

# *Multi-Year GPS Tracking Using a Coin Cell*



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COLD...  
WARM...  
HOT!  
COLD...









1978







4



18

19

20

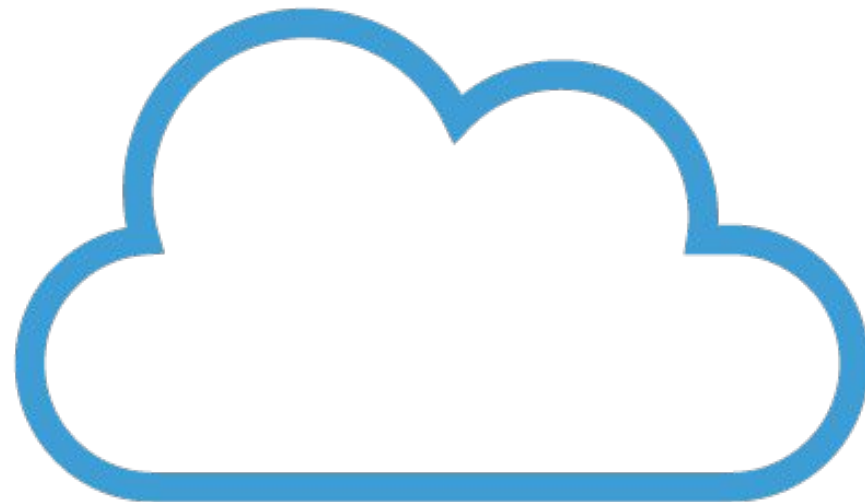
21



Van Diggelen. *A-GPS: Assisted GPS, GNSS, and SBAS*. 2009

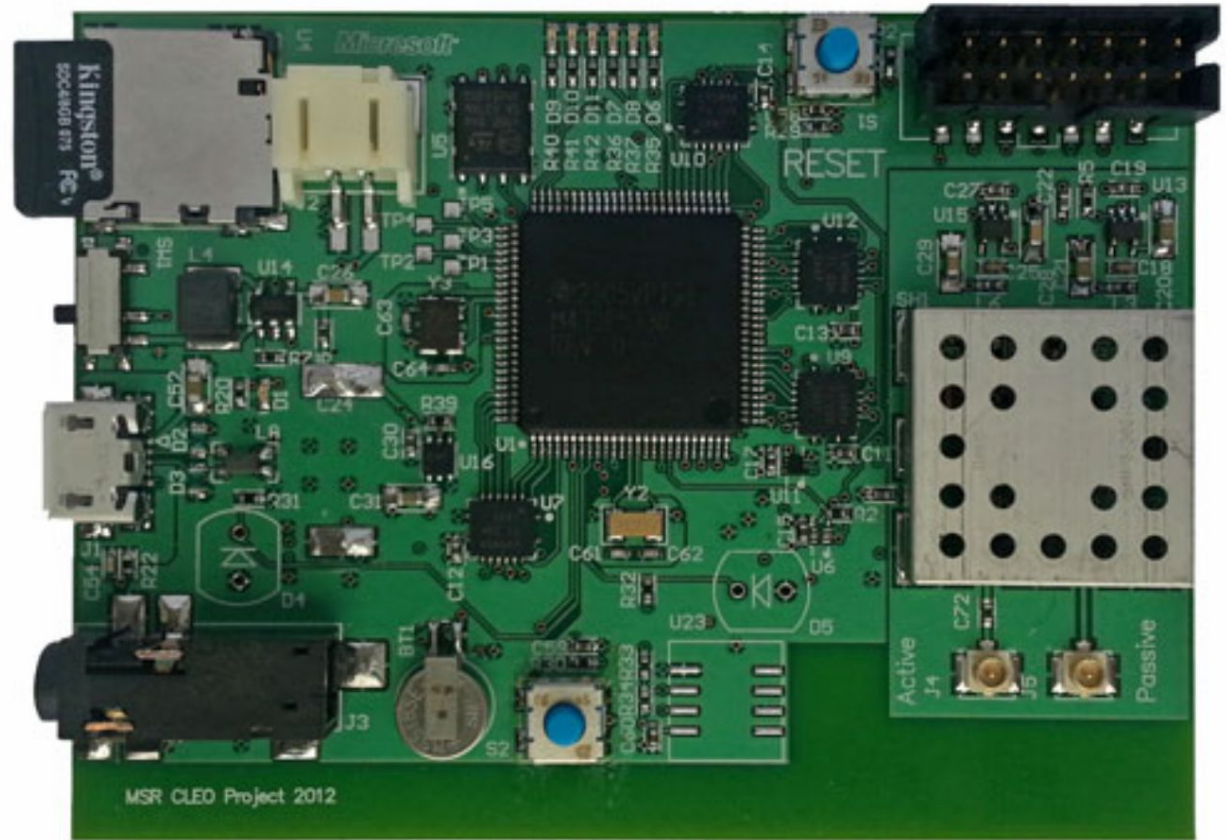


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Liu et al. *CO-GPS: Energy Efficient GPS Sensing with Cloud Offloading*. 2016

