802.11a - High Speed PHY in the 5 GHz band PHY overview

Naftali Chayat, 802.11 TGa Chair

BreezeCOM Ltd., ISRAEL

What is 802.11?

- Finalized a standard for Wireless LANs in the 2.4 GHz ISM band in July 1997
  - Single MAC, three PHYs: FHSS, DSSS, IR
  - Connectionless services
- Today the group works on
  - High speed PHY in the 5 GHz band
  - Higher speed PHY in the 2.4 GHz band
  - Wireless PAN (Personal Area Networks)

802.11 TGa status

- Task Group a formed in July 97
- Modulation selected in July 98
- Text finalized in Nov 98
- First letter ballot issued Nov 98, processed Jan 99, 82% support after revision
- Reconfirmation ballot issued Jan 99, to be processed in March 99, initially 92% support

802.11a - 5 GHz High Speed PHY Presentation Overview

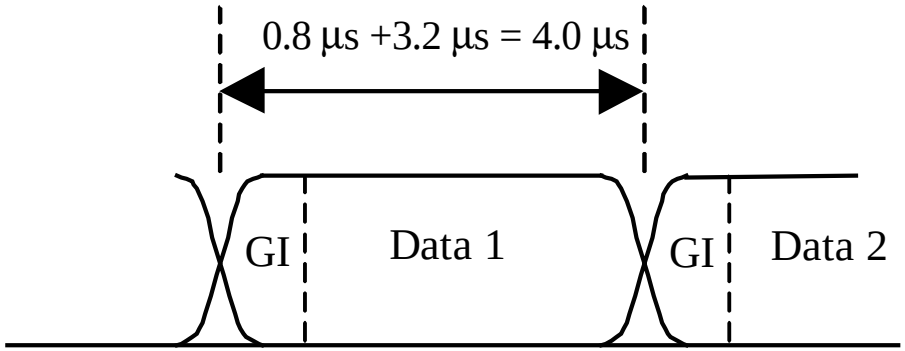
- Main parameters
- OFDM basics
- ECC, Modulations, Preamble design
- Channelization schemes
- Spectral mask requirements
- Overview of cooperation with other standards bodies (BRAN, MMAC)

Main Parameters

- 20 MHz channel spacing
  - 16.6 MHz signal bandwidth
- Multiple data rates- 6 to 54 Mbit/s
  - support of 6, 12 and 24 Mbit/s rates is mandatory
- OFDM modulation
  - BPSK, QPSK, 16QAM or 64QAM on each subcarrier
  - pilot assisted coherent detection
- 802.11 multirate mechanism support

