



GPS Lab Exercises

(4) Correlation and Signal Search

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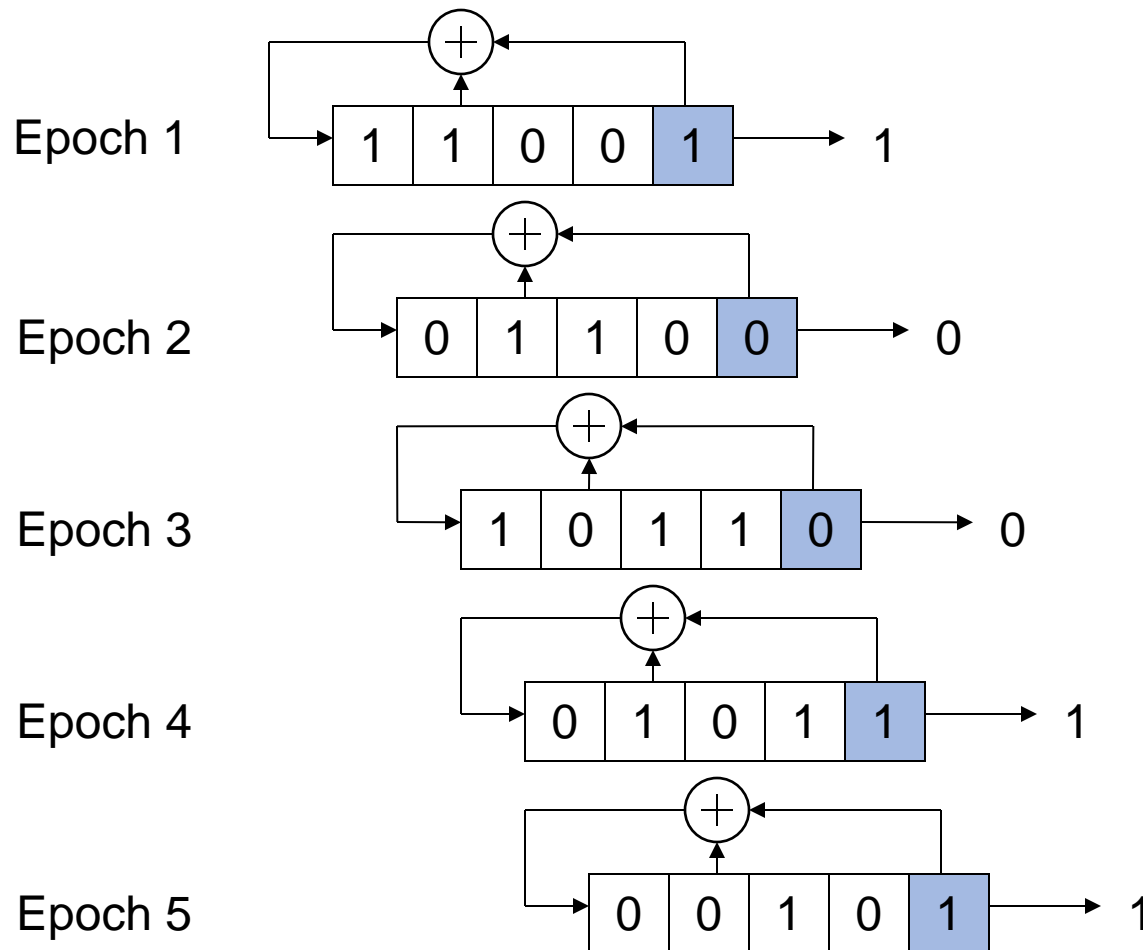




Gold-Code Generation

- Shift register (length n) with feedback creates periodic bit sequence
- Feedback value computed from exclusive-or of individual registers
 - $0 \oplus 0 = 1 \oplus 1 = 0$, $0 \oplus 1 = 1 \oplus 0 = 1$
 - Equivalent to multiplication of numbers $+1$ („0“) und -1 („1“)
- Favorable choice of feedback registers yields a sequence of maximum length $2^n - 1$ (*m-sequence*)
- Gold (1967): linear combinations of two (selected) m-sequences (with $n \neq 4, 8, \dots$) can provide a family of 2^{n+1} different *Gold codes* with optimum correlation properties