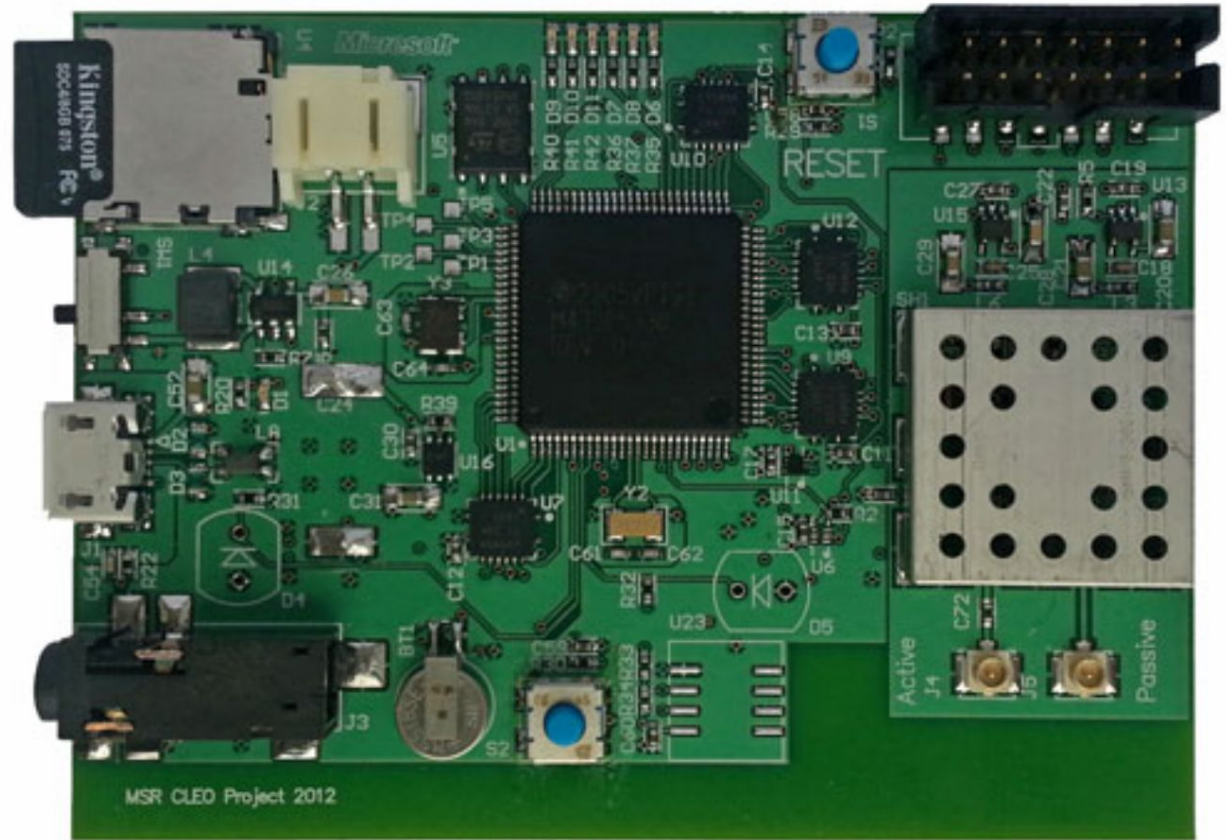
62 mJ  
2.5 mA idle  
10 ms

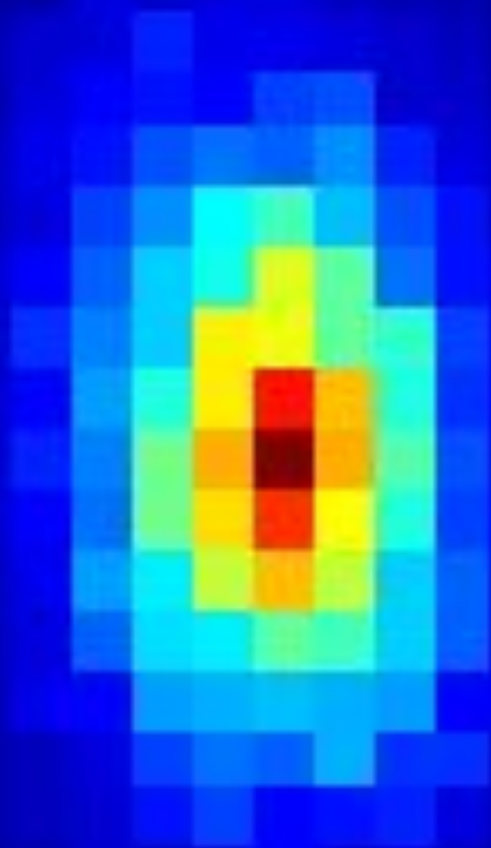


Liu et al. *CO-GPS: Energy Efficient GPS Sensing with Cloud Offloading*. 2016

62 mJ  
2.5 mA idle  
10 ms

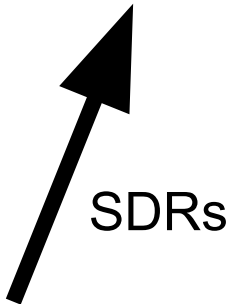
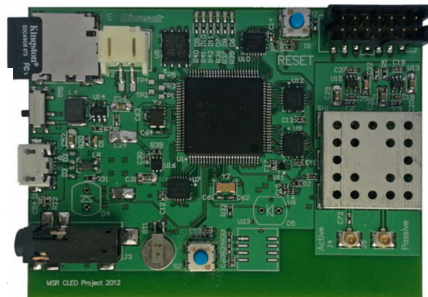
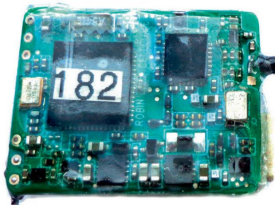
0.74 mJ  
4.5  $\mu$ A idle  
1 ms





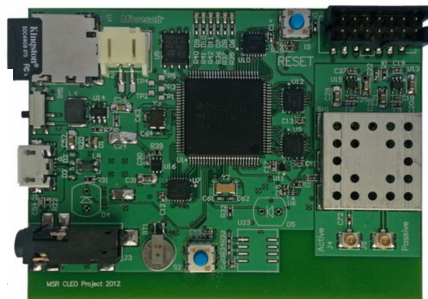
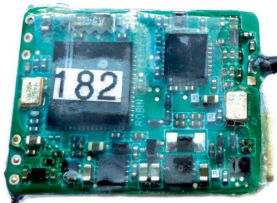
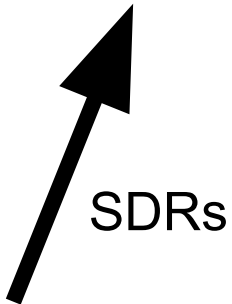
*Fast and Robust GPS Fix Using One Millisecond of Data*  
Bissig, Eichelberger and Wattenhofer. 2017

