EE538 DSPI

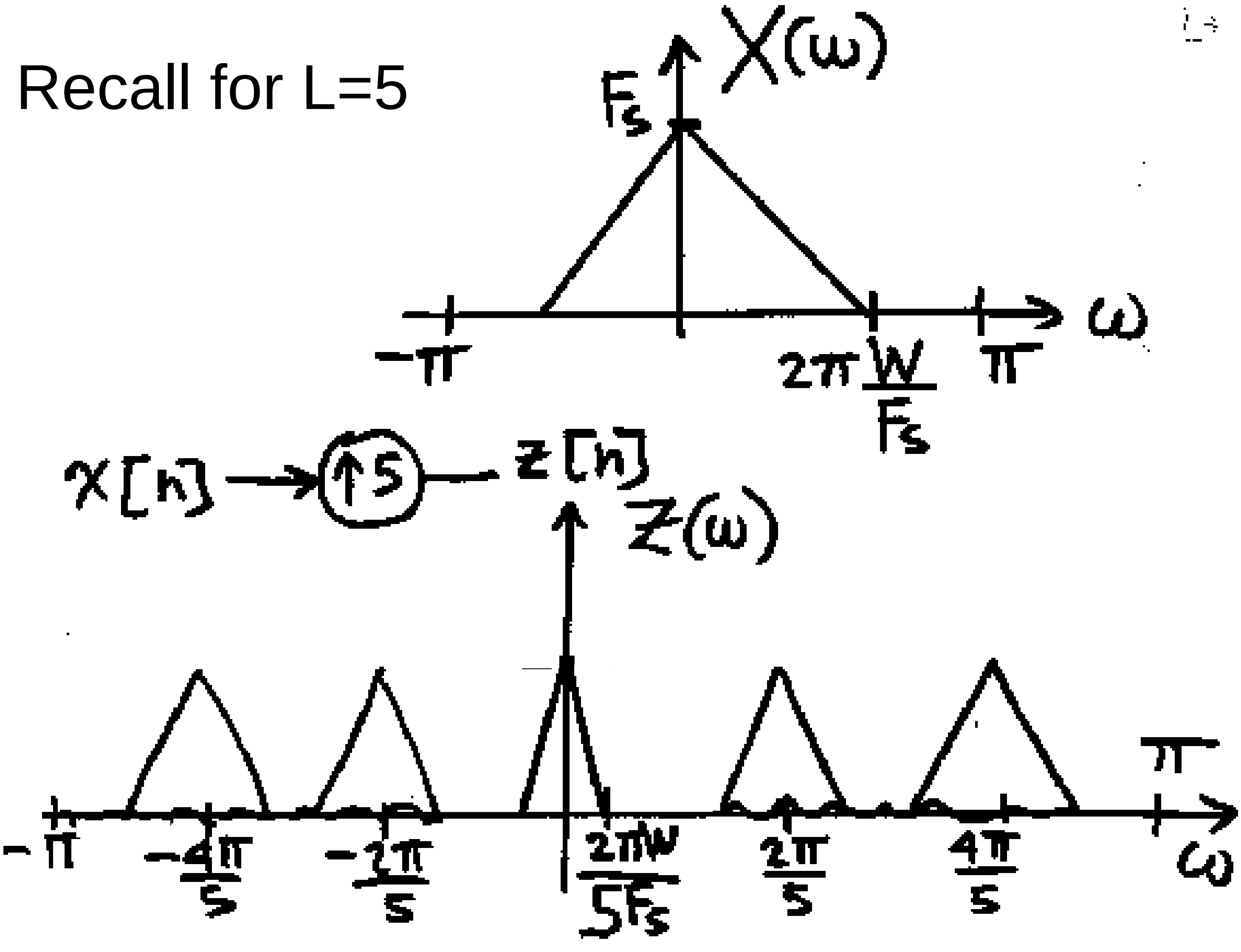
Session 12

Outline:

