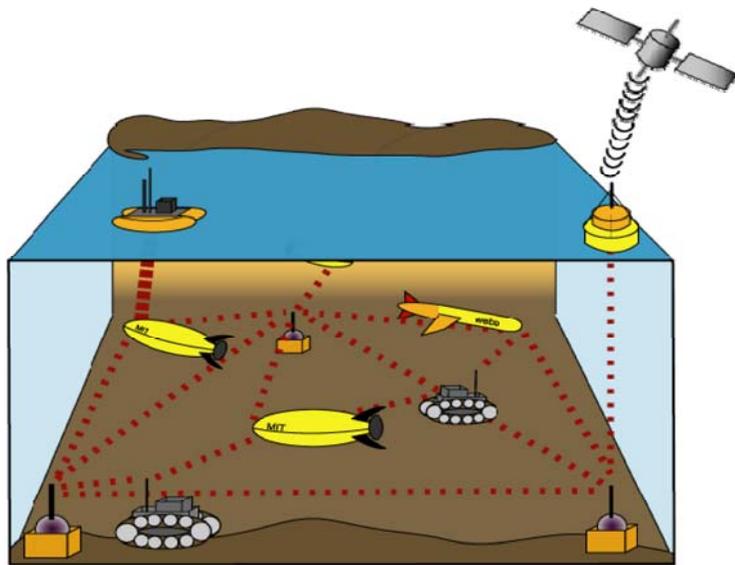


# Adapting the USRP as an Underwater Acoustic Modem

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Paul Ozog, Miriam Leeser, Milica Stojanovic  
*Department of Electrical and Computer Engineering*  
*Northeastern University, Boston MA*

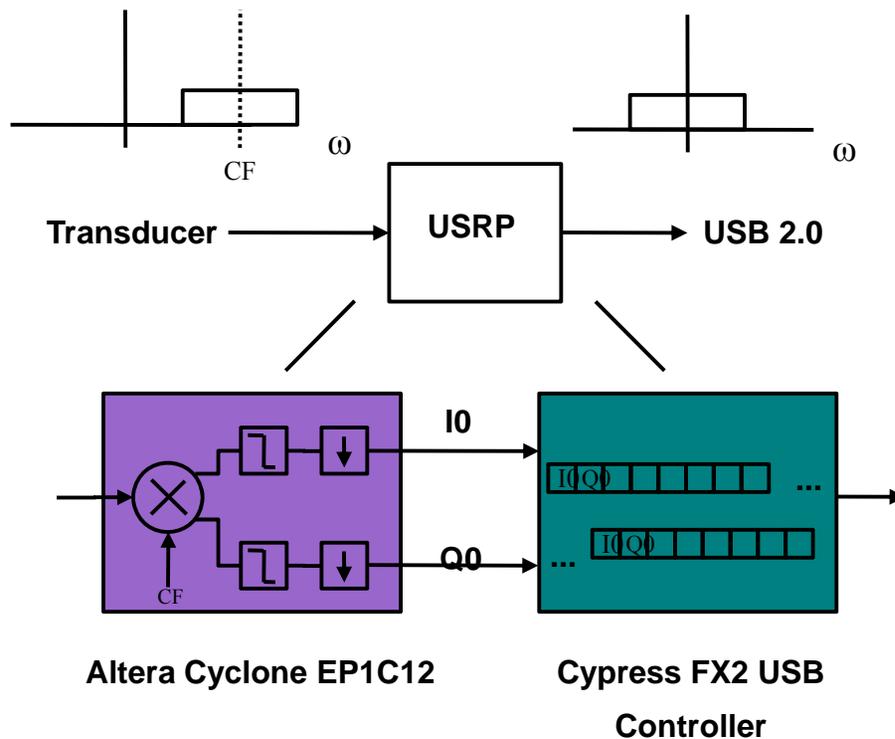


Provide underwater acoustic (UWA) researchers with a low-cost, configurable modem to implement their work  
→ Used to research underwater networks  
→ Lifts constraints imposed by cables



# The Universal Software Radio Peripheral:

[www.ettus.com](http://www.ettus.com)      [www.gnuradio.org](http://www.gnuradio.org)