Feedback Shift Registers

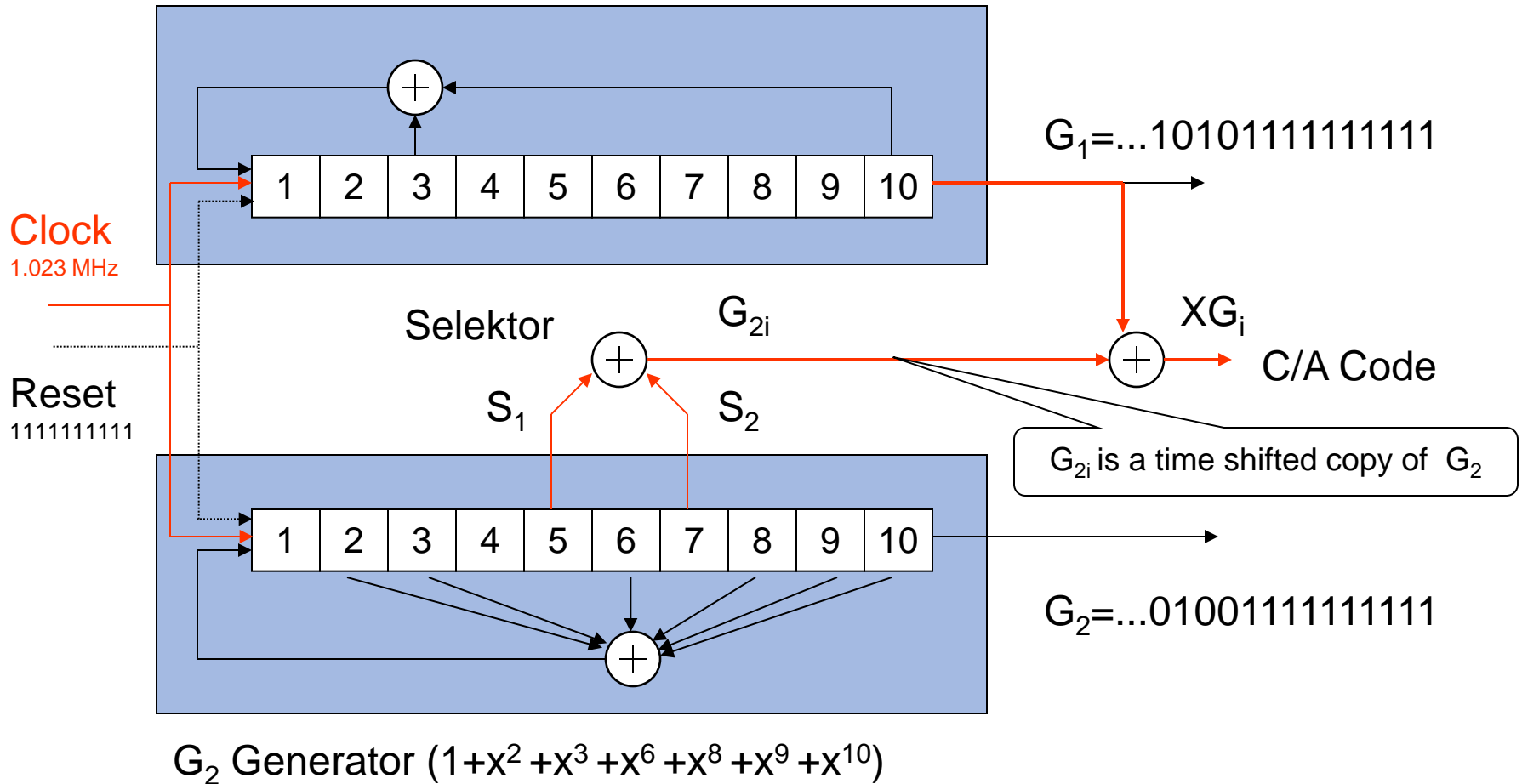


exclusive-or

\oplus	0	1
0	0	1
1	1	0

GPS C/A-Code Generation

G_1 Generator ($1+x^3+x^{10}$)

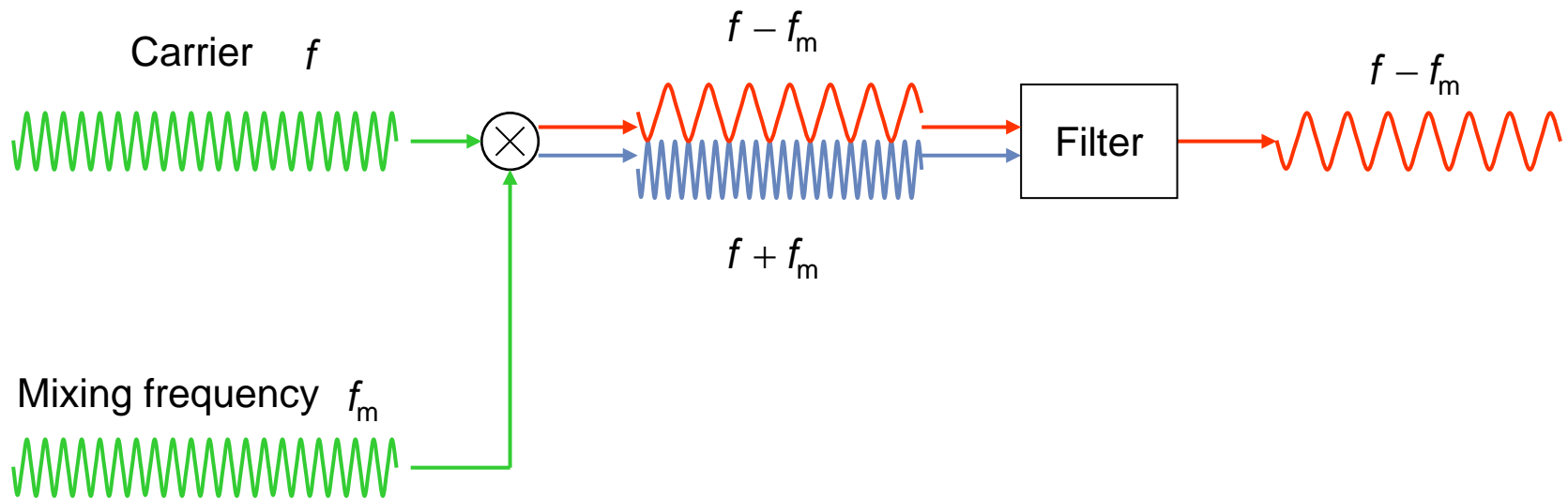




PRN Association (ICD-GPS-200)

PRN	Selector	Offset	PRN	Selector	Offset
1	$2 \oplus 6$	5	17	$1 \oplus 4$	469
2	$3 \oplus 7$	6	18	$2 \oplus 5$	470
3	$4 \oplus 8$	7	19	$3 \oplus 6$	471
4	$5 \oplus 9$	8	20	$4 \oplus 7$	472
5	$1 \oplus 9$	17	21	$5 \oplus 8$	473
6	$2 \oplus 10$	18	22	$6 \oplus 9$	474
7	$1 \oplus 8$	139	23	$1 \oplus 3$	509
8	$2 \oplus 9$	140	24	$4 \oplus 6$	512
9	$3 \oplus 10$	141	25	$5 \oplus 7$	513
10	$2 \oplus 3$	251	26	$6 \oplus 8$	514
11	$3 \oplus 4$	252	27	$7 \oplus 9$	515
12	$5 \oplus 6$	254	28	$8 \oplus 10$	516
13	$6 \oplus 7$	255	29	$1 \oplus 6$	859
14	$7 \oplus 8$	256	30	$2 \oplus 7$	860
15	$8 \oplus 9$	257	31	$3 \oplus 8$	861
16	$9 \oplus 10$	258	32	$4 \oplus 9$	862