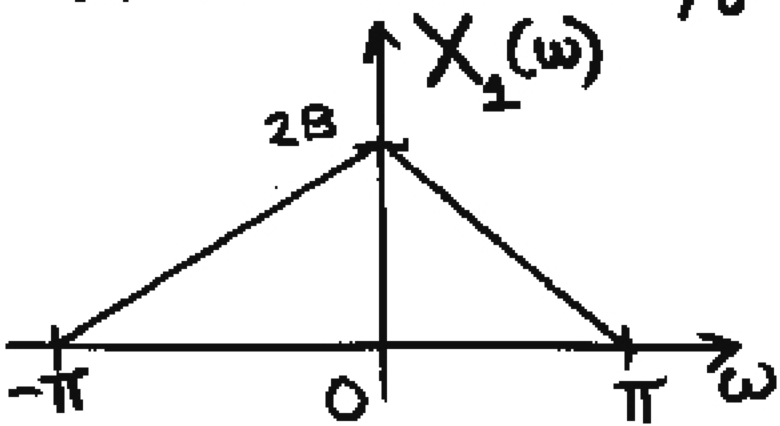
- Digital Subbanding Example

Transmultiplexers, Sect 11.10.2

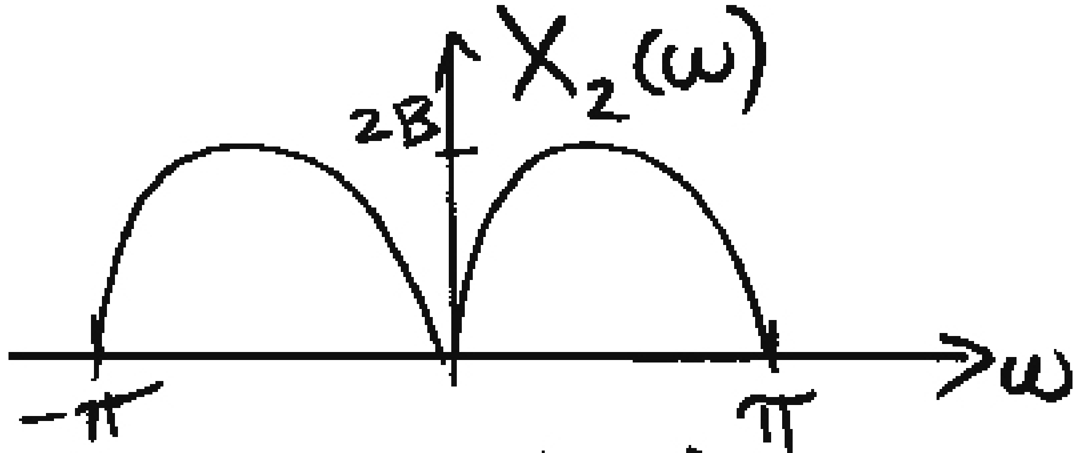
Recall for L=5

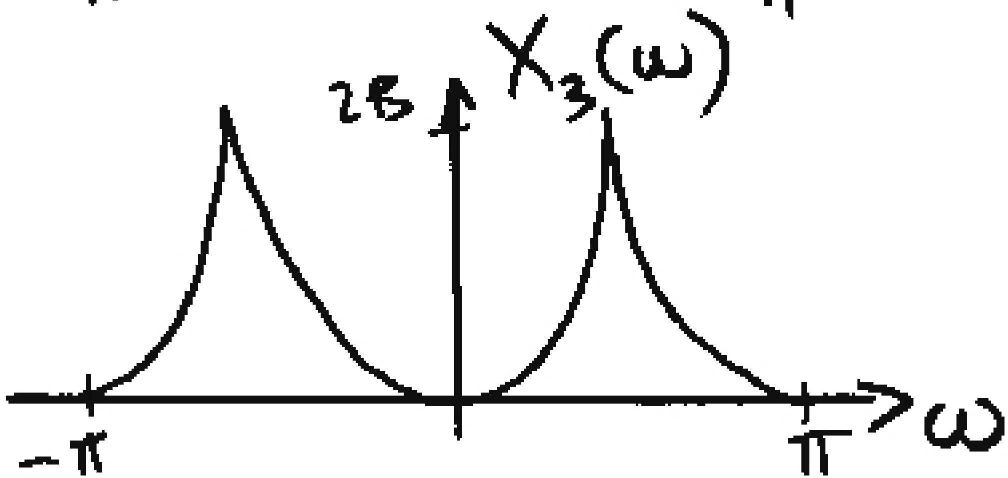


