Chapter I
Wireless Systems Overview
Transmitters Requirements

- The modulated carrier must be transmitted with adequate power (anywhere from 100 mW to 500 W).
- The distortion and noise in adjacent spectrum must be below a certain minimum set by the standard and the customer’s desired margin—this specification is called adjacent channel protection ratio or ACPR.
- Component-level margin is a big selling point. Some customers want 10-20 dB of margin, especially for distortion specifications.
In mobile wireless applications, the received signal voltage can vary in size by a factor of 1,000,000 (120 dB), depending on the proximity to the source.

Receivers must isolate and demodulate the desired signal, even in the presence of nearby signals (Blockers) that are up to 1 million times larger.

In-Band Blockers are generated by other users of the same standard or frequency.

Out-of-Band blockers Example: Co-located transceivers on one tower, cordless phones, WLAN Routers.
Error Vector Magnitude - EVM

- Noise and Imperfections in transmit and receive signal chains result in demodulated voltages which are displaced from their ideal location.
- Error Vector Magnitude expresses this dislocation.
- Large EVM will result in Symbol/data Errors.
- Solution: Choose components with higher Signal-to-Noise Ratio. Choose Modulator and DeModulator products which have precise quadrature, low harmonics and low LO leakage.

\[ EVM = \sqrt{\frac{\text{Mean Error Vector Power}}{\text{Mean Reference Power}}} \quad \text{Unit(\%)} \]
An IF-Based Wireless Transceiver
A Direct Conversion Wireless Transceiver
Transceiver Components

- LNAs amplify the signal received at antenna while adding very little noise
- High Power Amplifiers drive the antenna
- Mixers Convert signal between Radio Frequency (RF) and baseband
- IQ Modulators convert baseband signals in Cartesian (X,Y) format to real Intermediate Frequencies or Radio Frequencies.
- Power Detectors measure and control received and transmitted RF power
- Filters remove unwanted signals
- Amplifiers amplify the received signal and compensate for the losses of other components
- Variable Gain/AGC adjusts gain of receiver to yield a fixed output power at baseband
- ADC samples spectrum either at Intermediate Frequency (IF) or at Baseband
- IQ Demodulator extracts I and Q baseband signals from RF or IF carrier