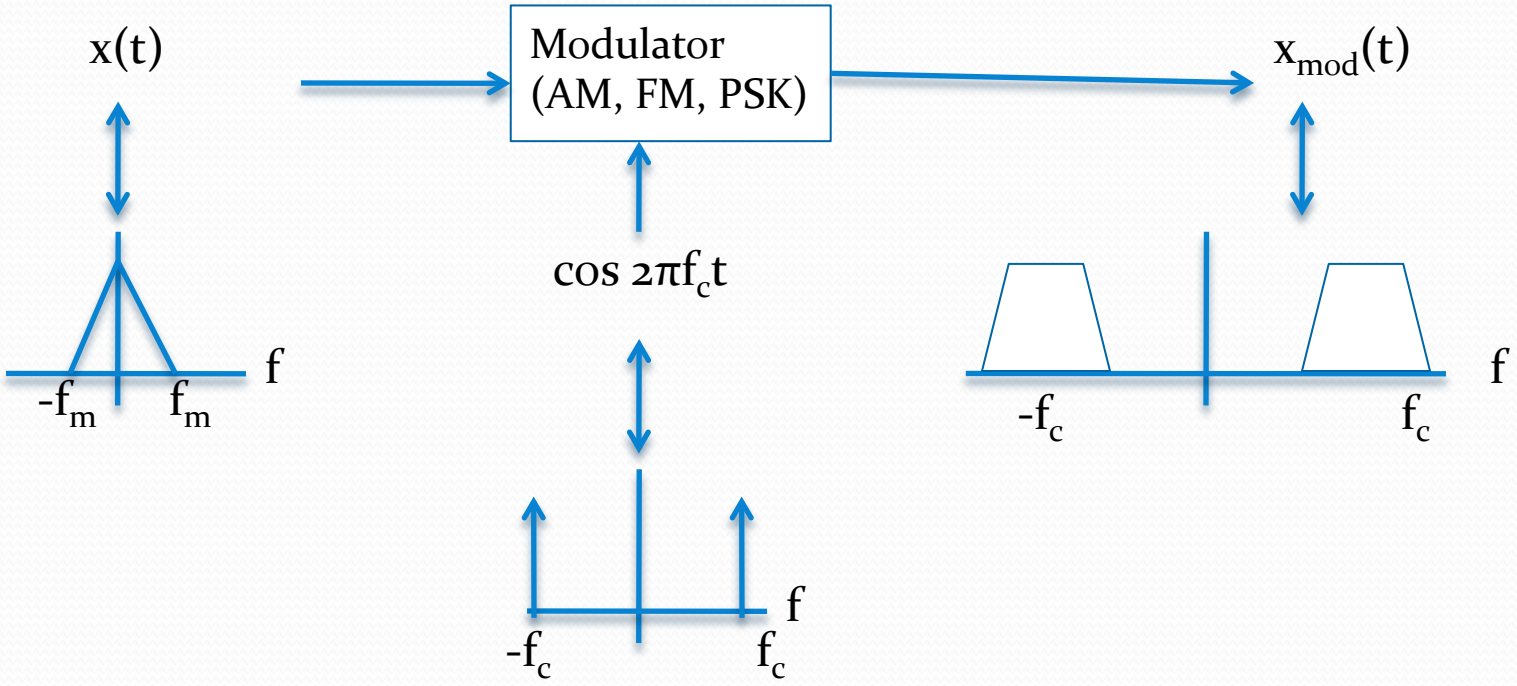
