

# Road to 24-bit

Our quest to perfect SDR radio

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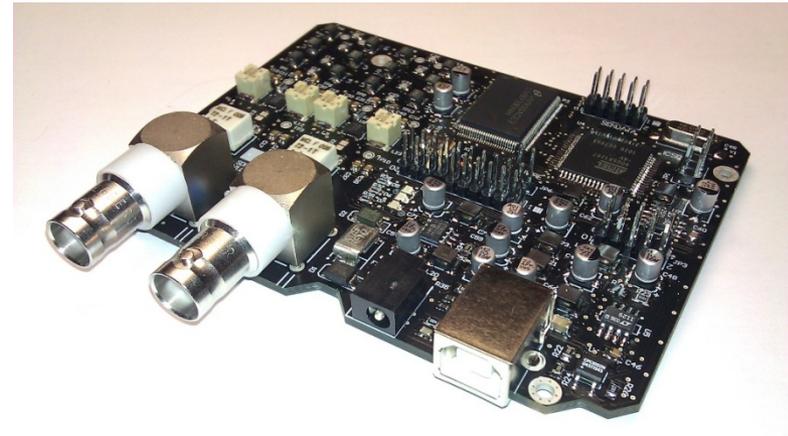


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# Generation 1: SDR MK1

- Development started in January 2011
- Ready in March 2011, in 3 months

- 12-bit dual-channel frontend
- 8-bit Atmel CPU @ 8MHz
- Works as USB audio card
- Component price < 100EUR

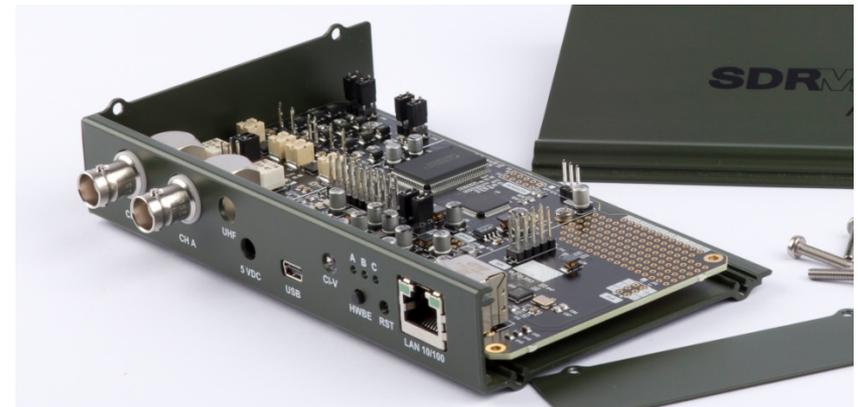


- Not enough USB speed for decent IF bandwidth
- CPU generally too slow
- Only 10 pieces sold, development started over on MK1.5
- Competition: SoftRock, sdr-IQ, all other low-end

# Generation 2: SDR MK1.5 Andrus

- Development started on June 2011
- Design finished on November 2011, in 6 months
- First boards shipped on January 2012

- same 12-bit frontend as MK1
- Atmel 32-bit CPU @ 60MHz
- 100 mbit network interface
- RF layout revisited
- Nice enclosure



- Decent receiver what competes well, but we can do better
- 12-bit dynamic range not enough for shortwave work
- 400kHz IF rate is ok, but narrow compared to \$12 “sticks”
- AVR32 CPU and Network chip too slow for 2014 standards
- Competition: NetSDR, Afedri-Net, Ettus, Perseus, QS1R