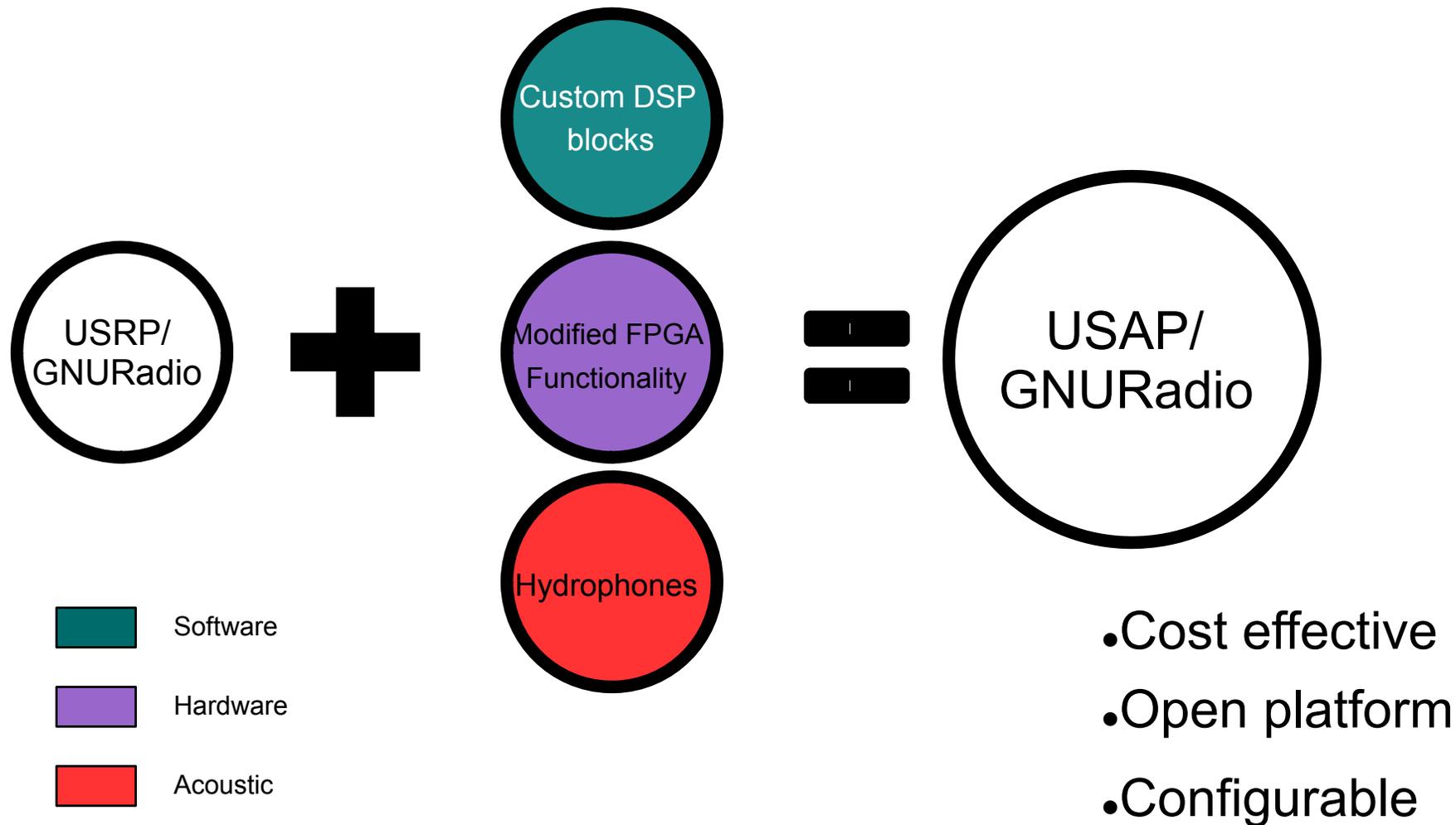


- Open source hardware/software
- ADC
  - 12 bit resolution
  - 64 Msps
- Digital Down Converter
  - Converts to baseband
- USB Interface
  - Interleaves multiple Rx channels over serial connection



# The Universal Software **Acoustic** Peripheral (USAP)

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# Obtaining Suitable Bandwidth Over USB 2.0

- Expected underwater acoustic (UWA) bandwidth: ~100kHz
- FPGA decimation factor: [8,256]

$$\text{USB Bandwidth} = \frac{\text{ADC Sample rate}}{\text{FPGA decimation}} = [256\text{kHz}, 8\text{MHz}]$$

**256kHz is too much bandwidth for UWA network research**

**Solution:** Define USAP object which maximizes USRP Digital Down Converter's decimation rate to 256 and performs “by 2” decimation in software, using pass band FIR:

