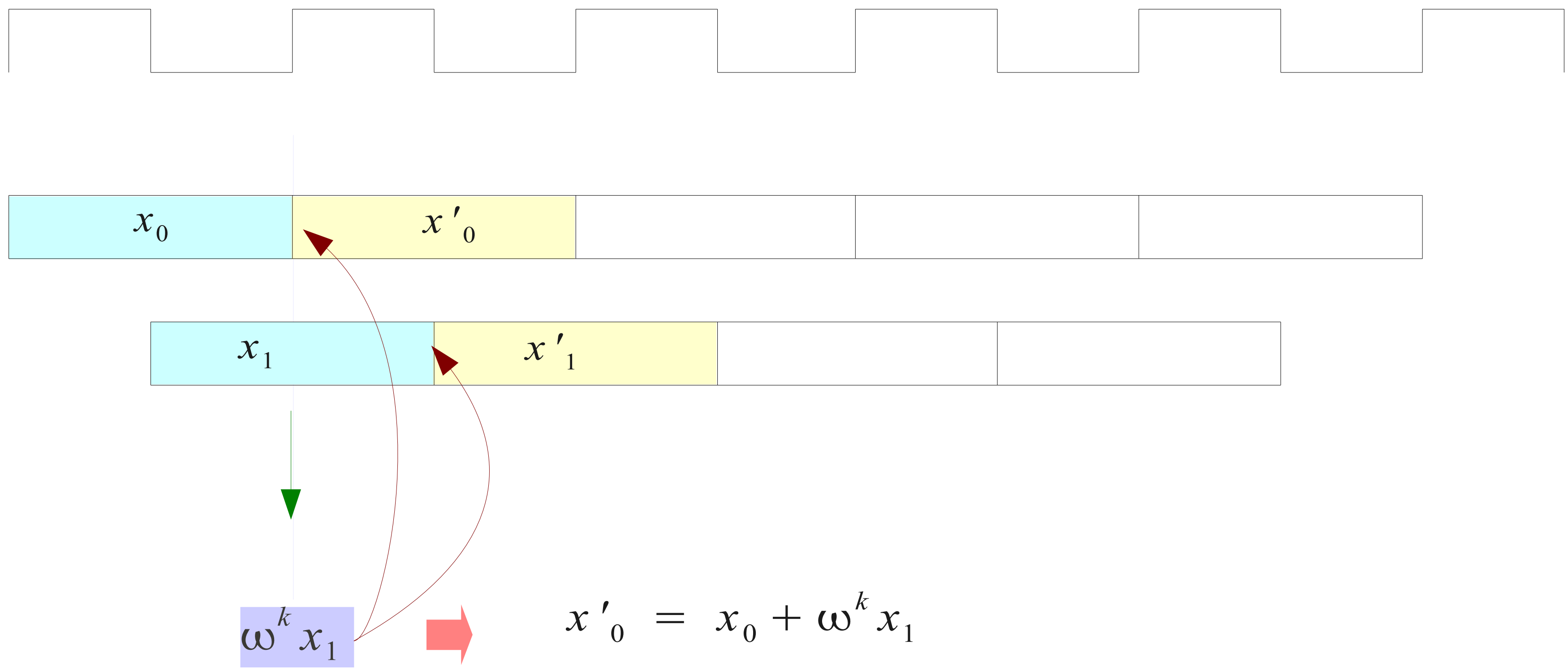
$$x'_1 = x_0 - \omega^k x_1$$

$$\Rightarrow \quad x'_1 = x'_0 - \omega^k x_1 - \omega^k x_1$$

$$x'_1 = x'_0 - \underline{2\omega^k x_1}$$



The Butterfly Operations (1)



