insight to FFT   Compute spectrum of 4kHz by 8 point FFT   by Toshio Iwata

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

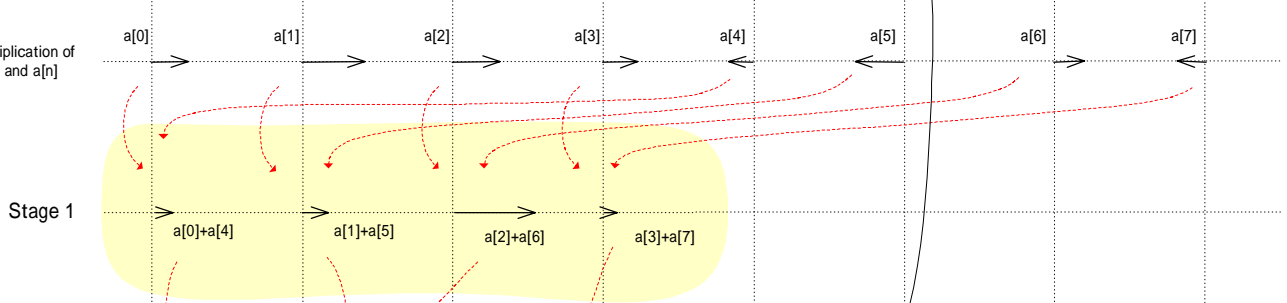**Stage 1**

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

means leading
(2/2) PI

Stage 2

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

Stage 3

Spectrum of 4kHz

lagging (2/2) PI   lagging (2/2) PI   lagging (2/2) PI   lagging (2/2) PI

w[0]   w[0]   w[0]   w[0]
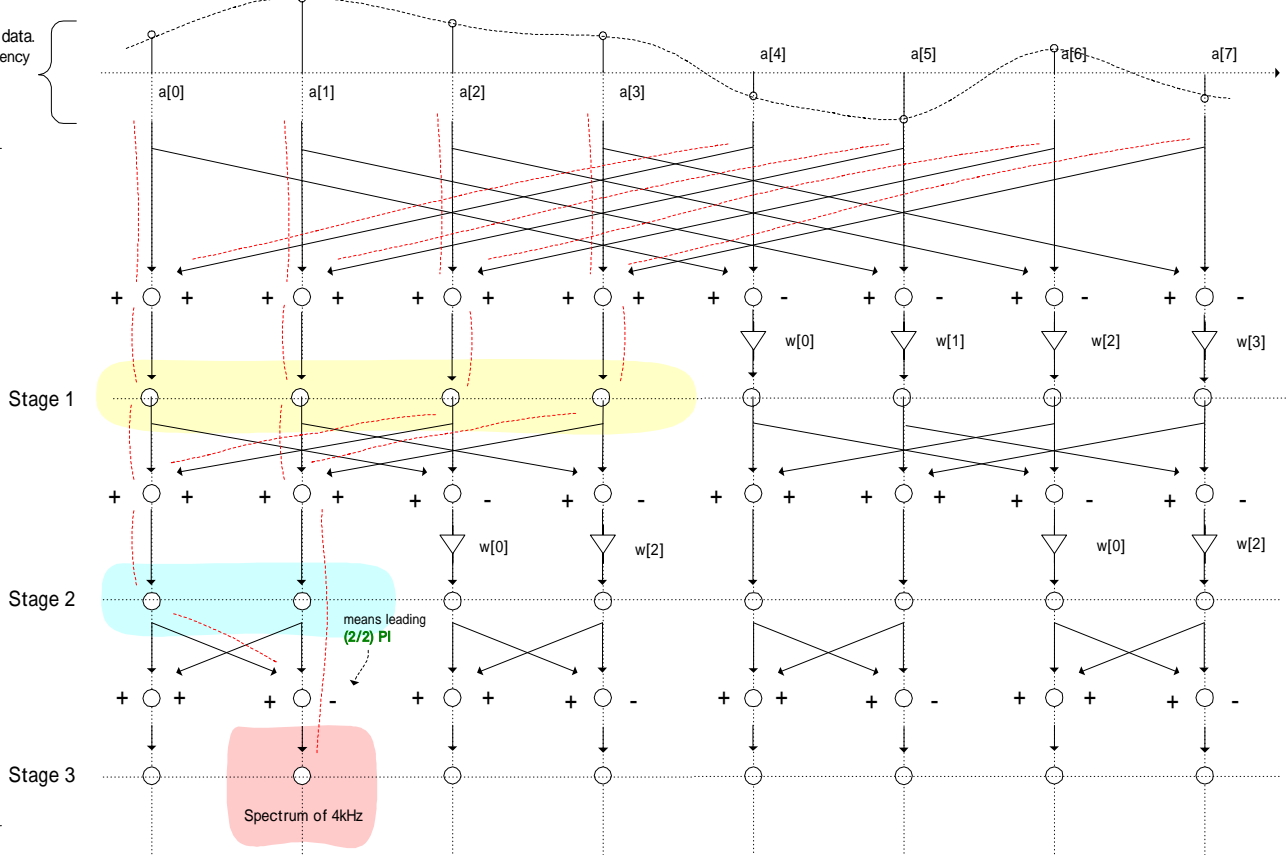
Twiddle Factor.
Twiddling Frequency
is **0kHz**
(the green is **4kHz**)

