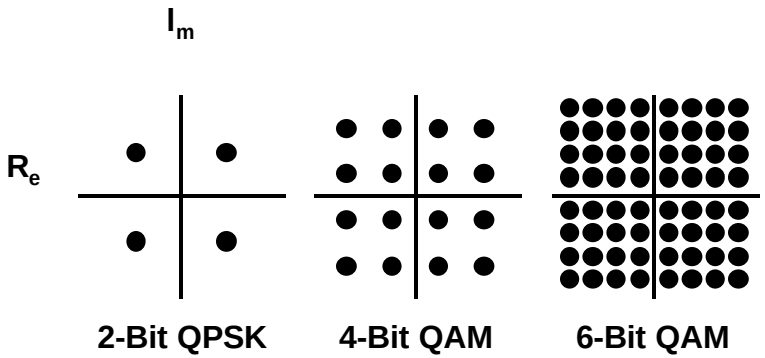
Discrete Multitone Data Transmission [DMT]

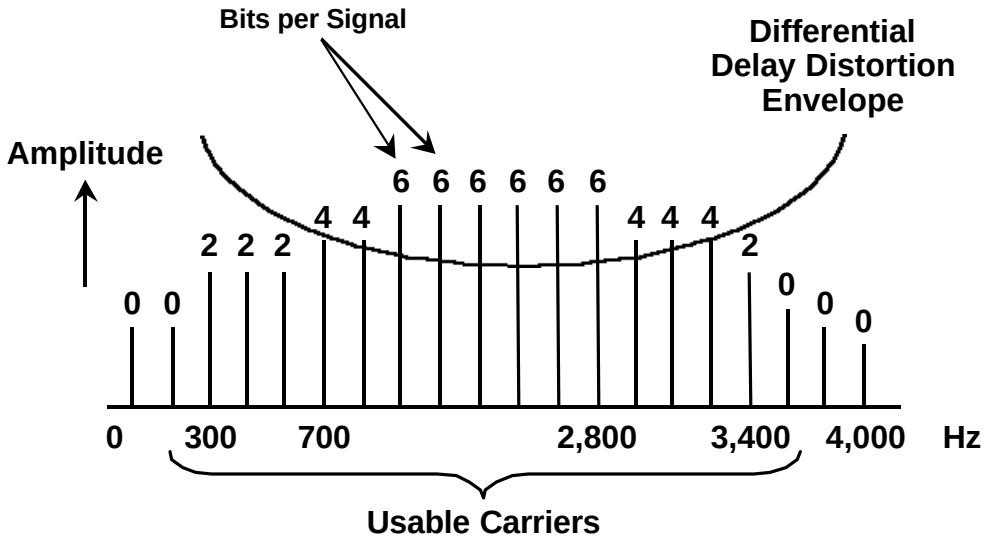
- Up till now, the data are presented to a single transmission channel and determine the line signal for the entire channel. They may determine points in a two-dimensional, or higher, signal space.
- As an alternative, one might ask if it is more advantageous to break the data up into lower-rate sub-streams that traverse different channels.
- Three main reasons for doing this:
  - to reduce the noise enhancement caused by liner equalization [Chapter 7]
  - to approach the Information Theory ideal ["water pouring" ---see pg. 129] of how transmitted signal energy should be distributed across the frequency band ----and avoid equalization issues and difficulties. Equalization is relatively simple, since the channels are very narrow.
  - To combat transients such as fading, by providing frequency diversity.
- In general the complexity of DMT compares favorably with regular full-channel [eg, QAM] serial data stream ----the DMT signal is generally realized by taking a Discrete Fourier Transform [DFT] of the input signal.
- DMT has its own vulnerabilities ---particularly sensitivities to tone-type interferences [which remove one or more channels].