Energy



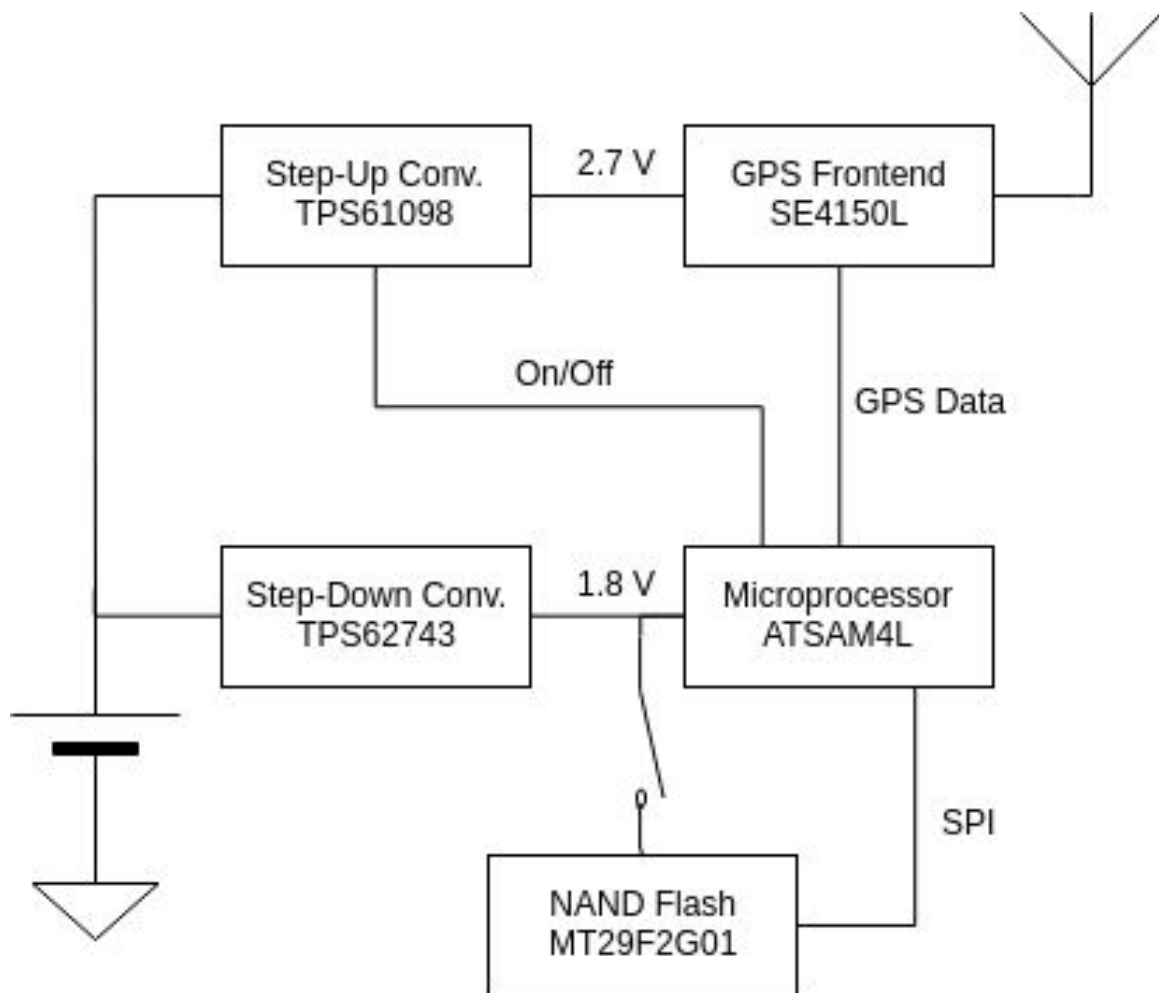
Size

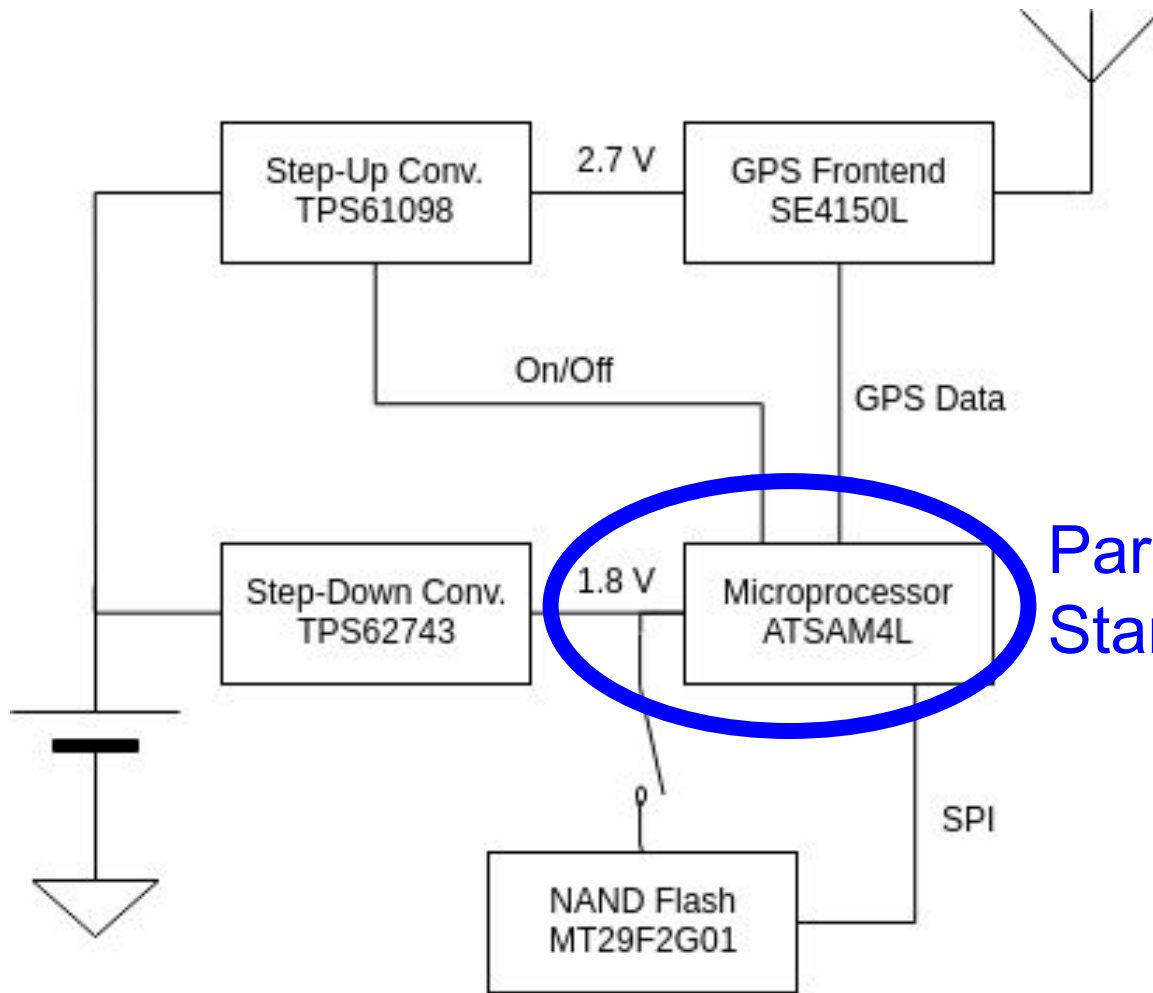
Energy



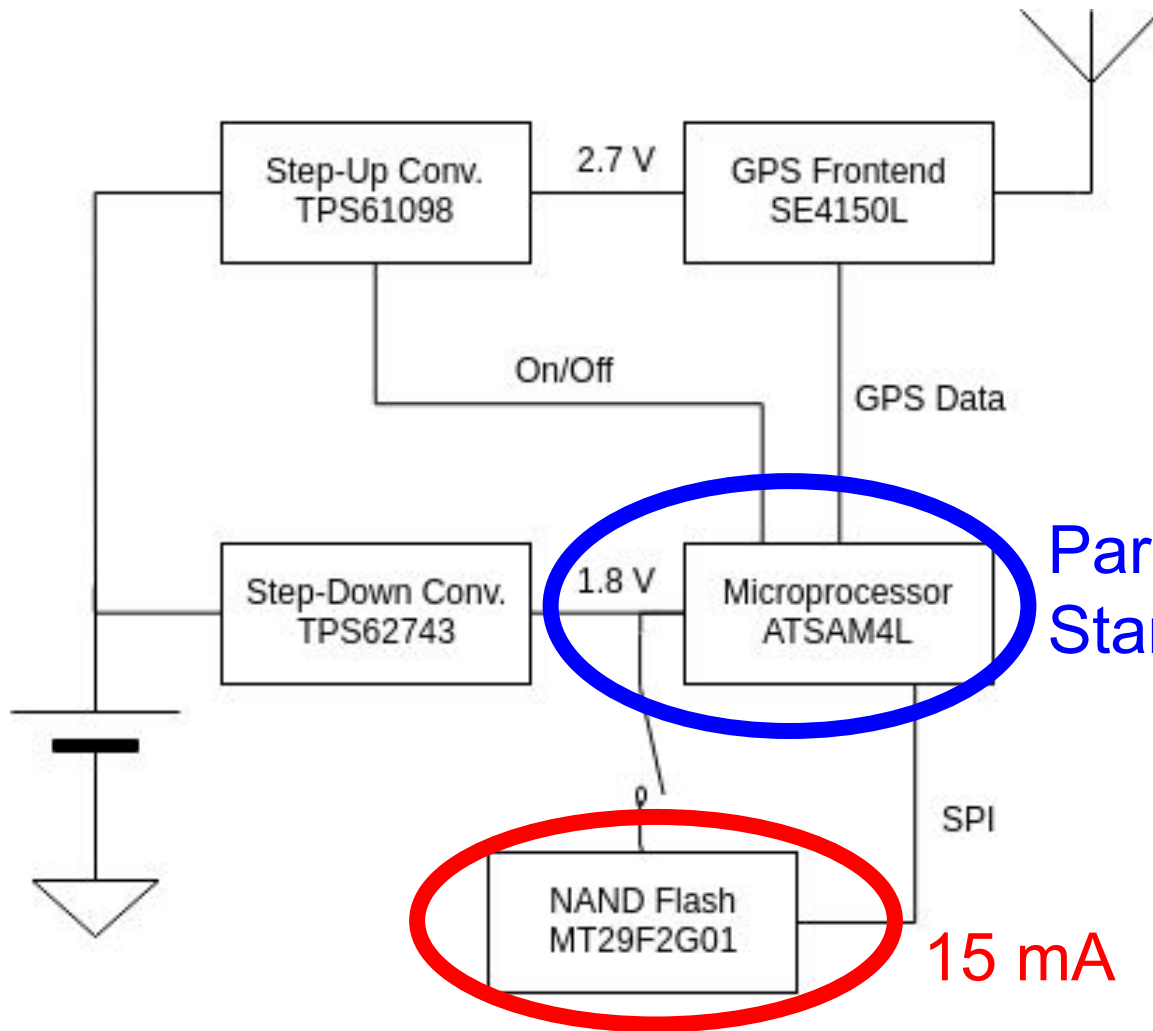
Size





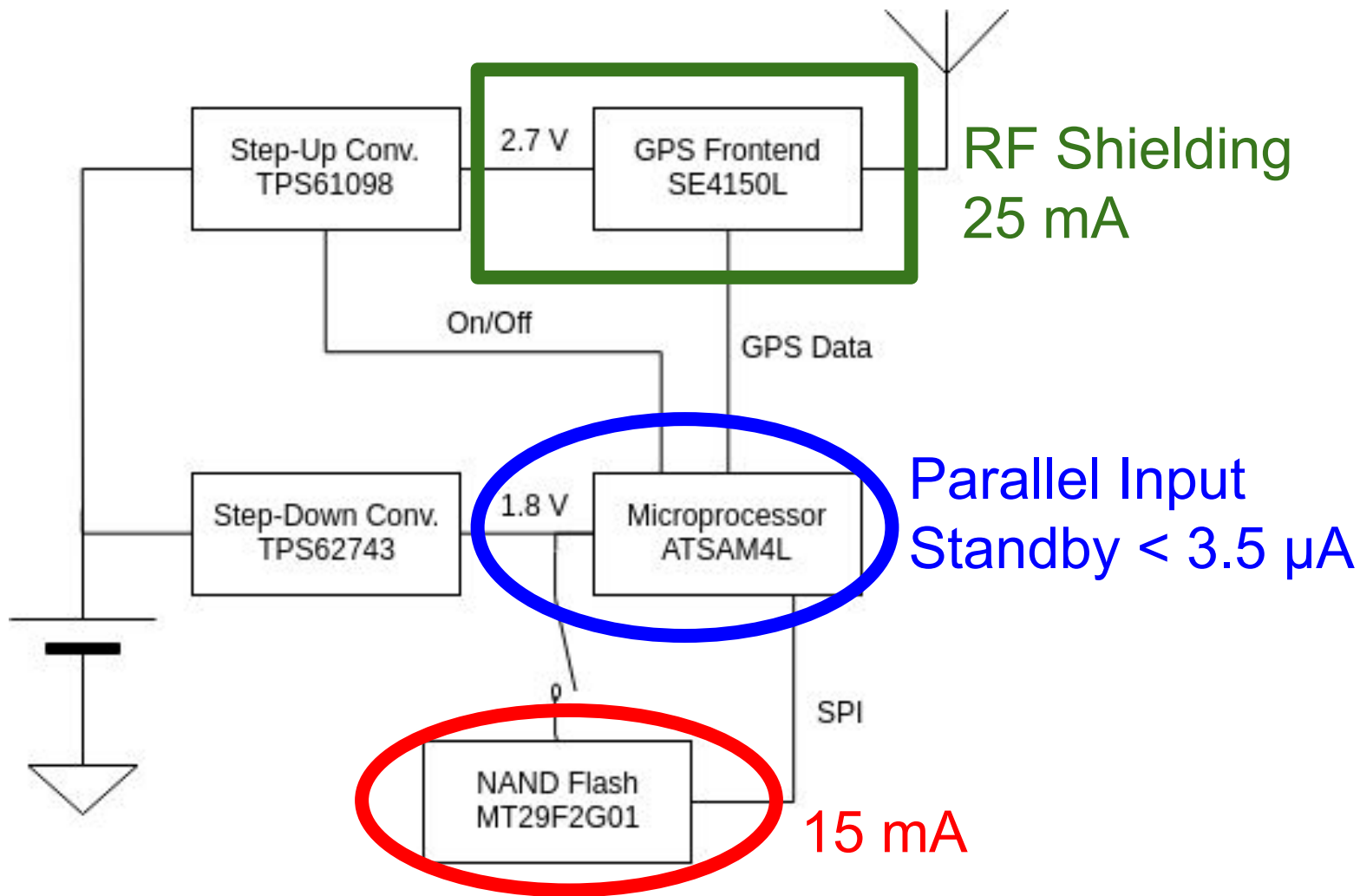


Parallel Input  
