

Designing Receivers for New GNSS Signals

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GNSS Signal Spectrum

Glonass



Galileo

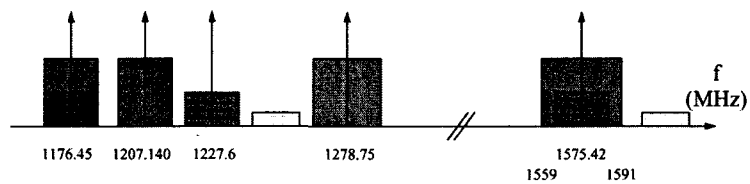


GPS



E5a E5b E6 E2 L1 E1

L5 L2 L1



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Phasing in of new Signals

- L2: 2005
- L5: 2006?
- Galileo (prototype): 2005?
- Many years before full constellations of signals are available
- How to incorporate new signals when available?
 - Software radio
 - Reconfigurable designs

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How Signals Might Combine

Band	E5 (L5)	L2	E6	L1
fmin	1164	1217	1260	1573
fmax	1214	1238	1300	1577
Ex. 1	X	X	X	X
Ex. 2	X	X		X
Ex. 3	X			X
Ex. 4		X		X

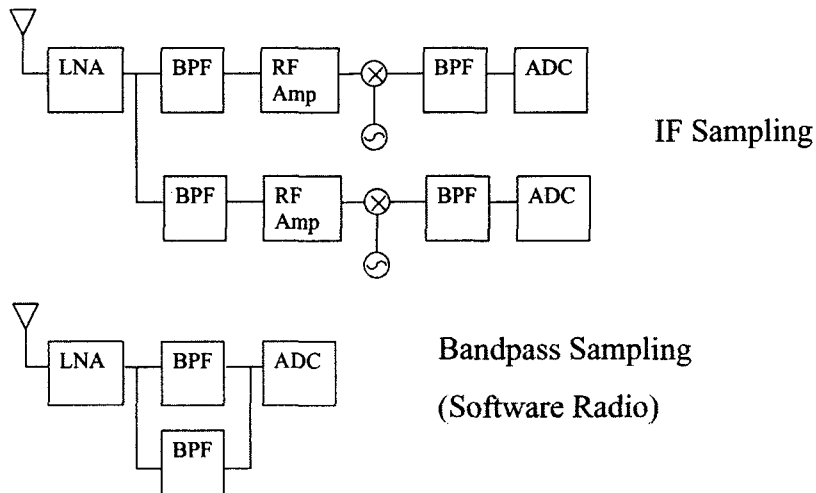
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Possible Rx Configurations



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Antenna Design

- Requirement for narrowband at L1 plus one broad band around 1.2GHz
- Patch antennas:
 - Robust and cheap
 - No simple cheap solution exists for multiple bands (especially broad bands)
- Helical variants
 - Bulky and not mechanically robust

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Bandpass Filter Design

- For Bandpass sampling:

$$\text{SNR}_s = \frac{S}{N_p + (n-1)N_0}$$

N_p in-band noise
 N_0 out-of-band noise
 n subsampling ratio

- Max subsampling ratio for GNSS is for L1 GPS:

$$n_{\max} = \left\lfloor \frac{f_{\max}}{B} \right\rfloor = 1576/2 = 788$$

- Requires N_p/N_0 of 29dB for 3dB SNR loss

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Bandpass Sampling

- Sampling rate must be at least twice the signal bandwidth (Nyquist)
- It must also, because a virtual downconversion results, ensure each downconverted band does not:
 - overlap dc,
 - overlap the Nyquist rate, or
 - overlap any other downconverted signal band

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Correlators

- L5 signals are QPSK but use direct sequence spreading
- Galileo signals are hexaphase and use binary-offset carrier (BOC) codes
- Therefore correlators will be more complicated, but this is not a huge step forward in complexity

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Power Consumption

- Sampling rate and processing effort (and therefore power consumption) are proportional to bandwidth
- Almost all of the new signals are much higher bandwidth than GPS L1
- New GNSS receivers will consume much more power so low-power techniques will be more important for mobile applications

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Conclusion: Challenges

- Software and reconfigurable techniques will be required for many years
- Wide-band antenna design
- High-Q RF front ends
- Careful selection of sampling rates
- Power consumption

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