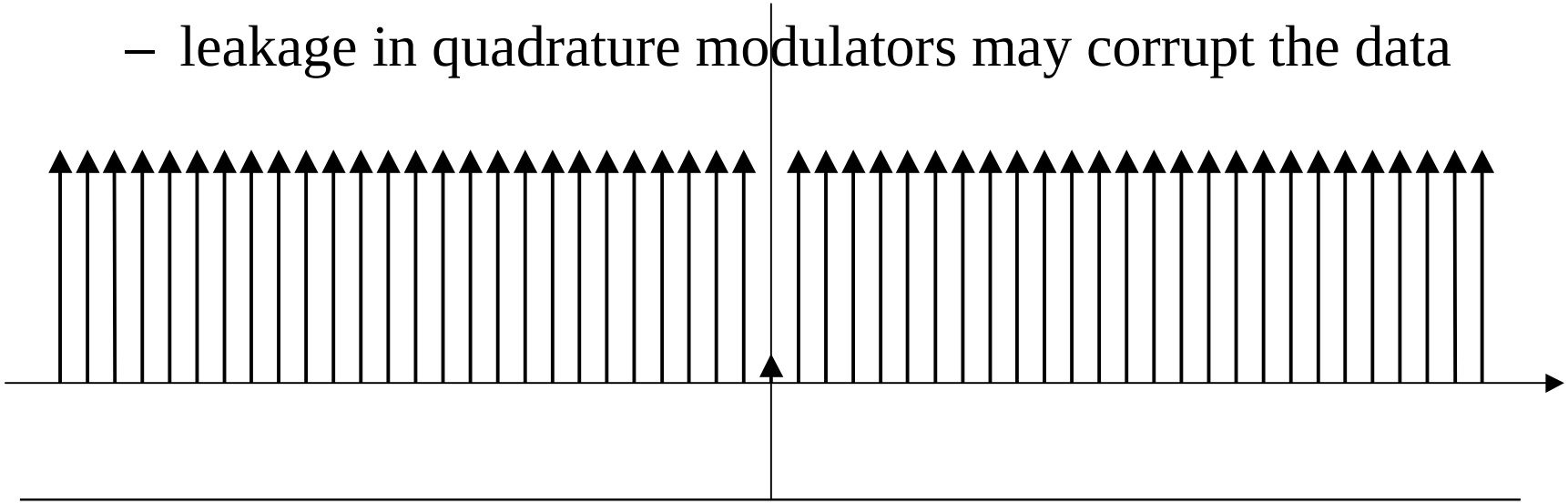
OFDM Frame Structure

- Carrier spacing is 312.5 KHz
- Fourier transform performed over 3.2 microseconds
- 0.8 microsecond Guard Interval for ISI rejection



Data and Pilot subcarriers

- 52 non zero subcarriers
  - 48 data subcarriers
  - 4 carrier pilot subcarriers
- Center frequency subcarrier not used
  - leakage in quadrature modulators may corrupt the data



Error Correction Coding

- ECC is a must - some subcarriers may fade
- Bit Interleaved Convolutional Coding used
  - more robust that trellis in Rayleigh fading
- Industry standard K=7, R=1/2 code
  - higher coding rates (2/3, 3/4) derived by puncturing
  - tail zero bits added to message (trellis termination)
- Interleaver spans one OFDM symbol
  - latency and complexity considerations

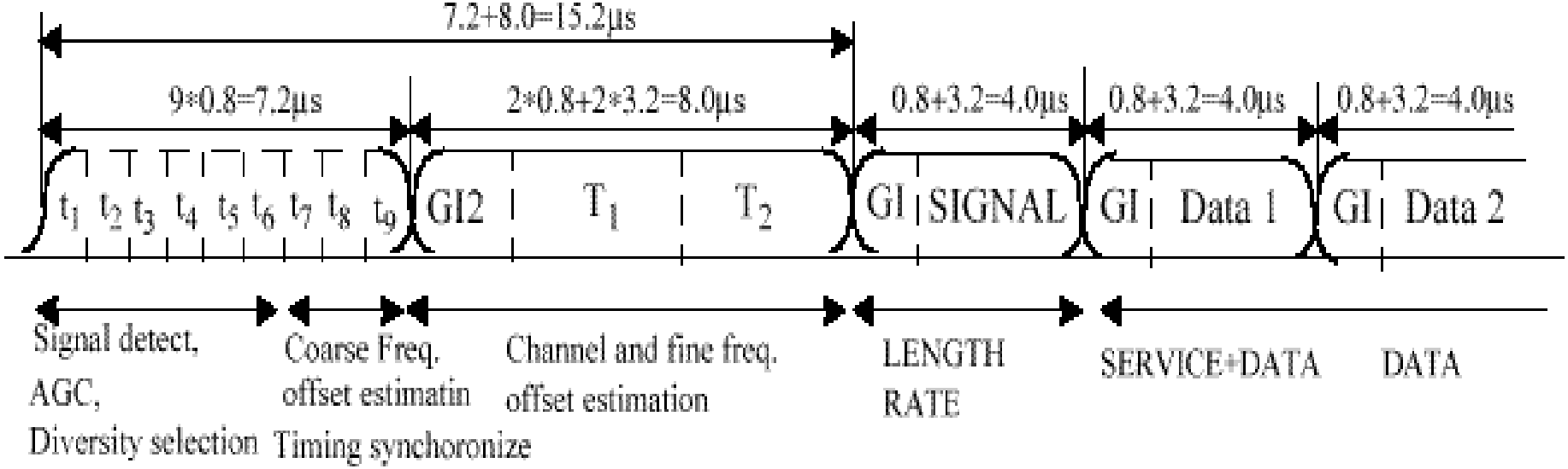
Supported Rates and Modulations

Constellation	coding rate		
	1/2	2/3	3/4
BPSK	6 Mbit/s		9 Mbit/s
QPSK	12 Mbit/s		18 Mbit/s
16 QAM	24 Mbit/s		36 Mbit/s
64 QAM		48 Mbit/s	54 Mbit/s