Standby < 3.5  $\mu$ A

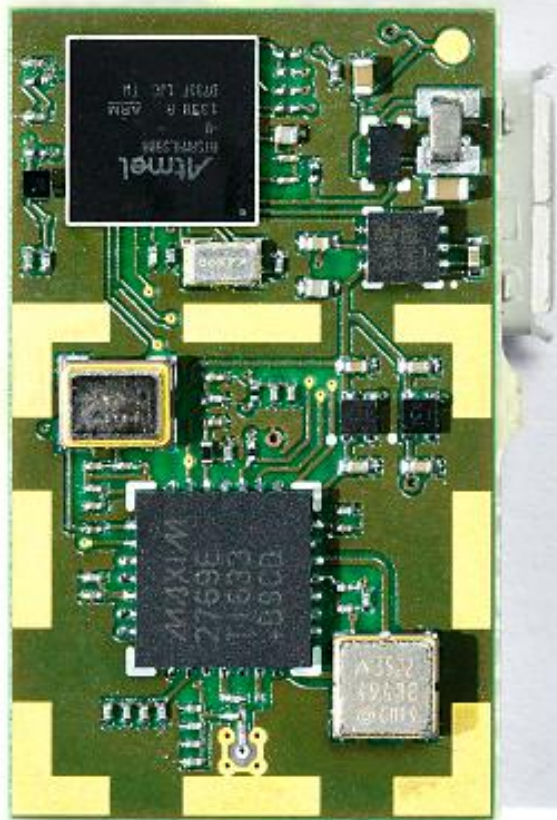


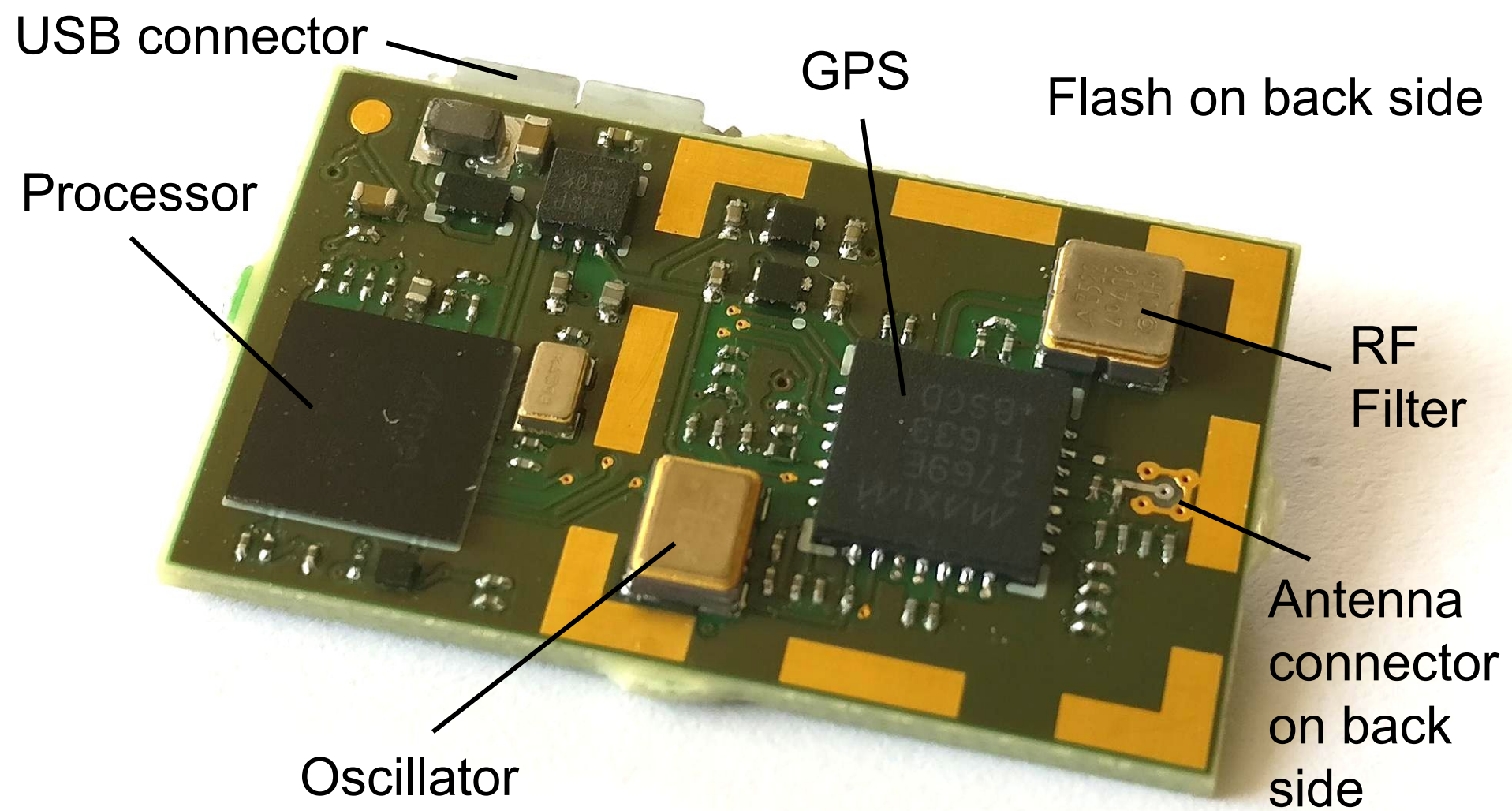
Parallel Input  
Standby < 3.5  $\mu$ A

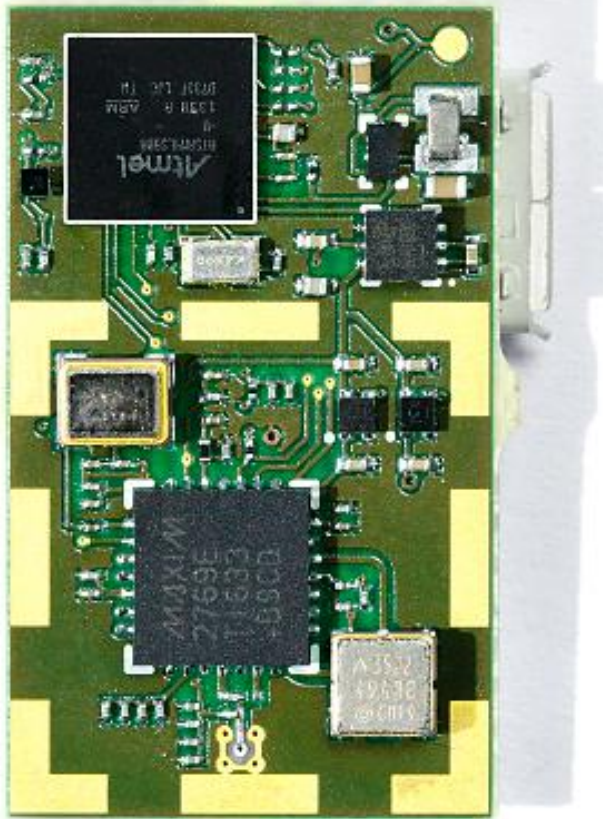
15 mA



1.3 g  
23 x 14 mm





