QAM over Ham Radio

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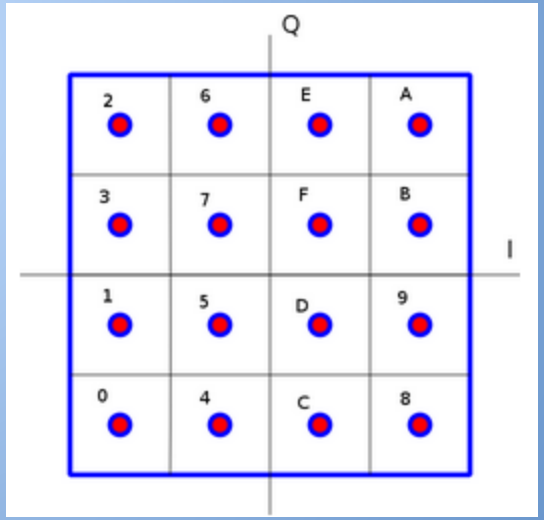
Quadrature Amplitude Modulation

- Modulation scheme
- Modulates digital symbols into two bit streams
  - Modulates amplitude of two carriers that are 90° out of phase

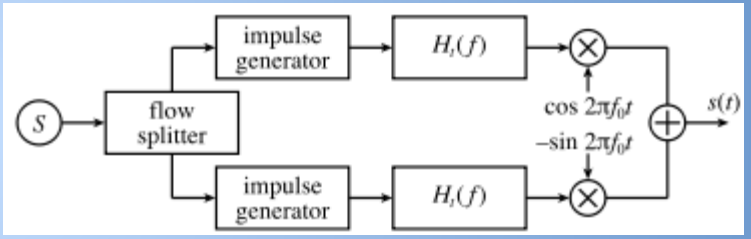
$$s(t) = \Re\left\{[I(t) + iQ(t)]\, e^{i2\pi f_0 t}\right\}$$
$$= I(t)\cos(2\pi f_0 t) - Q(t)\sin(2\pi f_0 t)$$

For this project, used QAM-16:



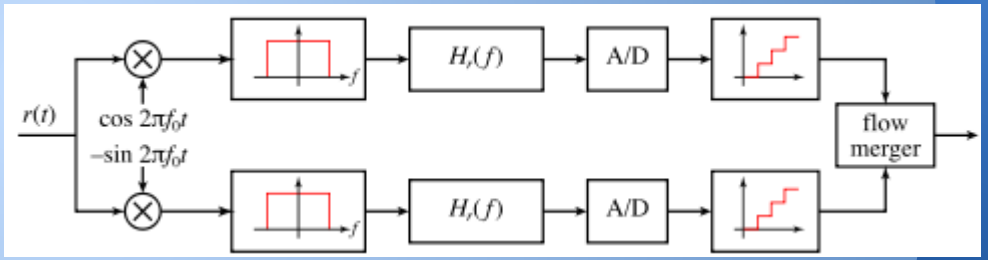
Transmitting QAM

- To transmit QAM, first group bits and encode into symbols depending on constellation mapping.
- Separate into real and imaginary parts (I and Q)
- Multiply by cosine and sine respectively, add together to get your final signal to send.



Receiving QAM

- Take input signal, multiply by a cosine and negative sine
- Low pass these
- Quantize and extract I and Q components
- Use this information to put symbols back together and decode to binary



Practical Considerations

- Noise - we just rely on low bit rate, no error correction
- Synchronization - have a symbol string to start each message that we use to correlate, synchronize to be able to decode

Implementation

Take a look at our Ipython notebook, plots...