Multitone Modulation

- **Called OFDM (Orthogonal Frequency Division Multiplexing) or DMT (Discrete Multi-Tone)**
- **Used in ADSL. Candidate for next-generation 802.11 [Wireless LANs], HiperLAN2, and 802.16 [Fixed Wireless Loop], and perhaps in 4G cellular.**
- **Can use a variable number of bits/bin (channel) and have overlapping signals in frequency**
- **Signal can be generated using DFT [Discrete Fourier Transform]**
- **Example system: 6 bits/bin, 400 channels (~10 Hz wide), and 1/T = 4 (T = 250 ms) 4 frames/sec ---> bit rate = 6 x 400 x 4 = 9.6 Kbps**
- **Delay across narrow "channel" BW may be << 1/T (no equalizer)**

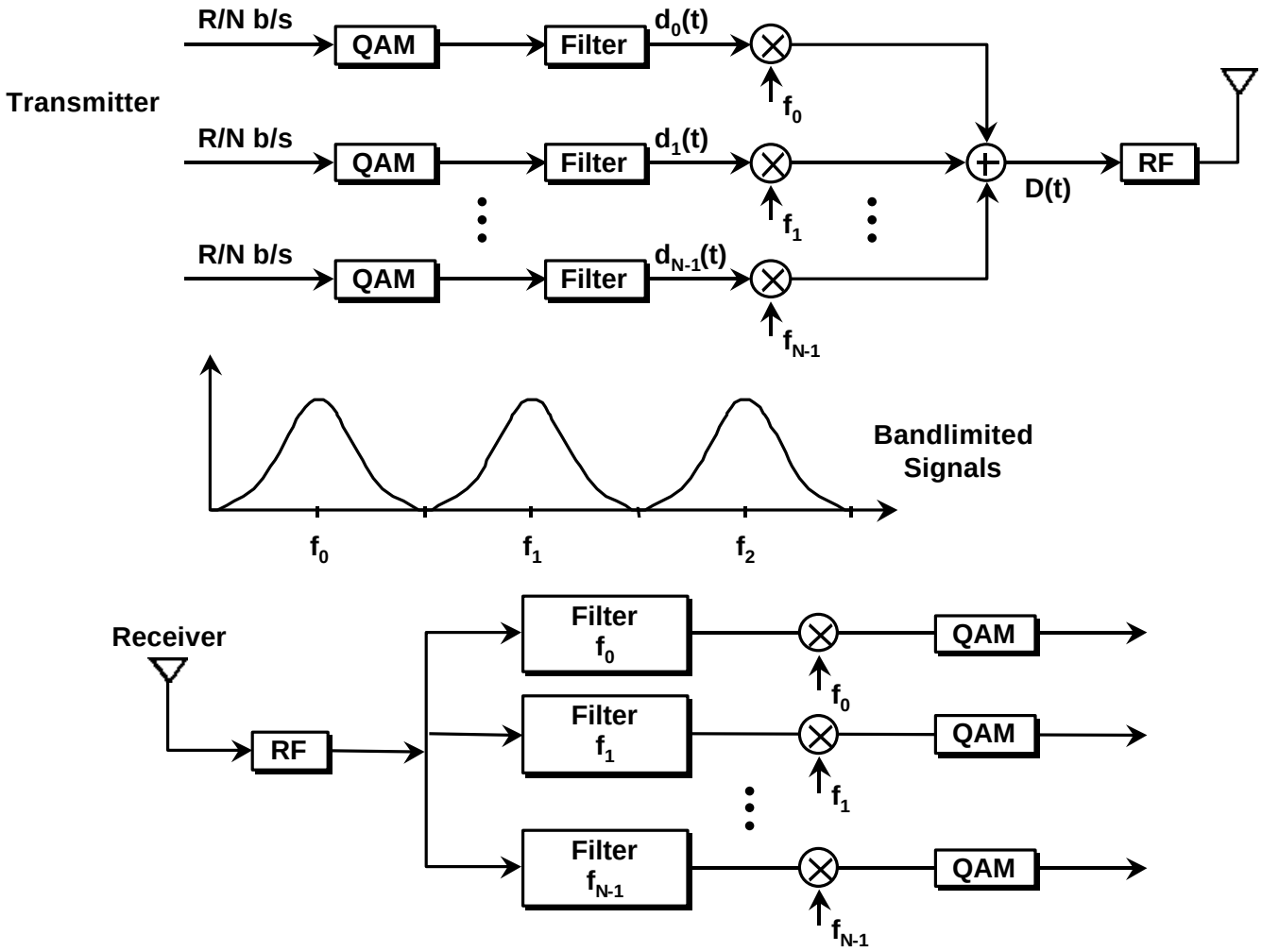
Modem Constellation Diagrams