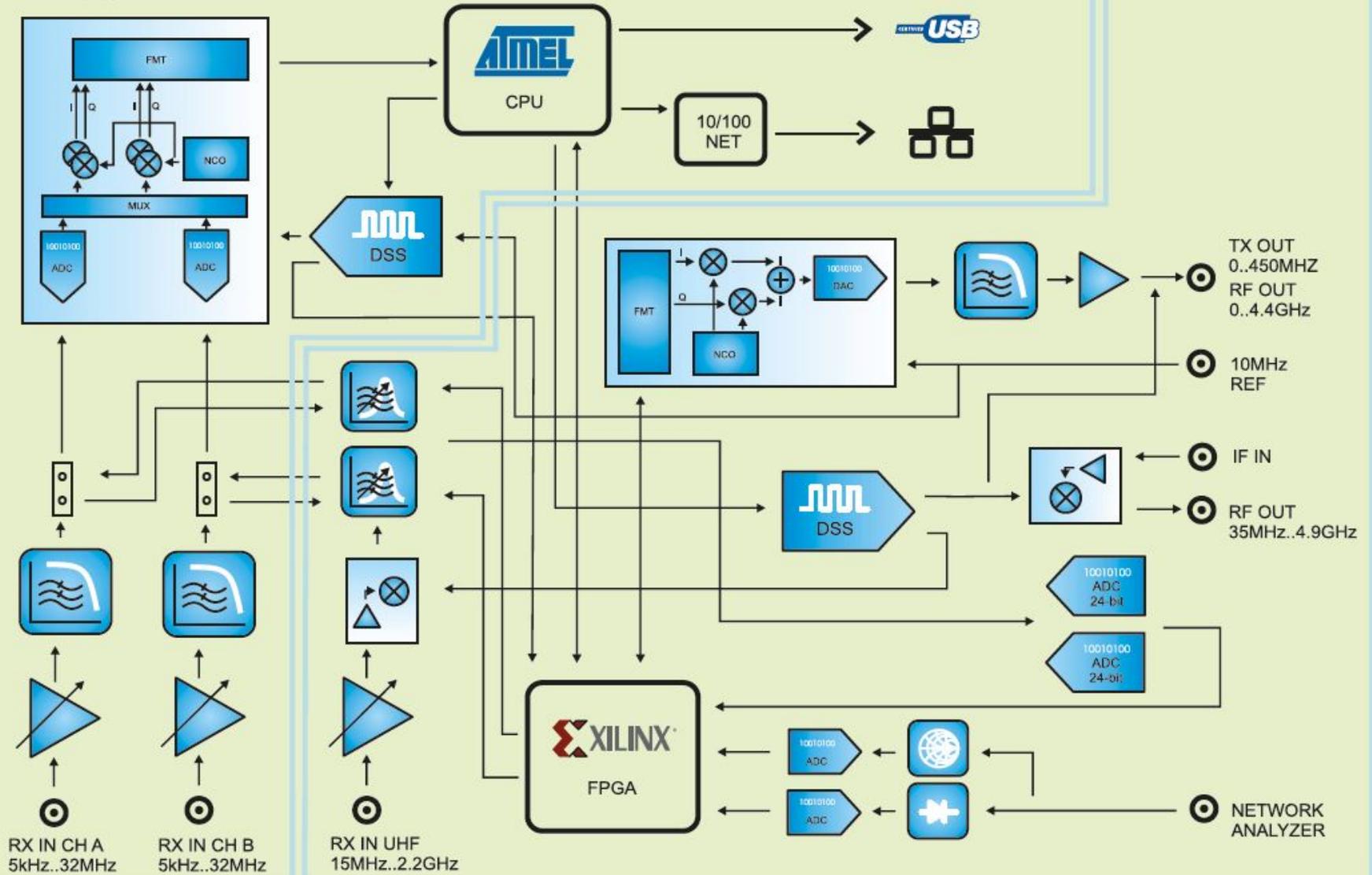
# Generation 3: TX8M for MK1.5

- Development started on January 2012
- First design scrapped on August 2012 and started all over
- Second design finished on March 2013
- First boards to beta-testers on February 2014
  - 24-bit ADC up to 4MHz IF
  - TX capability, 14-bit digital exciter
  - TX up to 400MHz direct, 4.6GHz max
  - addon card for MK1.5
  - Analog RX direct conversion up to 6.8GHz
  - Raspberry Pi as alternative digital board
  - Network analyzer, up to 1.7GHz vector
- 2 years in making, still no competition today
- Highest dynamic range vs. IF bandwidth on market
- Integrated TX functionality, fully digital IQ approach
- Only state of the art development for shortwave



**SDR MK1.5**  
Andrus

**TX8M**  
Satrian



# Lessons so far

- Development cycle may be long if you push boundaries
- For each new design, use only newest and most innovative components possible
- Software work takes as long as hardware design, especially if FPGA-s are involved
- Community support is essential to maintain morale –  
THANK YOU FOR ALL YOUR GOOD WISHES
- SDR market is developing rapidly, so next version is already planned ...



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