w[0]   w[4] w[0]   w[0]   w[4] w[0]   w[0]   w[4] w[0]   w[0]   w[4] w[0]

to counter-
clockwise
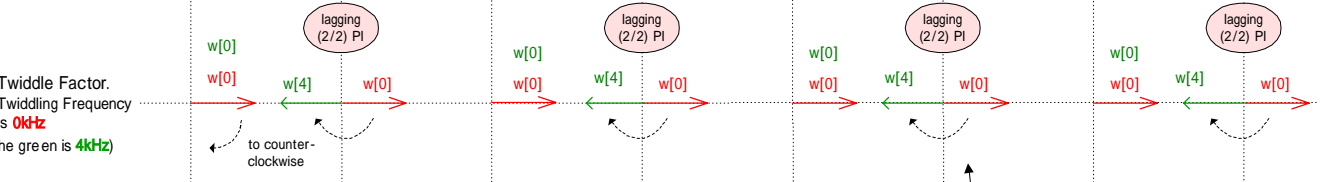
Multiplication of
w[0] and a[n]

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

Stage 1

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

Vector
calculation and
FFT result

Stage 2

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

leads
(2/2) PI

Compensates vectors for lag-lead
e.g.
lagging (2/2) PI is canceled
by leading (2/2) PI

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

b[0]   b[1]   b[2]   b[3]   b[4]   b[5]   b[6]   b[7]
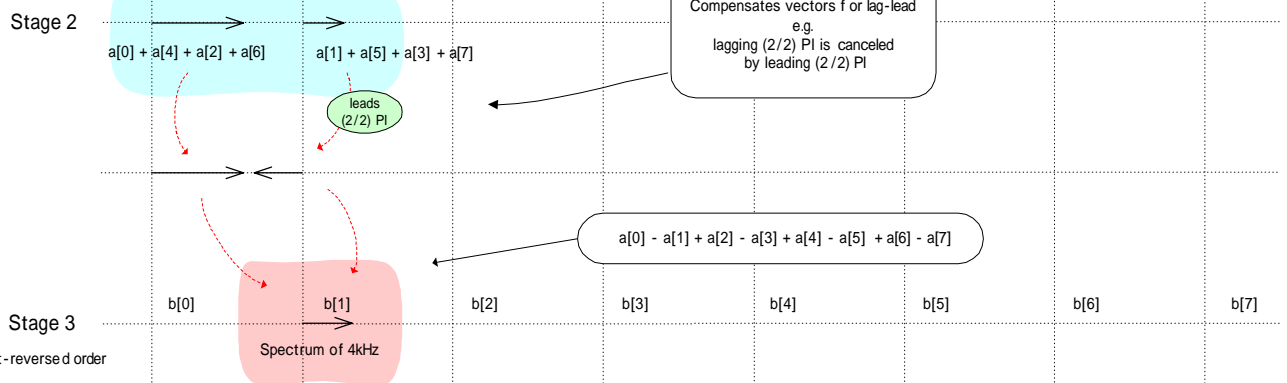
Stage 3
Bit-reversed order

Spectrum of 4kHz

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]