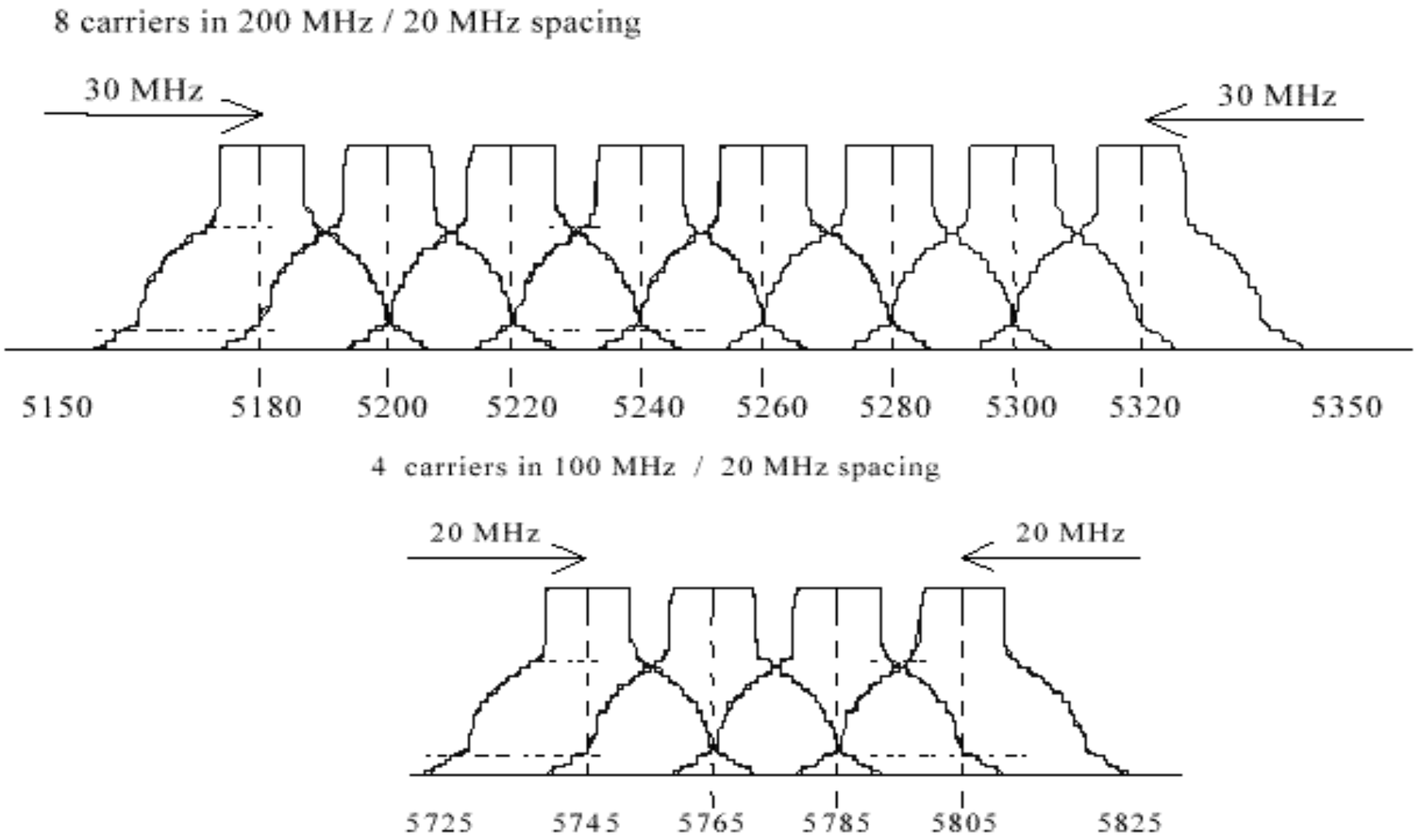
- Modulation of the data subcarriers by either
  - BPSK, QPSK, 16QAM or 64QAM
  - 1, 2, 4, or 6 bits/subcarrier, correspondingly
- 12 Msubcarriers/sec (48 subcarriers each 4 μsec)

Preamble Structure

- Nine repetitions of short sequence in the beginning
  - Signal Detection, AGC convergence, Diversity resolution, Timing estimation, Coarse frequency estimation
- Two repetitions of long sequence with Guard Interval
  - Fine frequency estimation, Channel Estimation