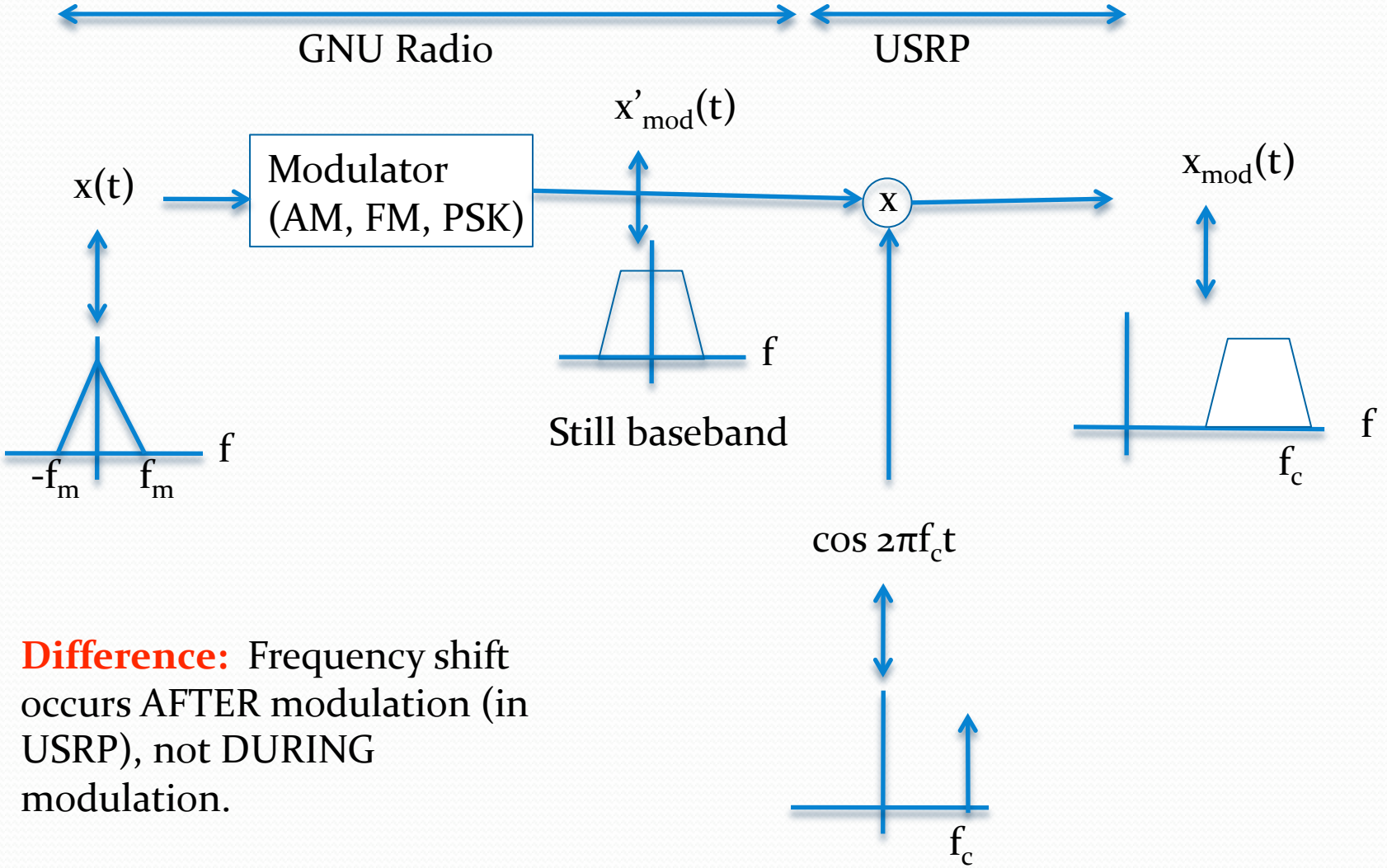
Transmitting with the USRP