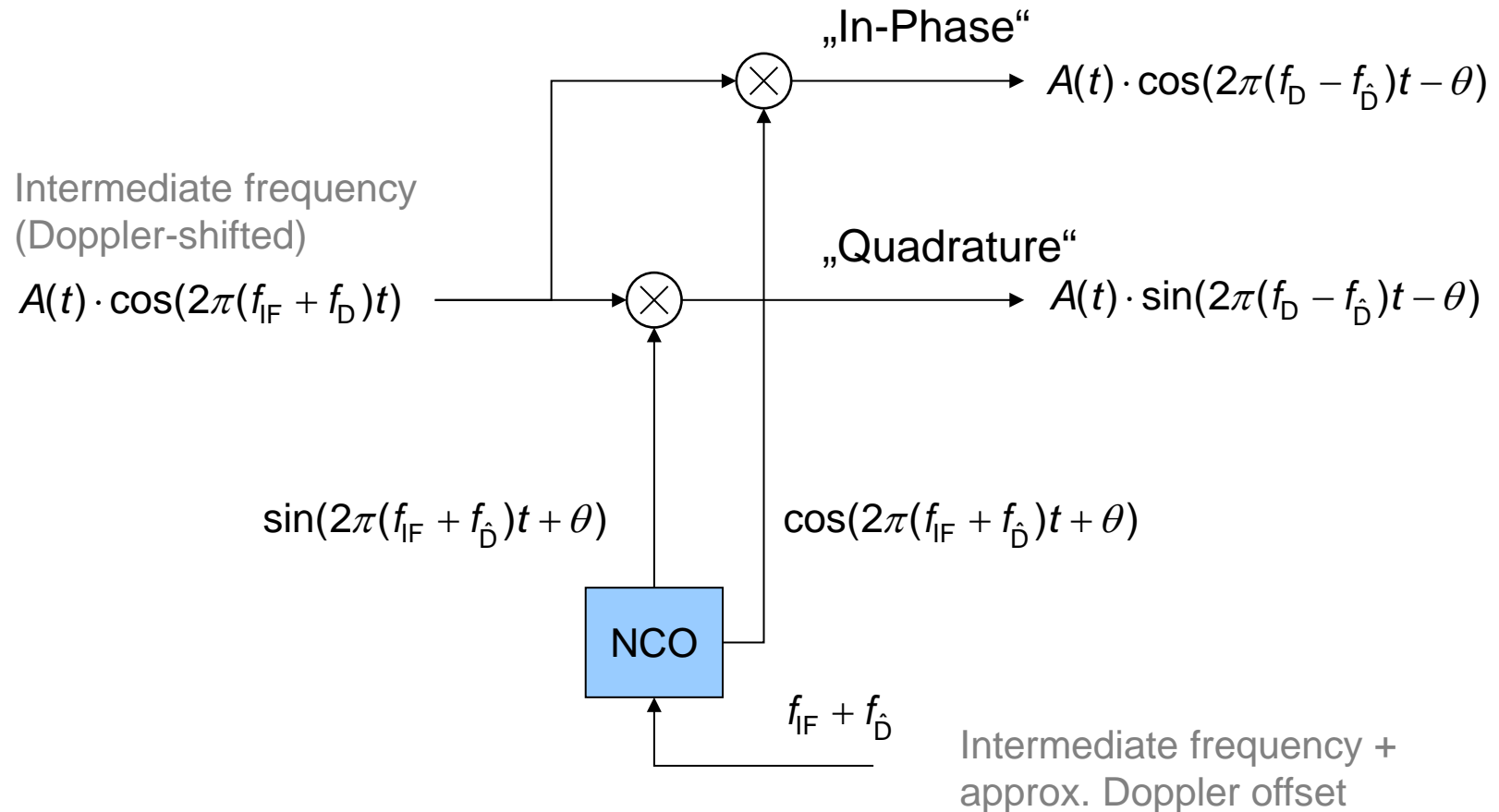
Mixing



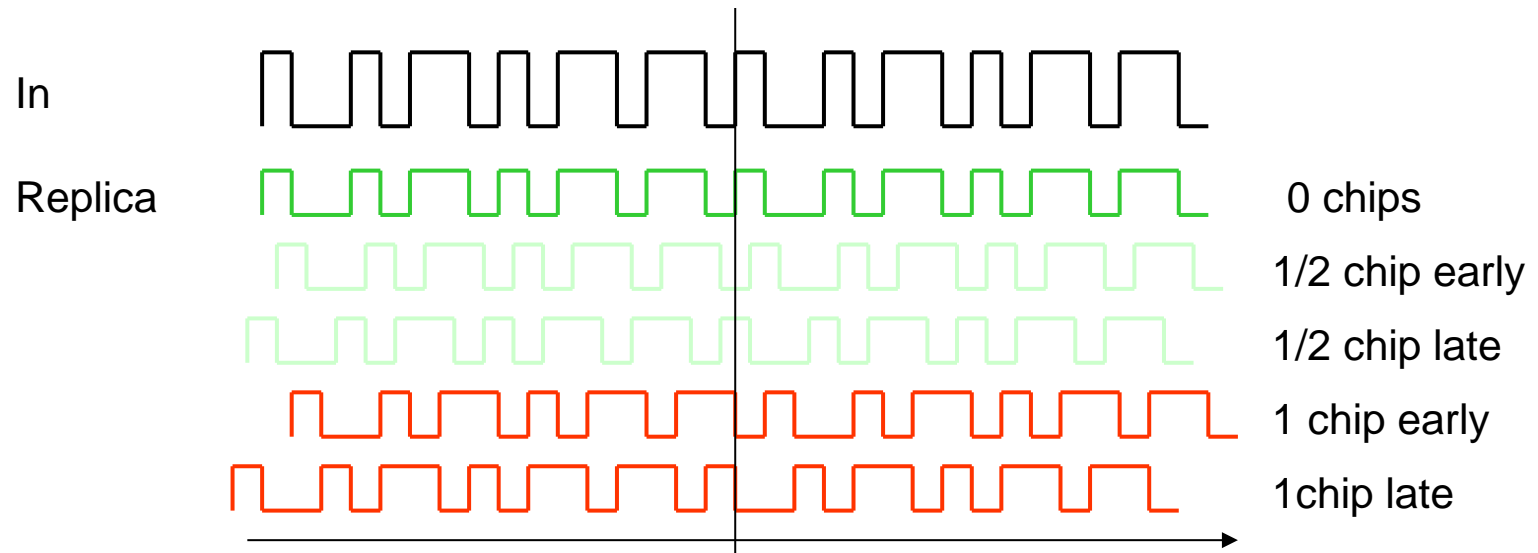
$$\cos(2\pi f t) \cdot \cos(2\pi f_m t) = \frac{1}{2} \cos(2\pi(f - f_m)t) + \frac{1}{2} \cos(2\pi(f + f_m)t)$$



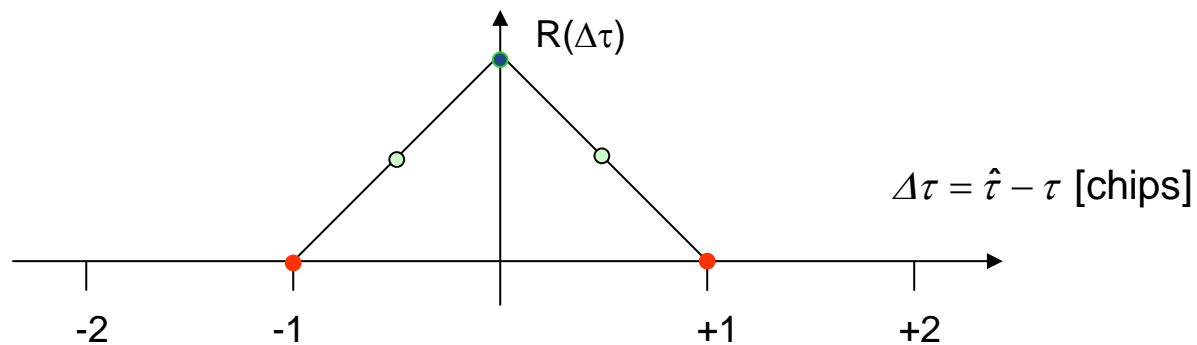
Doppler Compensation, In-Phase and Quadrature Channel