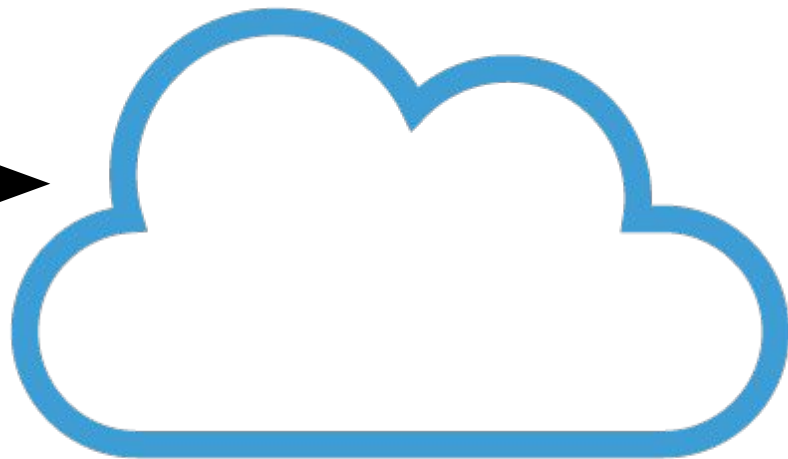


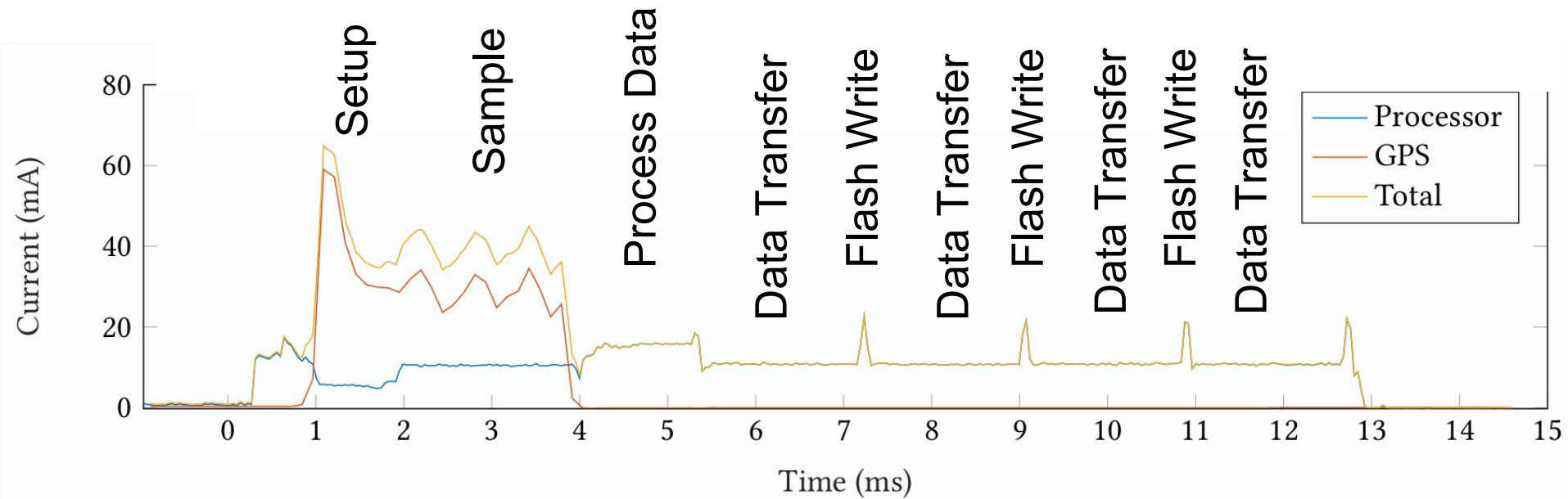
USB

Bluetooth

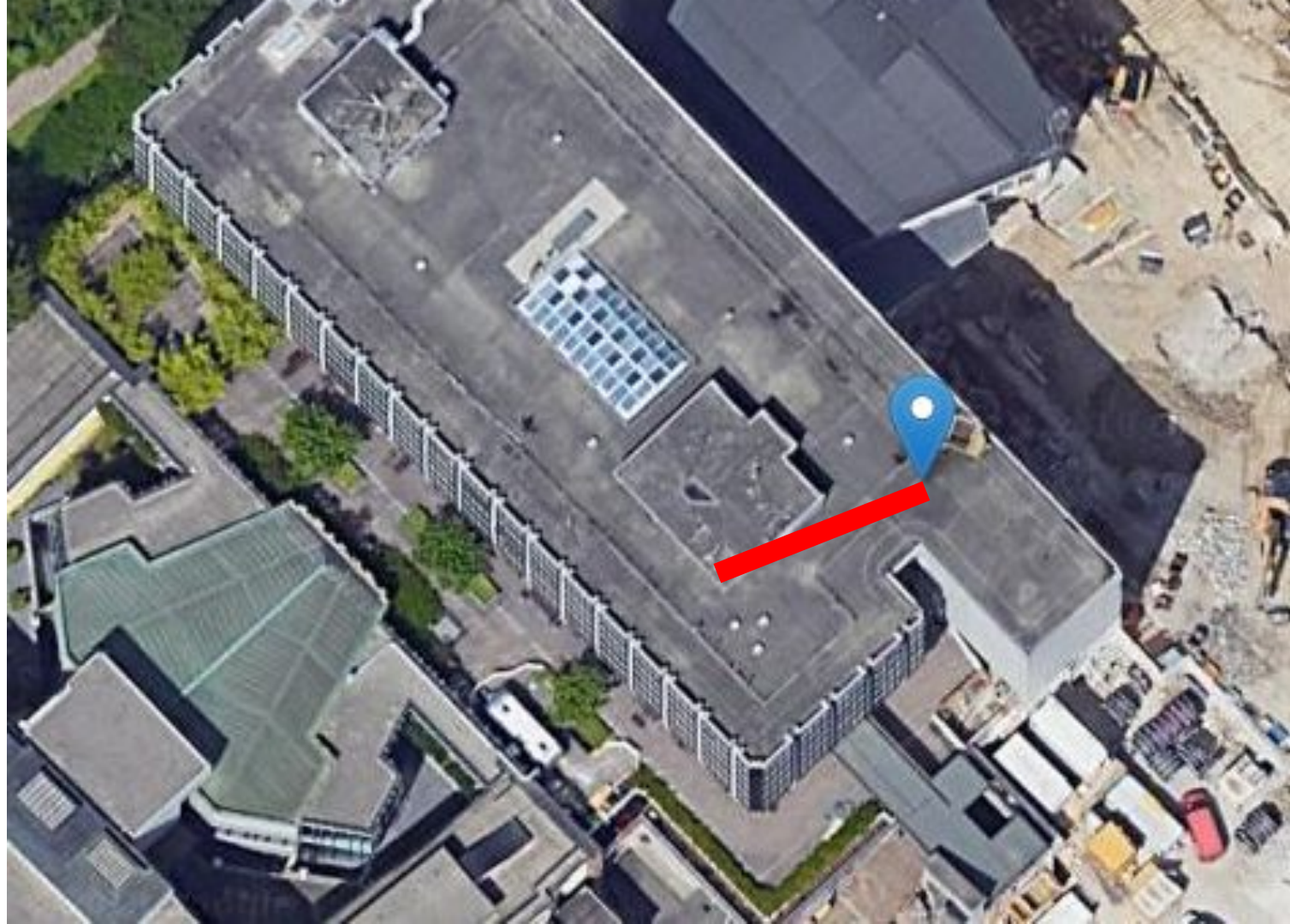


WiFi  
LTE





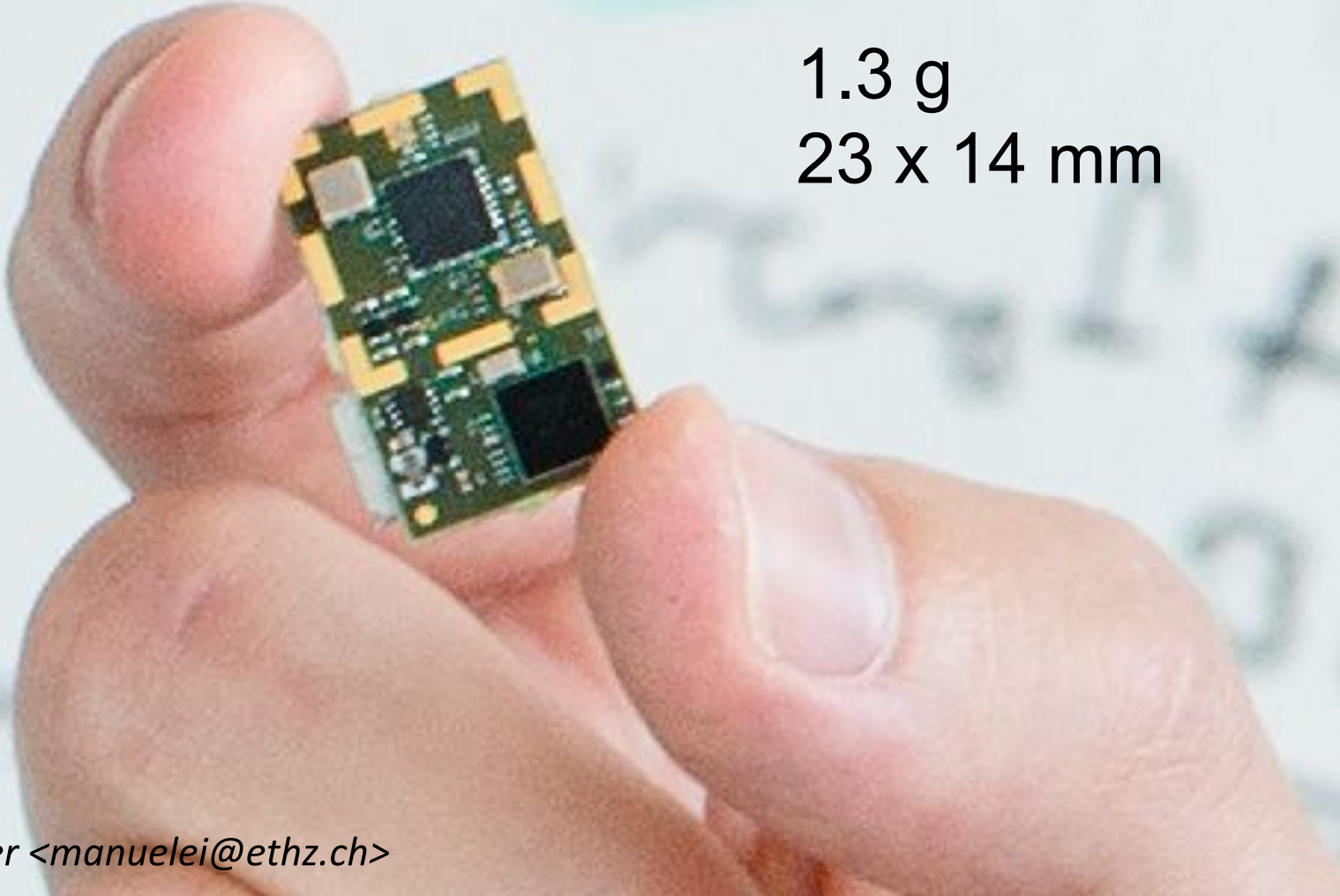