Sharlene Katz, David Schwartz and James Flynn

Traditional Transmitter



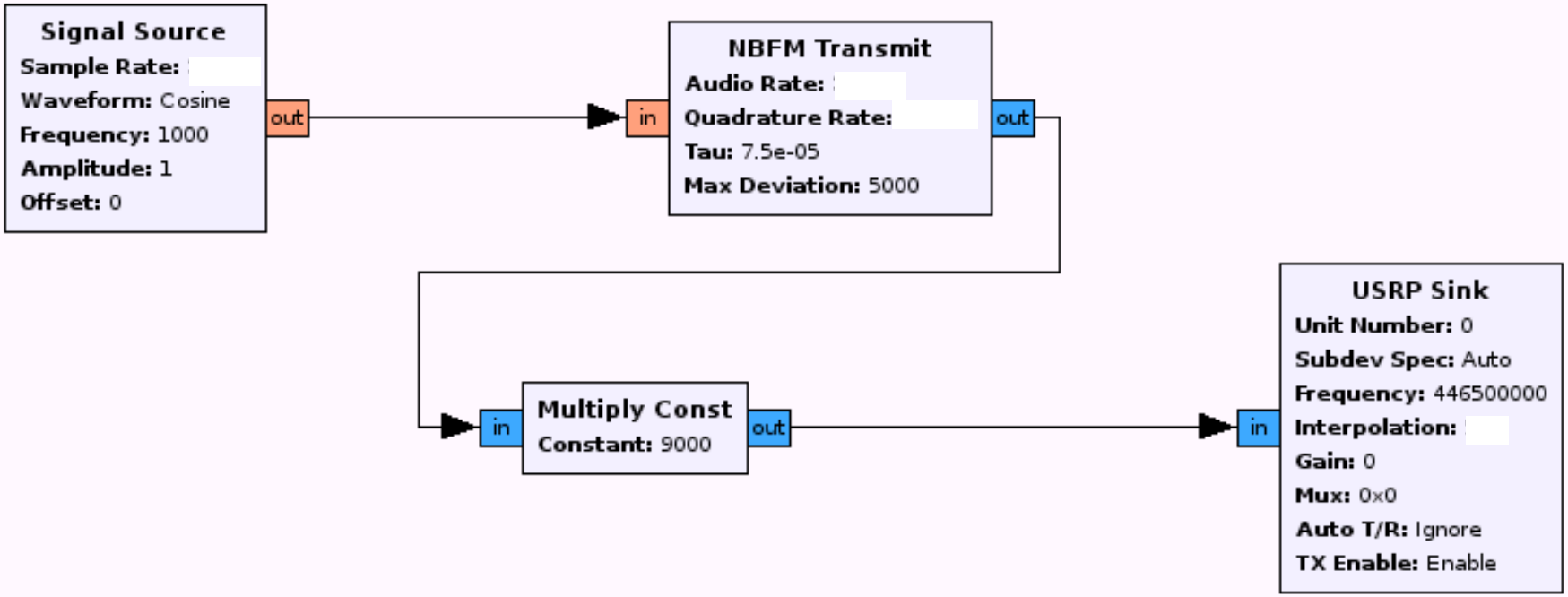
SDR Transmitter



