Basic Structure of a analog communication system:

Information source 🡪 transmitter (signal processing, modulation) 🡪 send over a channel, the channel adds what is known as noise, this is the transmission medium. The noise is based on multiple independent factors. Upon travelling the desired distance, the signal is caught by a receiver. Inside the receiver are applied the demodulation and processing of the received signal. Then, the signal is reconstructed in the receiver.

The frequency spectrum is used to transmit the information over a channel. The information signal is loaded on a certain frequency band, based on its frequency bandwidth. The signal’s Fourier transform, or spectrum is sent using the modulation process. The allowed frequency bands vary, from 3 KHz to 3000 GHz. The bigger the frequency scale, the shorter the signal wavelength. E.g. when casting on 300-3000 GHz you are on a under-millimeter scale signals.

The wireless channel between two users is the perfect source of randomness. This aspect of the channel can be exploited as a cryptographic key.

This concept can be applied on the physical layer of the communications protocol stack. The communications protocol stack refers to the ordered layers of consecutive communication establishing protocols. Also known as the OSI stack. This aspect can be integrated in various ecosystems, such as Internet of Things and Long-range communications.

Basic Formulas

Shannon-Hartley Channel Capacity:

Conversion from numeric SNR to SNR on logarithmic scale:

Received signal over fading channel is:

Where the h is the fading coefficient of the channel from the source to the destination. is the noise coefficient, , which is additive white Gaussian noise (AWGN), at the destination. The channel coefficients follow a certain channel distribution, which is most cases can be Gaussian or Rayleigh. The Rayleigh fading corresponds to an ideal OFDM subchannel. OFDM stands for Orthogonal Frequency-Division Multiplexing. It is a type of digital transmission and a method of encoding digital data on multiple carrier frequencies. OFDM has developed into a popular scheme for Wideband Digital Communication, used on digital television and audio broadcasting, DSL internet access, wireless networks, power line networks and 4G/5G mobile communications. In OFDM multiple closely spaced spectra are transmitted to carry data in parallel. Demodulation is based on FFT algorithms. Orthogonality means statistic independence, which subdues to the fact that the signals are unrelated. This aspect allows the signals to be transmitted in parallel. Each subcarrier is modulated with a conventional modulation scheme (such as QAM or PSK) at a low symbol rate. This maintains total data rates similar to conventional single-carrier modulation schemes in the same bandwidth.

The main advantage of OFDM over single-carrier schemes is its ability to cope with severe channel conditions. Such conditions can refer to narrowband interference and frequency-selective fading due to multipath). The OFDM does not need complex equalization filters to achieve this.

Basic concepts of any physical layer transceiver system model.

* Relays:
* Wireless networks