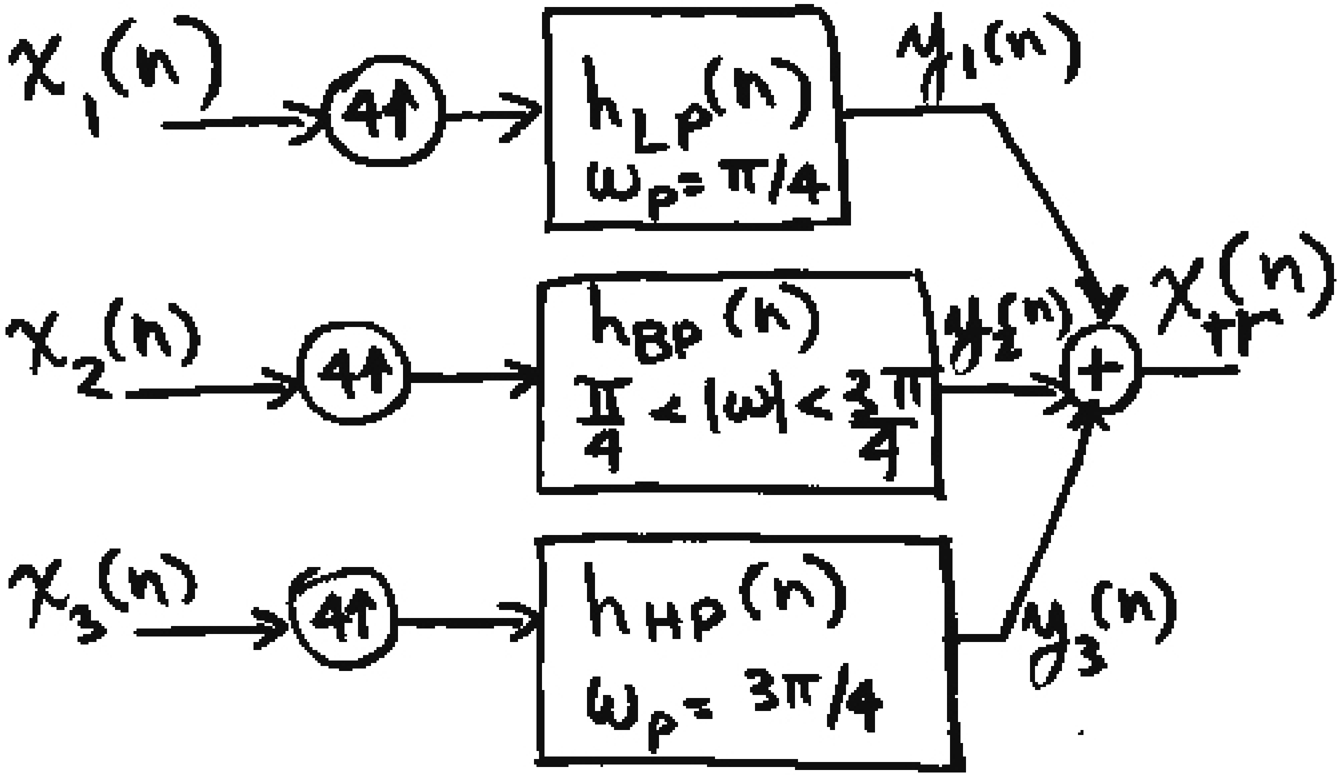
- Another example of digital subbanding thru interpolation and decimation – no modulation
- Consider 3 signals sampled at or near Nyquist rate