Multicarrier Realizations

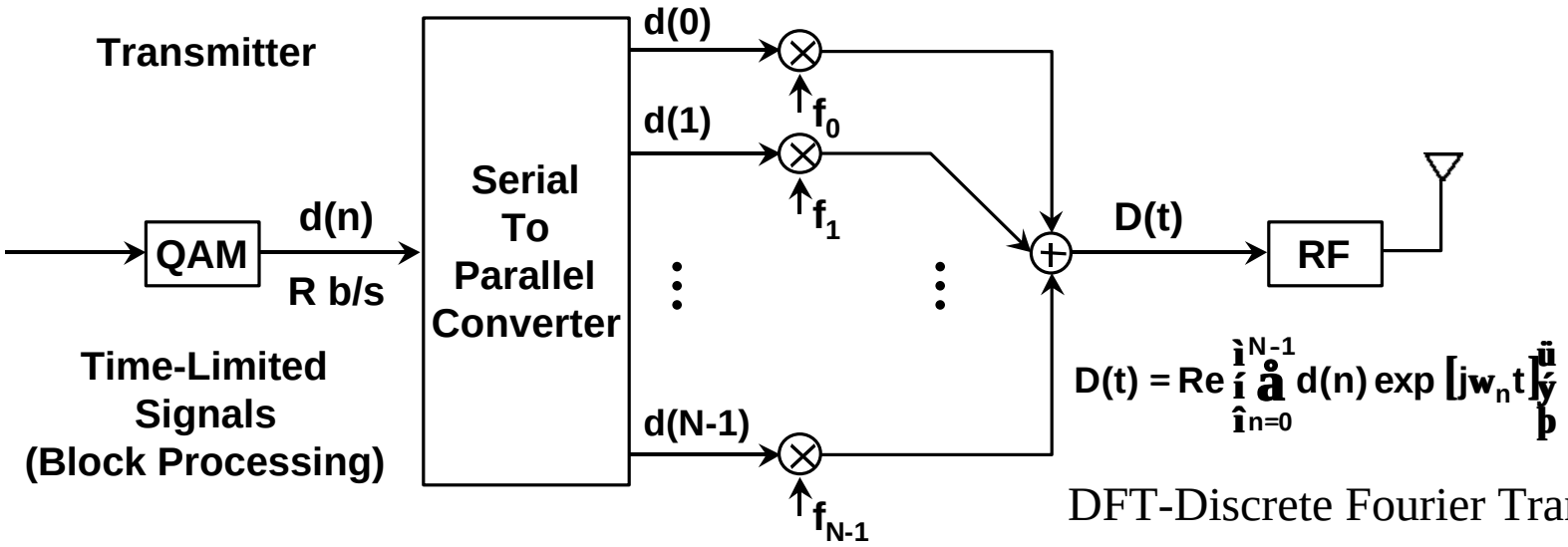
Non-Overlapping Subchannels - "Multitone"



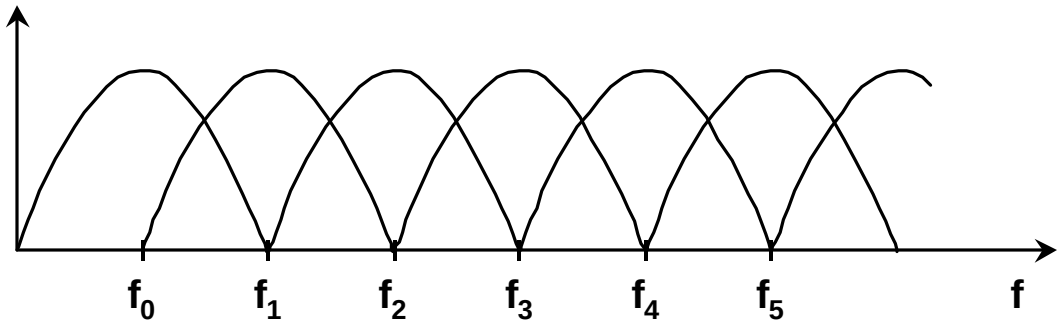
Discrete Multitone Modulation (DMT)

Multicarrier Realizations

Overlapping Subchannels - OFDM ["Orthogonal Frequency Division Multiplexing"



DFT-Discrete Fourier Transform



By the properties of the DFT, the spectral overlap between frequency channels does not cause interference (in the frequency domain), but there will likely be overlap in the time domain. The time domain overlap is removed by using the cyclic extension described in the text. The subchannels in the receiver are separated by taking the Inverse DFT