15 minute duty cycle:

- 18  $\mu\text{W}$  mean power
- 683 days lifetime  
(limited by flash size)

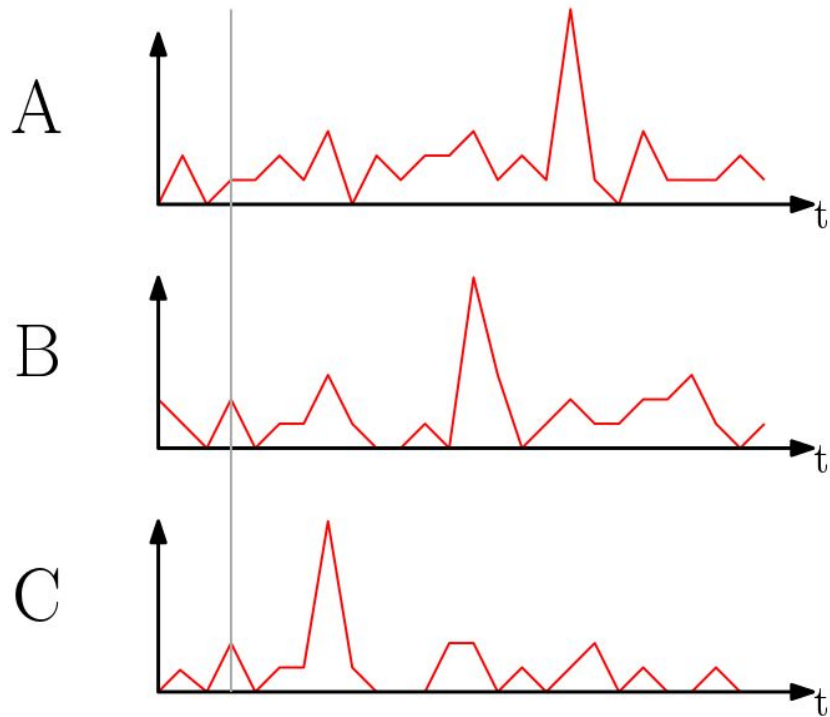


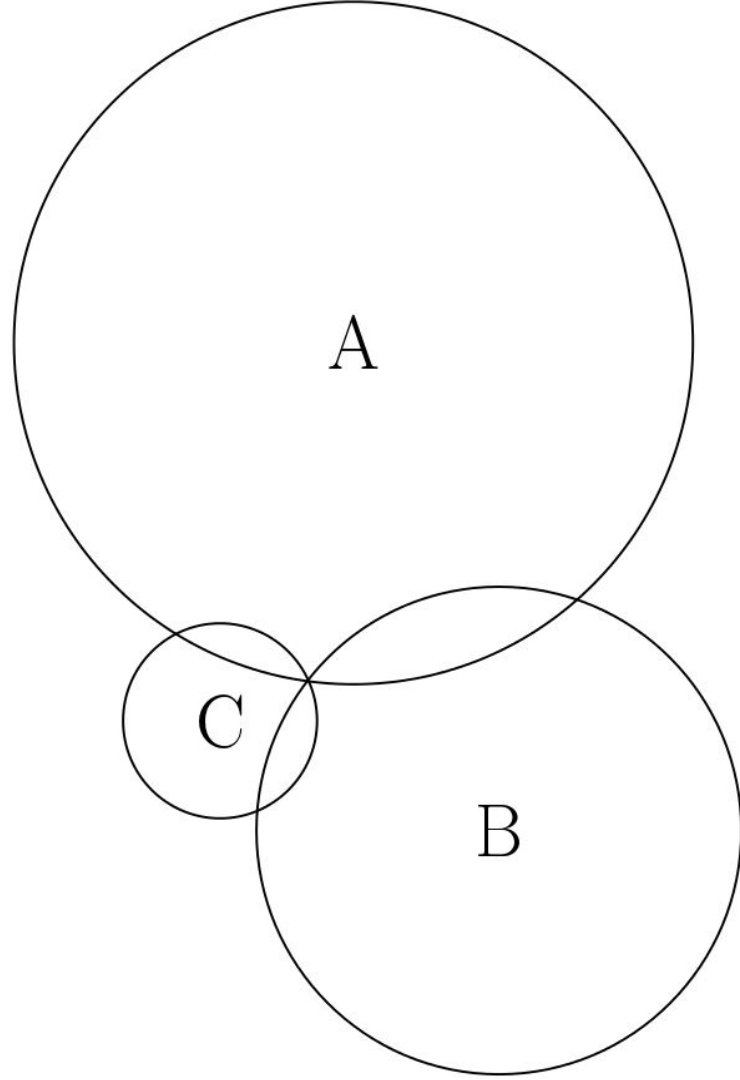
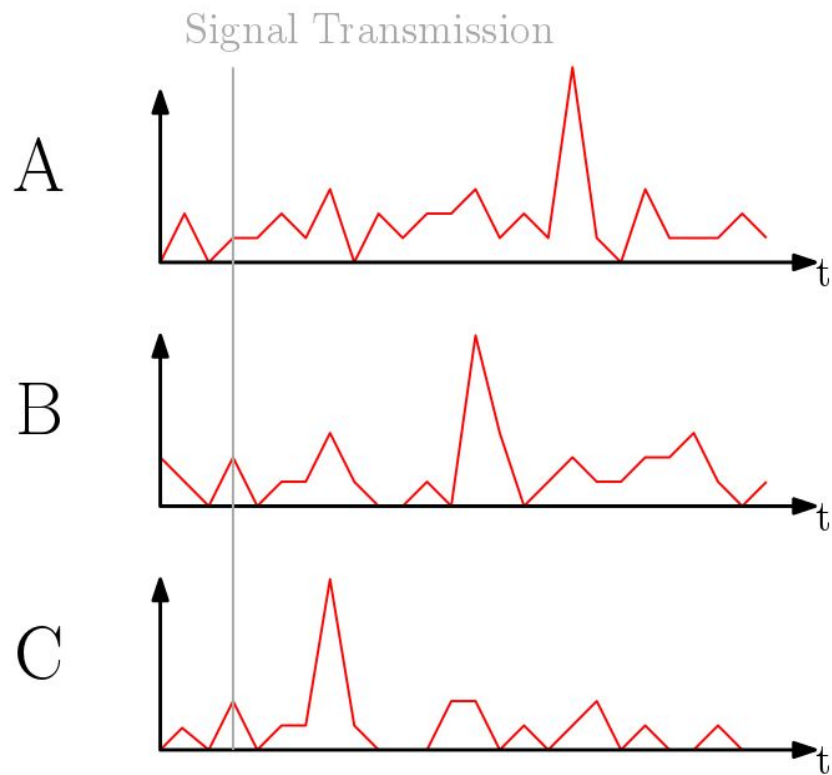