is available

$$x'_0 = x_0 + \omega^k x_1$$

$$x'_1 = x'_0 - \underline{2\omega^k x_1}$$

only one multiplier
is needed

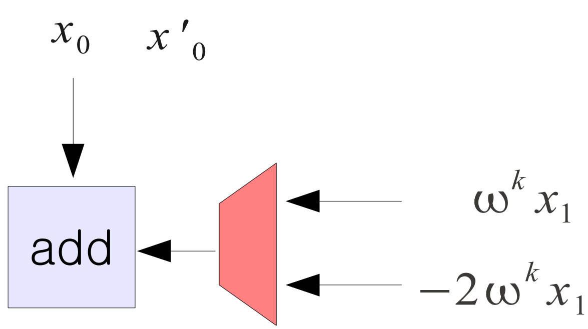
Shift left → wiring

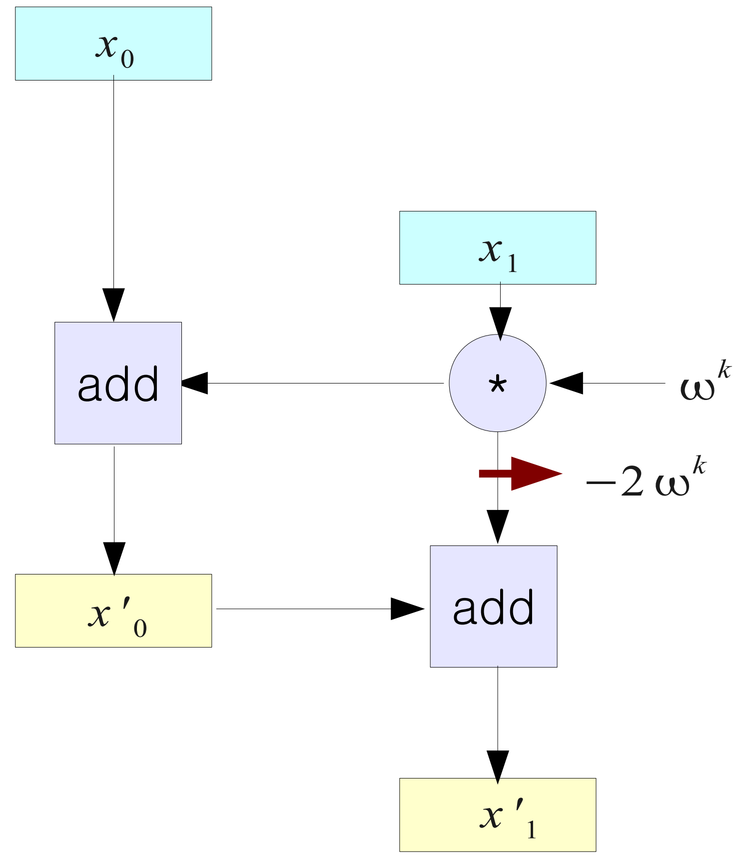
The Butterfly Operations

$$\begin{cases} x'_0 = x_0 + \omega^k x_1 \\ x'_1 = x_0 - \omega^k x_1 \end{cases}$$

$$\boxed{x'_0 = x_0 + \omega^k x_1}$$

$$\boxed{x'_1 = x'_0 - \underline{2\,\omega^k x_1}}$$





The Butterfly Time Multiplexed Operations (2)

$$\begin{cases} x'_0 = x_0 + \omega^k x_1 \\ x'_1 = x_0 - \omega^k x_1 \end{cases}$$