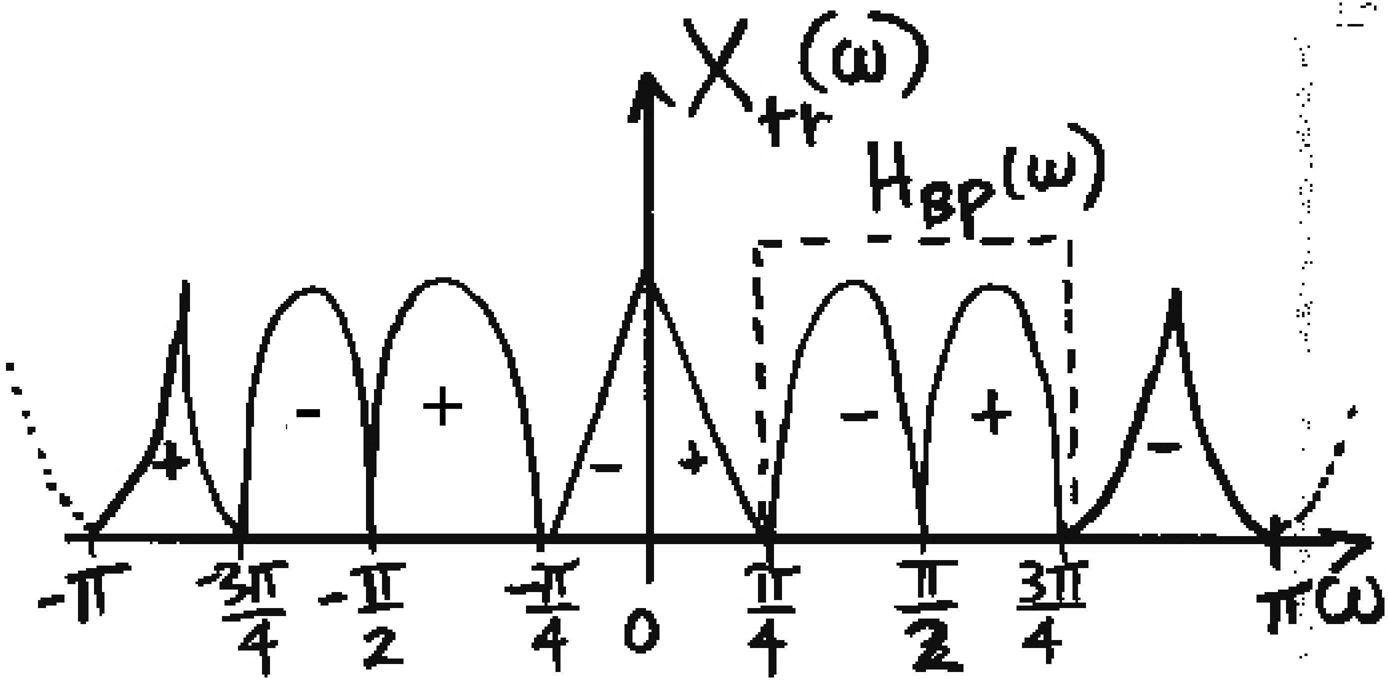
- assume wlog each signal has same bandwidth $= B$ and $F_s = 2B$


$X_2(\omega)$
$2B$
$-\pi$
π
ω


$X_3(\omega)$
$2B$
$-\pi$
π
ω



x1(n)
4↑
hLP(n)
ωp = π/4
y1(n)
x2(n)
4↑
hBP(n)
π/4 < |ω| < 3π/4
y2(n)
+
xtr(n)
x3(n)
4↑
hHP(n)
ωp = 3π/4
y3(n)



$$h_{BP}(n) = \frac{\sin\left(\frac{\pi}{4}n\right)}{\pi n} e^{j\frac{\pi}{2}n}$$

• easy to verify that:

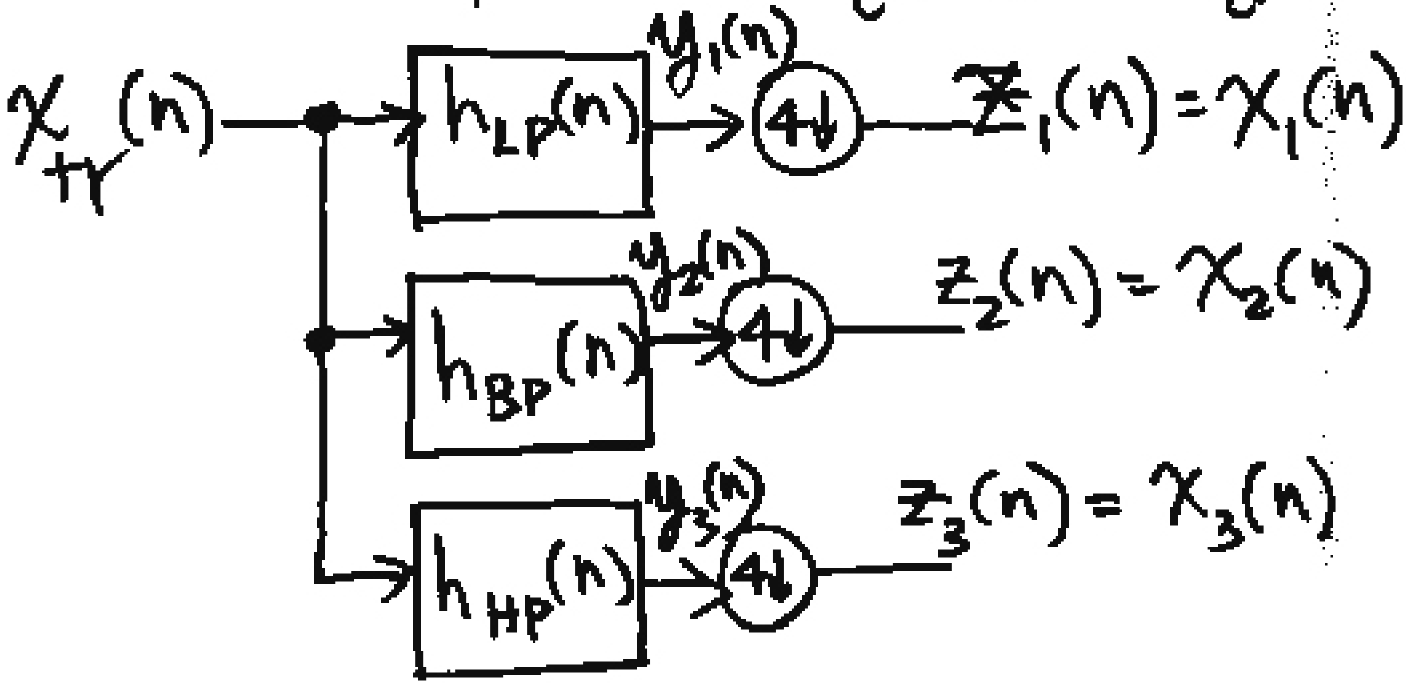
F_{s_0} = original sampling rate $> 2B$

$$y_1(n) = x_{1a}\left(\frac{n}{4F_{s_0}}\right)$$

$$y_2(n) = x_{2a}\left(\frac{n}{4F_{s_0}}\right)\cos\left(\frac{2\pi}{4}n\right)$$

$$y_3(n) = x_{3a}\left(\frac{n}{4F_{s_0}}\right)\underbrace{\cos\left(\frac{2\pi(2)}{4}n\right)}_{\cos(\pi n)}$$

- Recovery of original signals:



$$z_2(n) = y_2(4n)$$

$$= x_{2a}\left(\frac{4n}{4F_{s0}}\right)\cos\left(\frac{\pi}{2}(4n)\right)$$

$$= x_{2a}\left(\frac{n}{F_{s0}}\right)$$

$$z_3(n) = y_3(4n)$$

$$= x_{3a}\left(\frac{4n}{4F_{s0}}\right)\cos\left(\pi(4n)\right) = x_{3a}\left(\frac{n}{F_{s0}}\right)$$