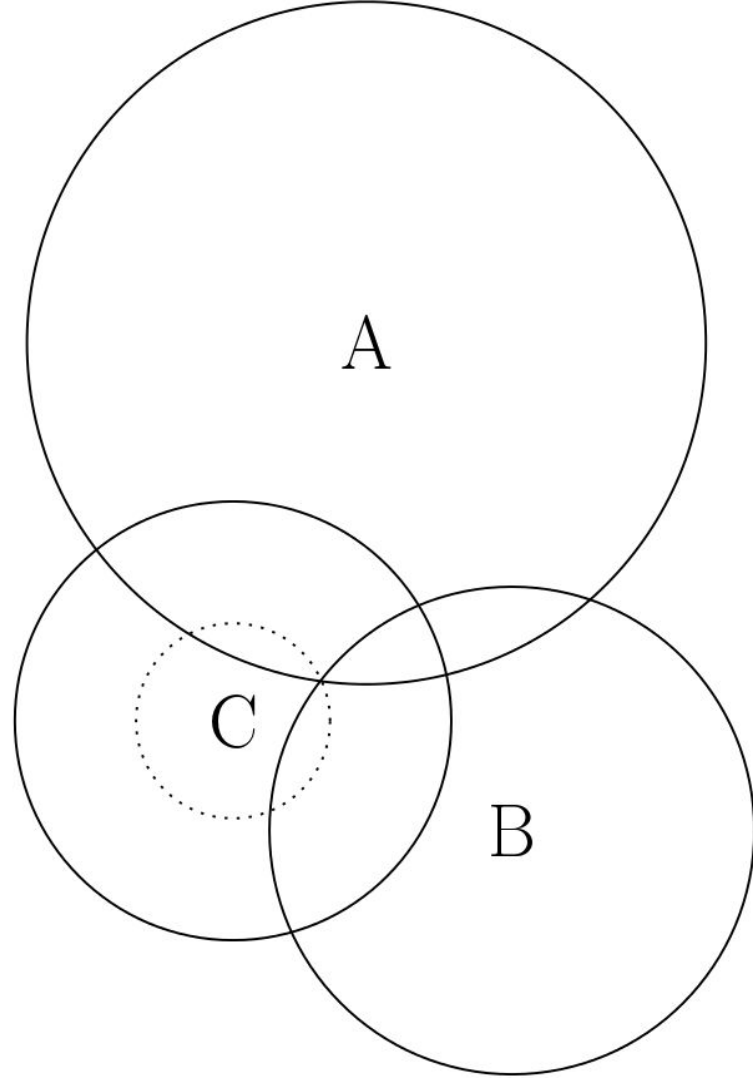
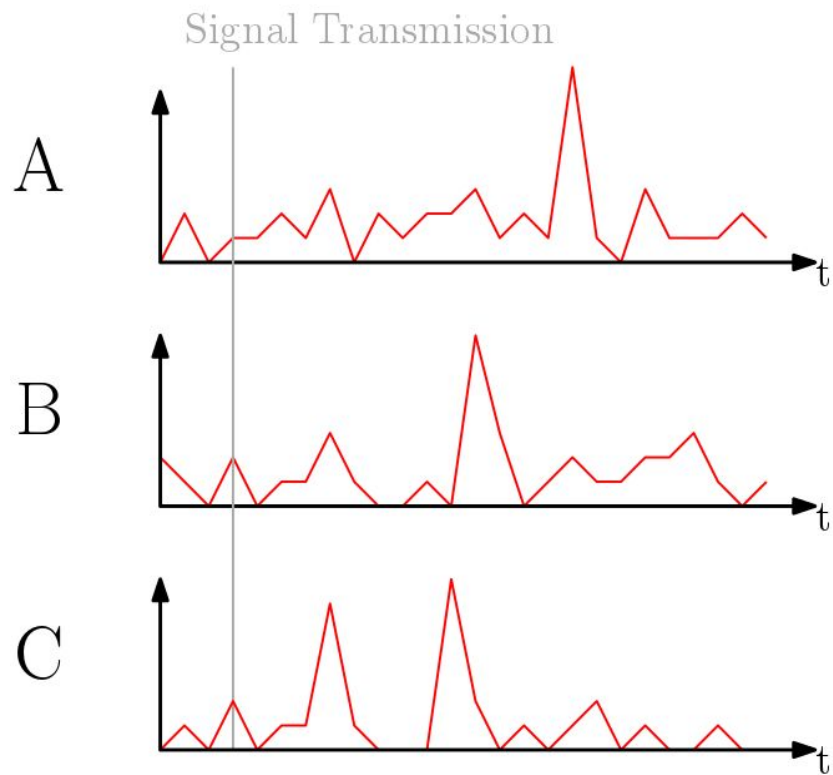
1.3 g  
23 x 14 mm