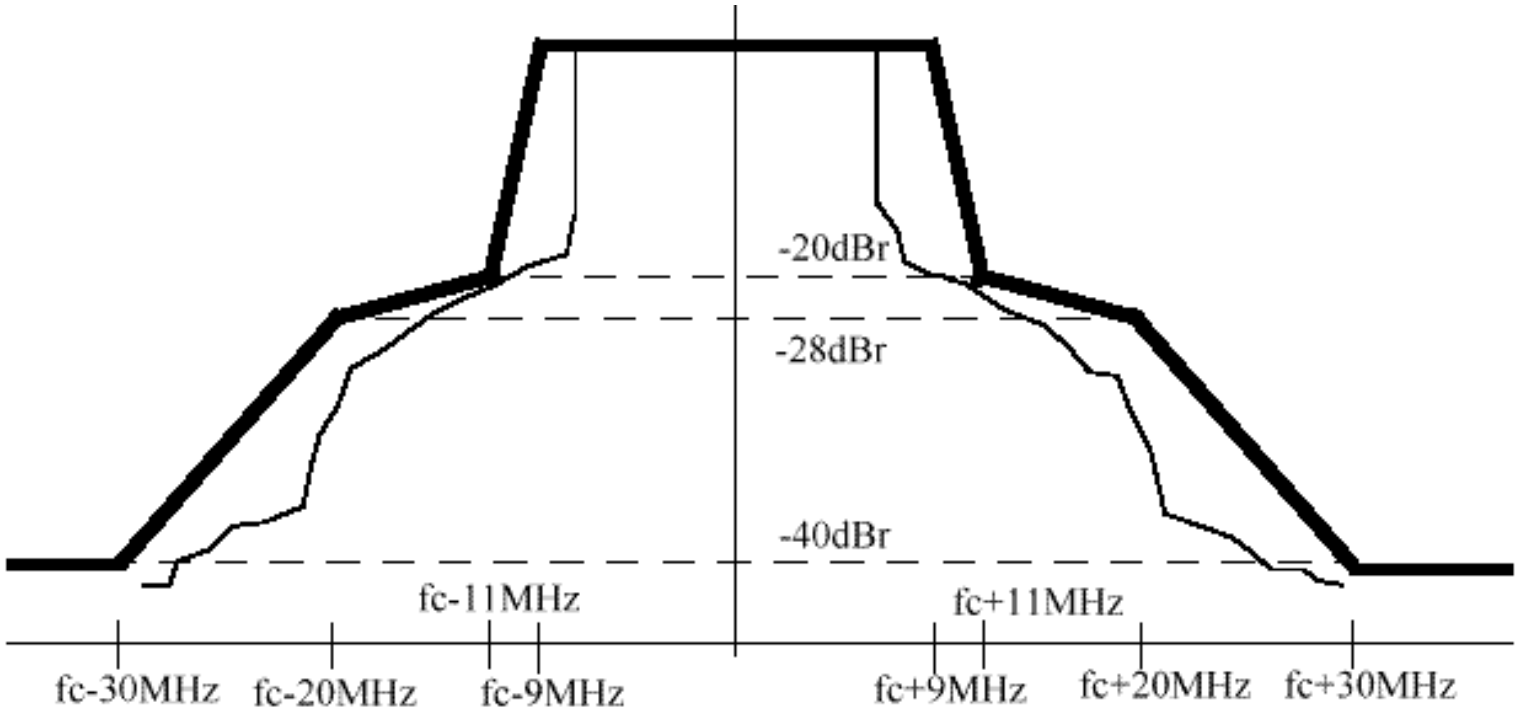


Channelization in US



Spectral Mask Requirement

- The mask determines worst case ACI
- The need to pass local regulatory requirements is explicitly mentioned



Coordination with other Standards Committees

- 802.11 TGa cooperates with the European ETSI BRAN (Broadband Radio Access Networks) and with Japanese MMAC (Mobile Multimedia Advisory Council) to achieve commonality in PHY specifications
- MMAC Wireless Ethernet group will adopt 802.11a
- MMAC Wireless ATM group and BRAN agreed on basic parameters (52 subcarrier OFDM, channel spacing), but adapt some details such as preamble structure and rate signaling to their requirements