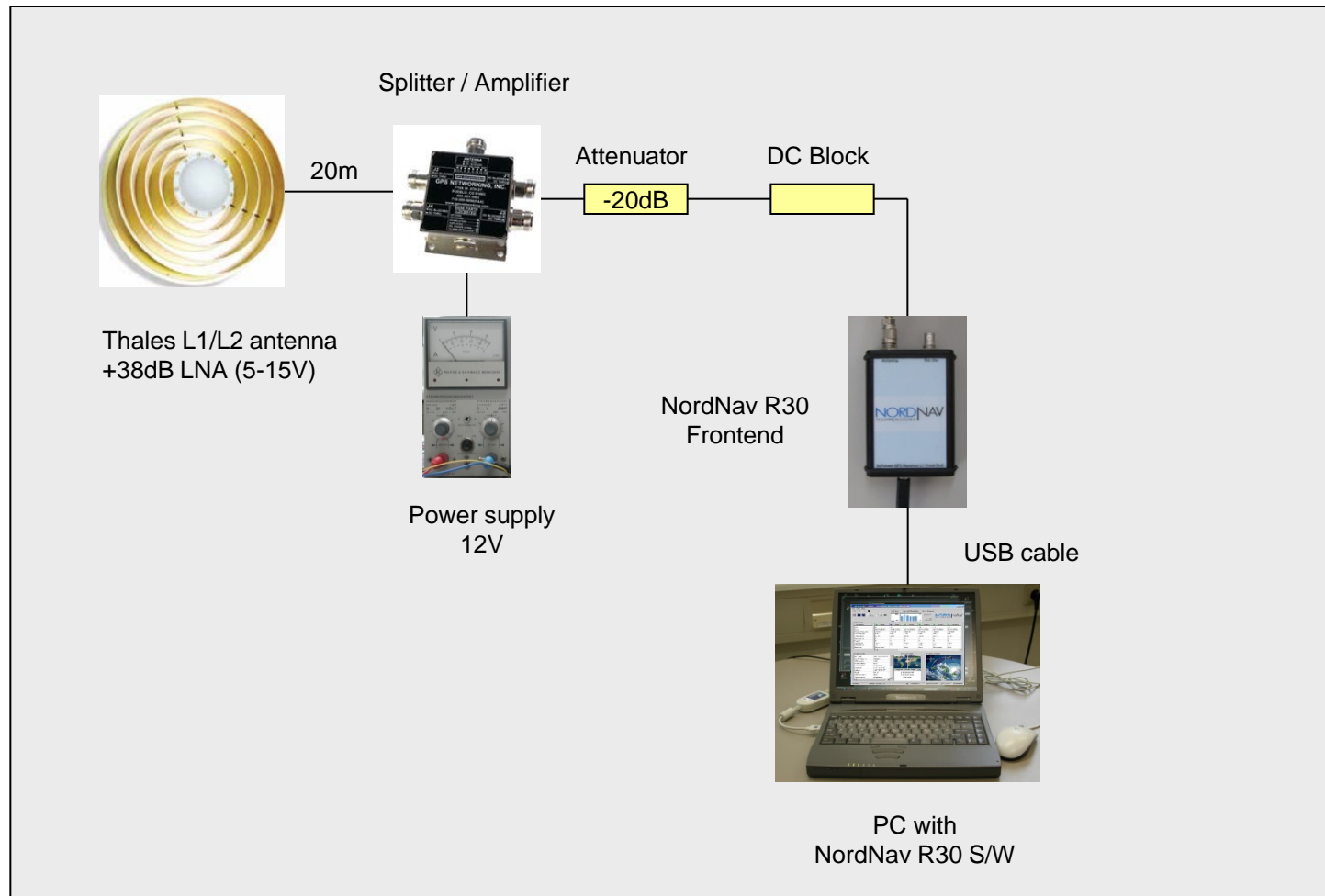
Code Correlation



Correlation



Measurement Setup



Example