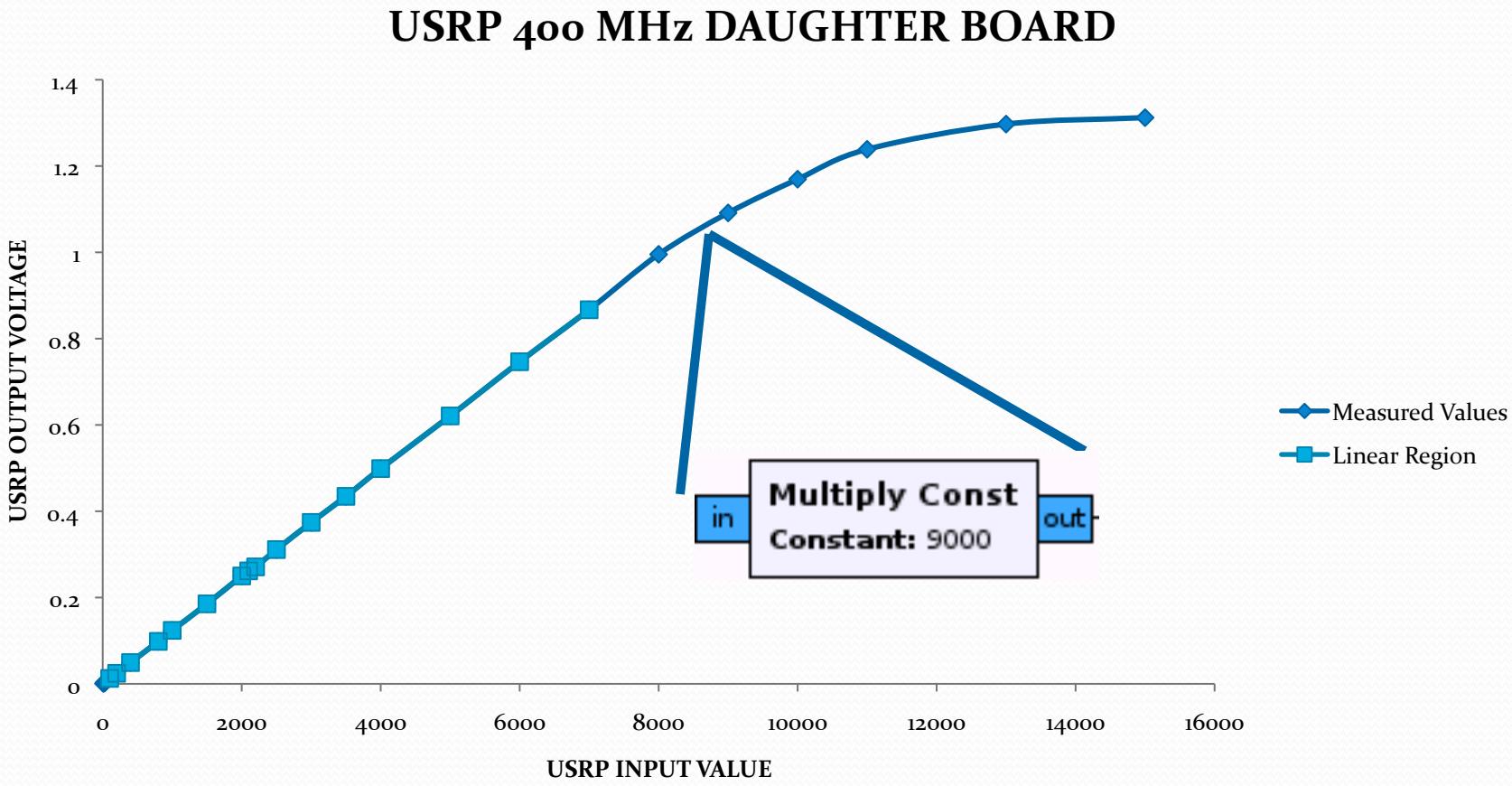
Difference: Frequency shift occurs AFTER modulation (in USRP), not DURING modulation.