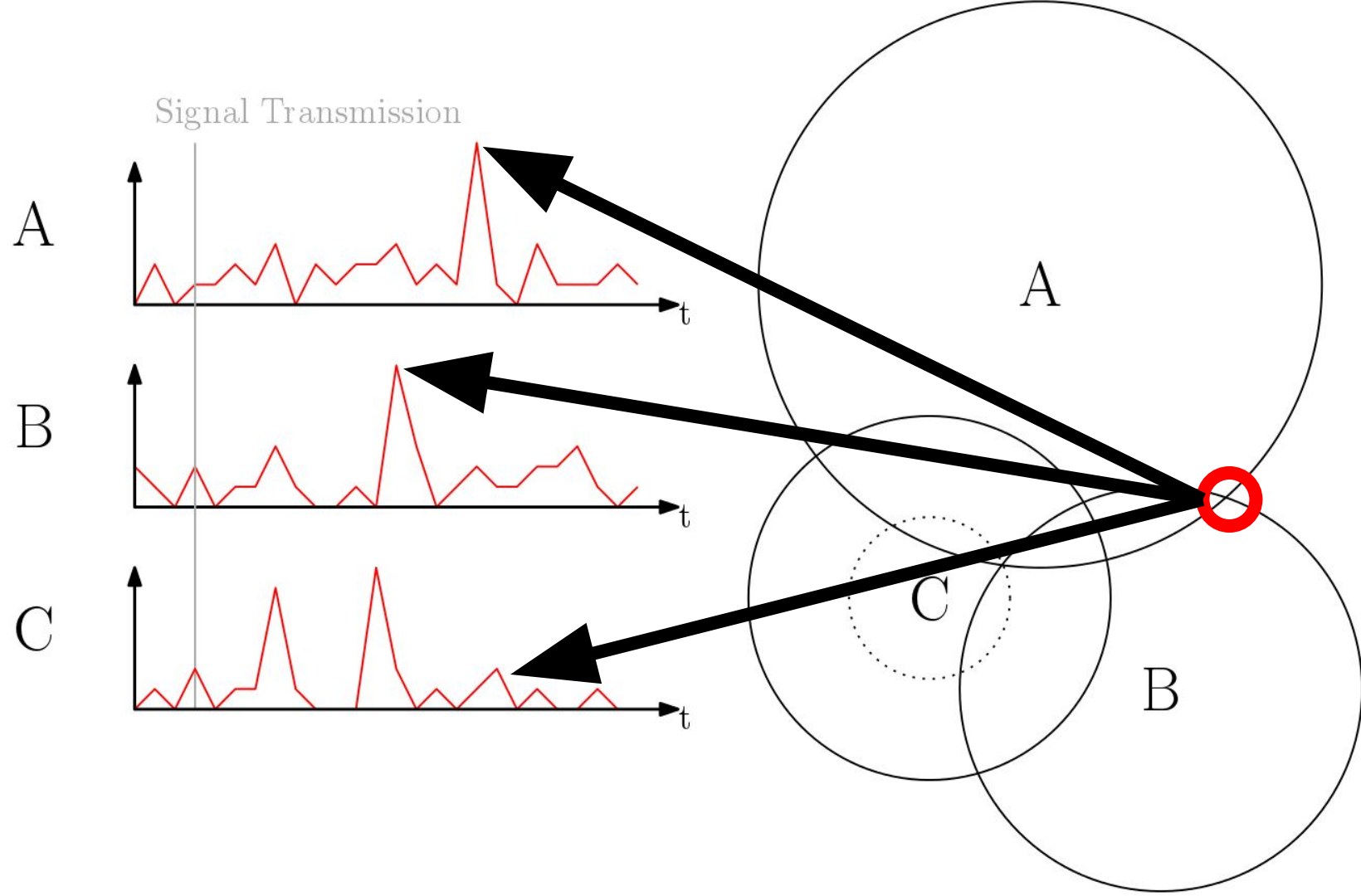
# Signal Transmission

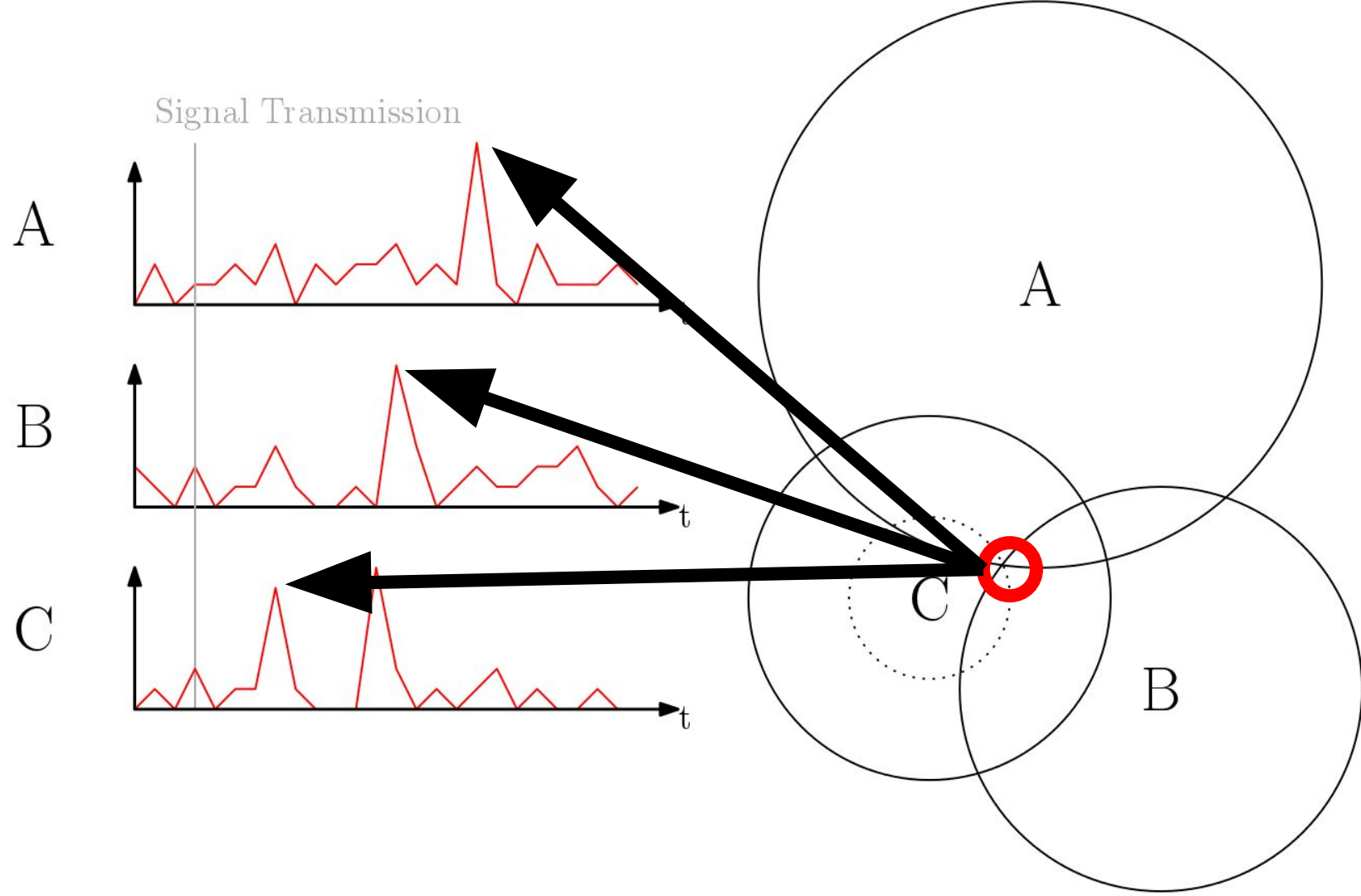


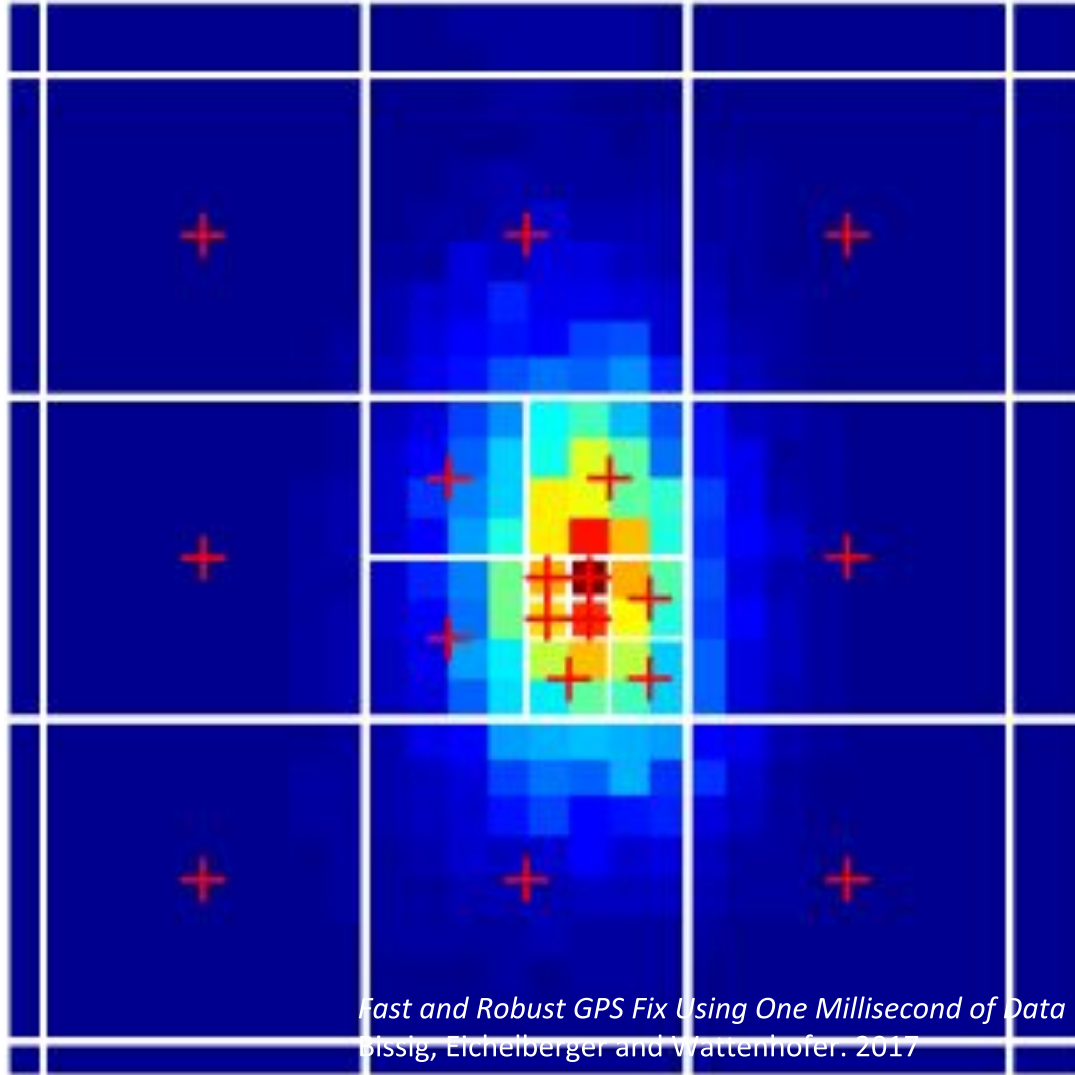












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