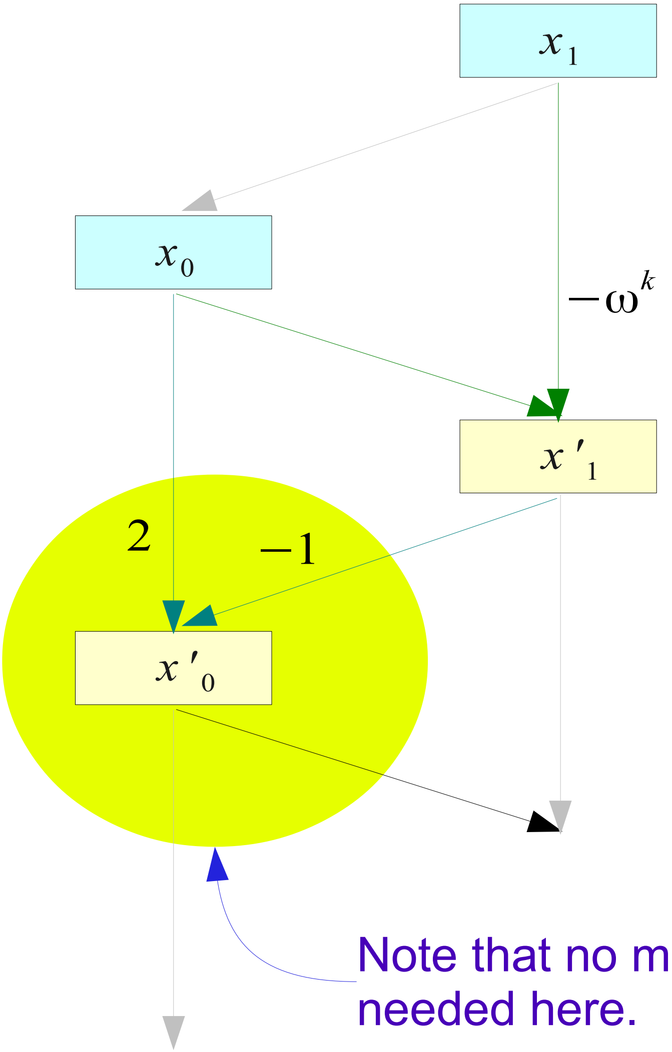
$$x'_1 = x_0 - \omega^k x_1$$

$$\omega^k x_1 = (x_0 - x'_1)$$

$$x'_0 = x_0 + \omega^k x_1$$

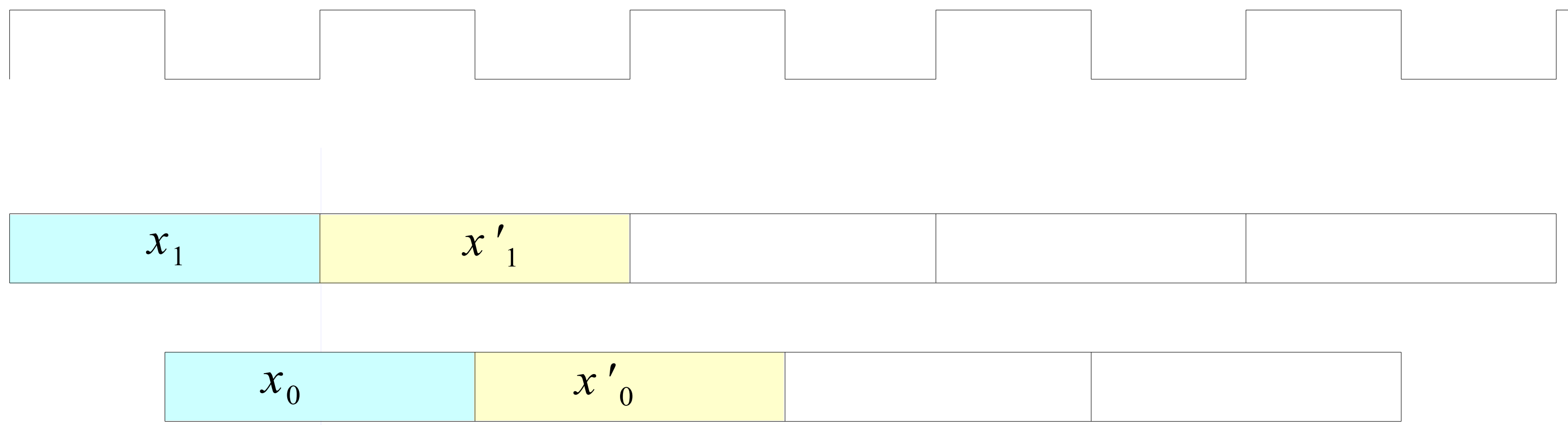
$$\Rightarrow \quad x'_0 = x_0 + (x_0 - x'_1)$$

$$x'_0 = 2x_0 - x'_1$$



Note that no multiplier is needed here.

The Butterfly Operations (2)



only one multiplier
is needed

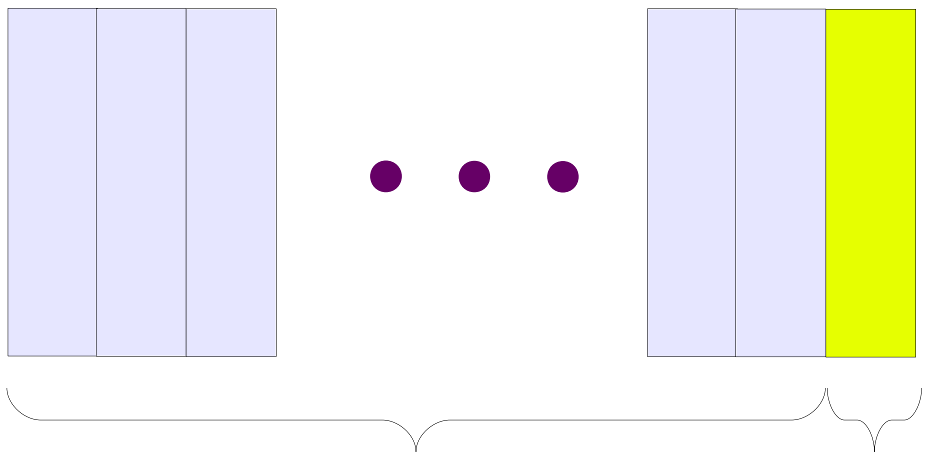
$\omega^k x_1$ is available

$$x'_1 = x_0 - \omega^k x_1$$

$$x'_0 = 2x_0 - x'_1$$

Shift left → wiring

Micro-Pipelined CORDIC



x'_0 $\quad x'_1 = x_0 - \omega^k x_1 \quad x'_0 = 2x_0 - x'_1$

Utilize adder in the
CORDIC hardware ?

Combining CORDIC architecture ?

Some background survey on CORDIC + FFT Architecture

Different level of parallelism

High fanout – mux , adder

References

[1] http://en.wikipedia.org/
[2] J.H. McClellan, et al., Signal Processing First, Pearson Prentice Hall, 2003
[3] A "graphical interpretation" of the DFT and FFT, by Steve Mann