insight to FFT

Compute spectrum of 1kHz by 8 point FFT

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Time-domain data.
Sampling Frequency
is **8kHz**

a[0] a[1] a[2] a[3] a[4] a[5] a[6] a[7]

Block diagram of FFT

+ + + + + + + + + − + − + − + −

w[0] w[1] w[2] w[3]

Stage 1

+ + + + + − + − + + + + + + + +

w[0] w[2] w[0] w[2]

Stage 2

+ + + − + + + − + + + − + + + −

Stage 3

Spectrum of 1kHz

Twiddle Factor.
Twiddling Frequency
is **1kHz**

w[0] w[1] w[2] w[3]

-w[0] (=w[4])   -w[1] (=w[5])   -w[2] (=w[6])   -w[3] (=w[7])

steps 1 to
counter-
clockwise

Negative value inverts the direction of vectors.

Multiplication of
w[n] and a[n]

w[0] a[0]   w[1] a[1]   w[2] a[2]   w[3] a[3]   -w[0] a[4]   -w[1] a[5]   -w[2] a[6]   -w[3] a[7]

Vector
calculation and
FFT result

Stage 1

w[1] (a[1]-a[5])   w[2] (a[2]-a[6])

w[0] (a[0]-a[4])   w[3] (a[3]-a[7])
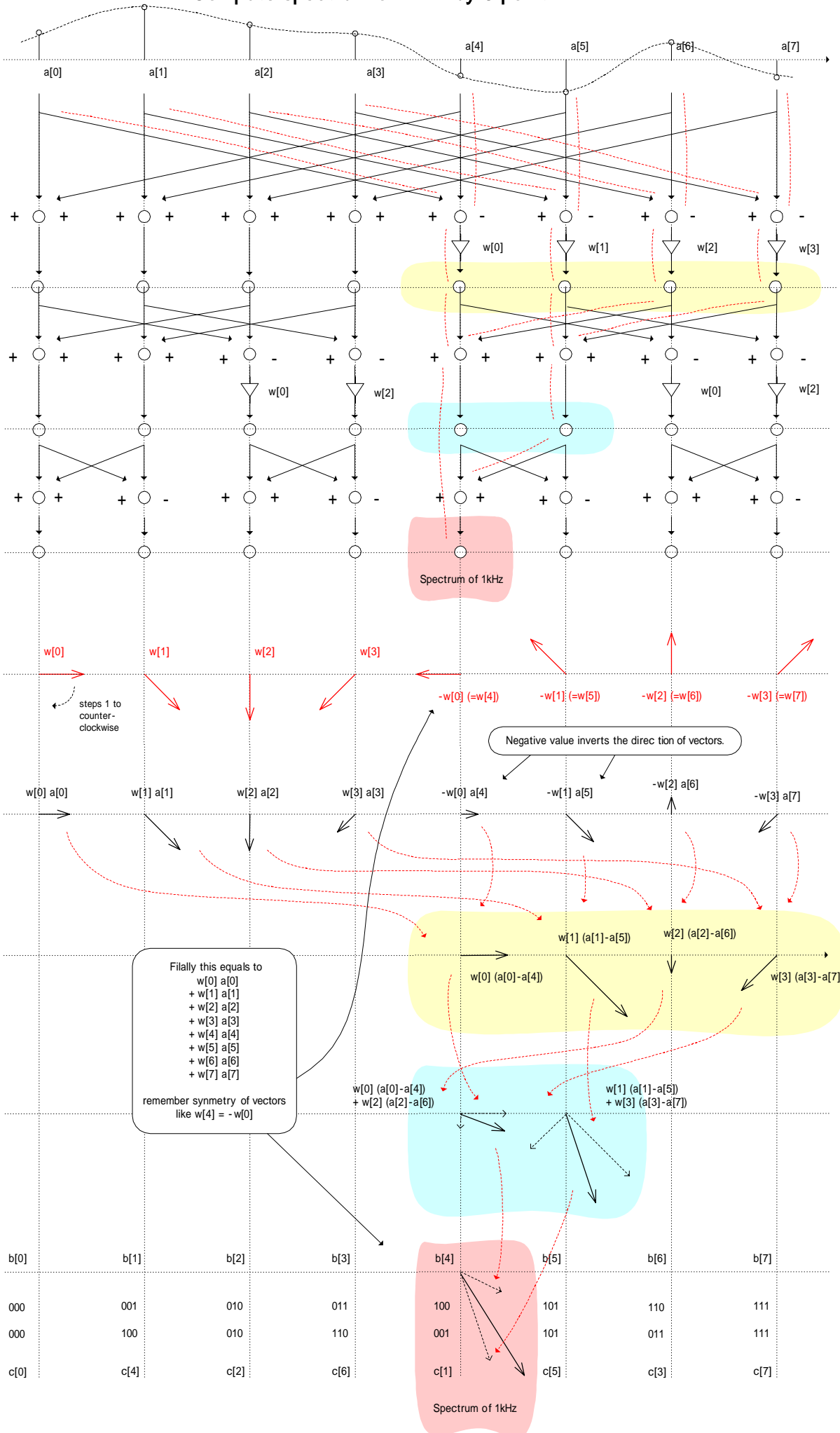
Filally this equals to
w[0] a[0]
+ w[1] a[1]
+ w[2] a[2]
+ w[3] a[3]
+ w[4] a[4]
+ w[5] a[5]
+ w[6] a[6]
+ w[7] a[7]

remember synmetry of vectors
like w[4] = - w[0]

Stage 2

w[0] (a[0]-a[4])   w[1] (a[1]-a[5])
+ w[2] (a[2]-a[6])   + w[3] (a[3]-a[7])

Stage 3	b[0]	b[1]	b[2]	b[3]	b[4]	b[5]	b[6]	b[7]
Bit-reversed order								
	000	001	010	011	100	101	110	111
	000	100	010	110	001	101	011	111
Actual order of FFT	c[0]	c[4]	c[2]	c[6]	c[1]	c[5]	c[3]	c[7]

Spectrum of 1kHz

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