Narrowband FM Transmitter

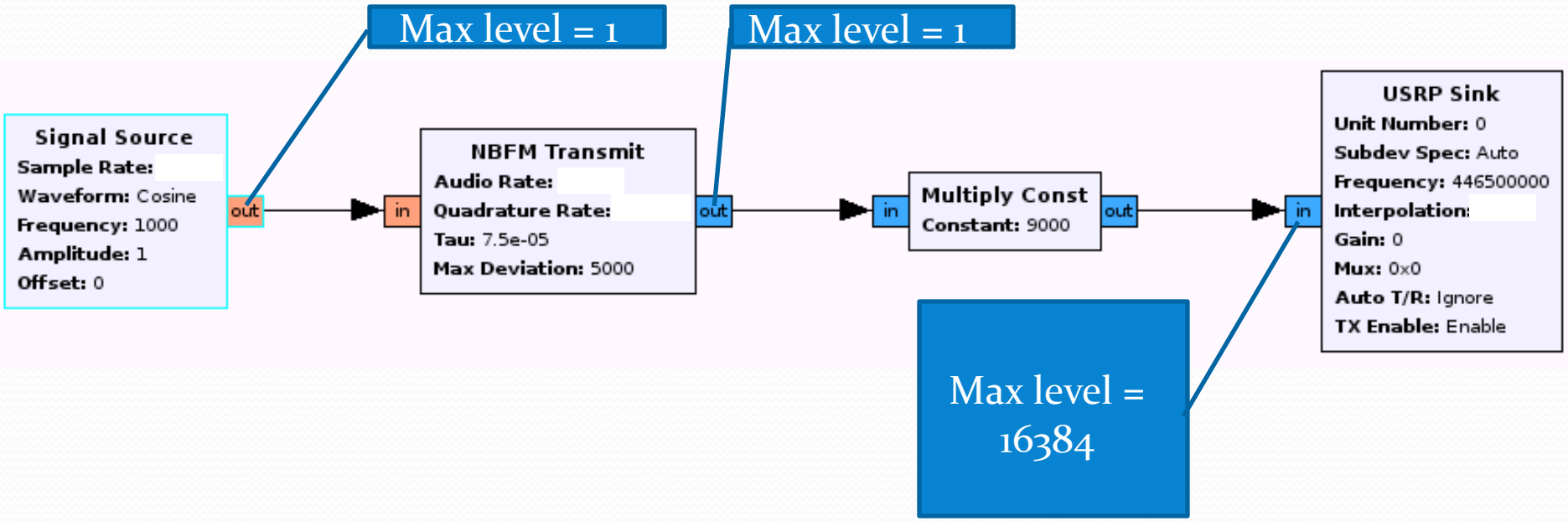
- Basic GRC layout of NBFM Transmitter with sine wave signal source.



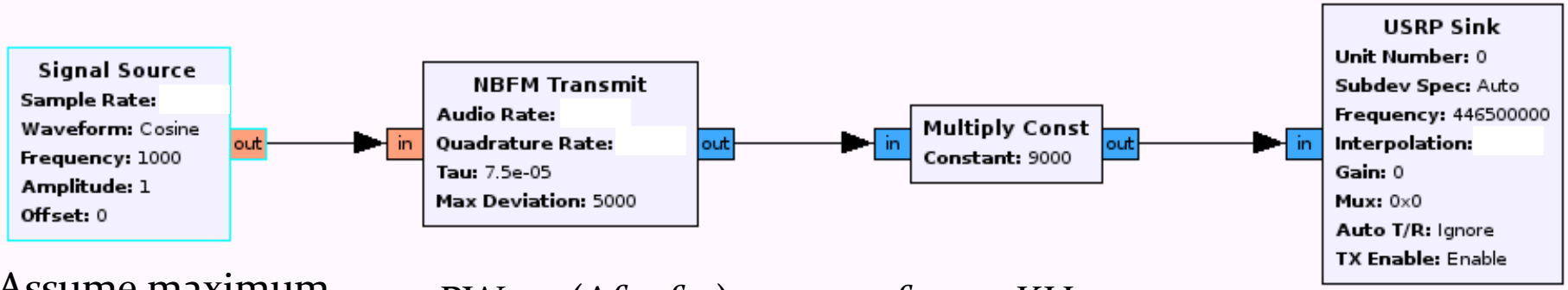
Gain Compression



Narrowband FM Transmitter (Signal Levels)



Sample rates / Interpolation



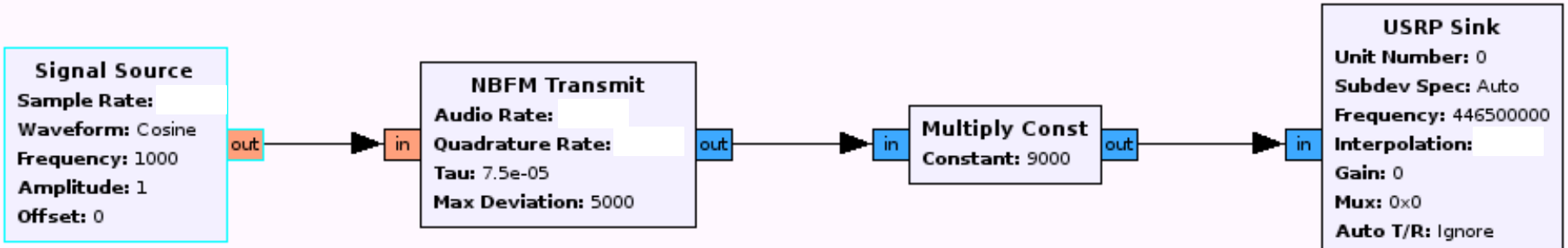
Assume maximum baseband frequency, $f_m = 3KHz \rightarrow f_{s1} \geq 6$ KHz

$BW = 2(\Delta f + f_m)$
$= 2(5K + 3K)$
$= 16KHz$
$\rightarrow f_{s2} \geq 32KHz$

$f_{s3} \geq 32KHz$

FPGA	DAC
Interpolation factor of up to 512 (must be multiple of 4)	Requires 128 M s/s

Sample rates / Interpolation



$f_{s1} \geq 6$ KHz

$f_{s2} \geq 32$KHz

$f_{s3} \geq 32$KHz

FPGA | DAC

Interpolation factor of up to 512 (must be multiple of 4)

Requires 128 M s/s

Example 1:

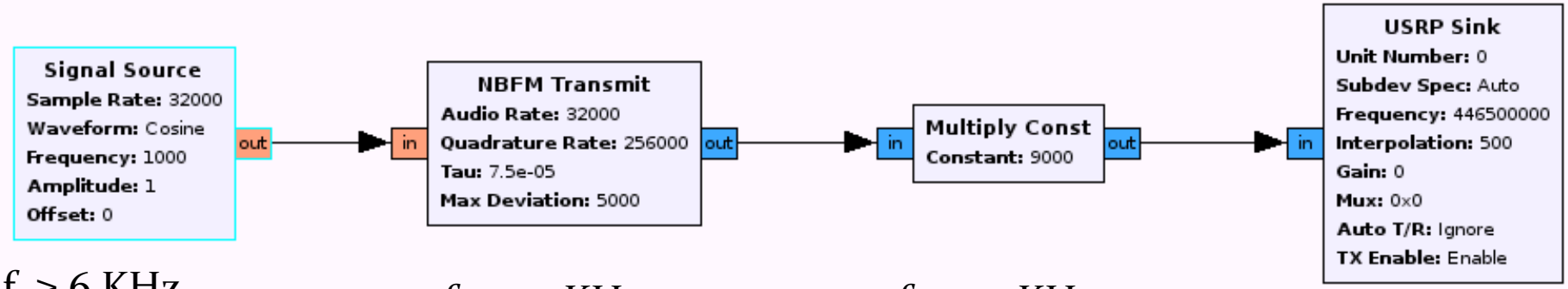
f_{s1}: Pick f_{s1} = 8KHz (factor of 128M s/s)

f_{s3}: Minimum value of 128M/512 = 250K

Pick f_{s3} = 256K (multiple of 8K)

Use $f_{s2} = f_{s3}$ = 256K (eliminate need for resampler)

Sample rates / Interpolation



$f_{s1} \geq 6$ KHz

$f_{s2} \geq 32$KHz

$f_{s3} \geq 32$KHz

FPGA | DAC

Interpolation factor of up to 512 (must be multiple of 4)

Requires 128 M s/s

Example 2:

f_{s1}: Pick f_{s1} = 32KHz (factor of 128M s/s)

f_{s3}: Minimum value of 128M/512 = 250K

Pick f_{s3} = 256K (multiple of 32K)

Use $f_{s2} = f_{s3}$ = 256K (eliminate need for resampler)

Set interpolation on USRP to be 128M/256K = 500

Final Design and Demo