FBMC physical layer - principle

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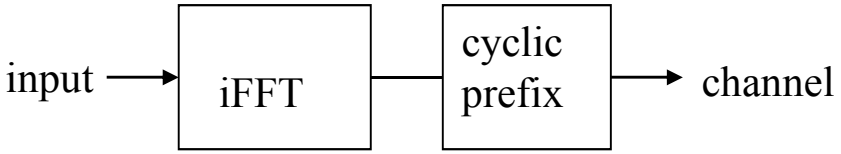
Phydyas physical layer

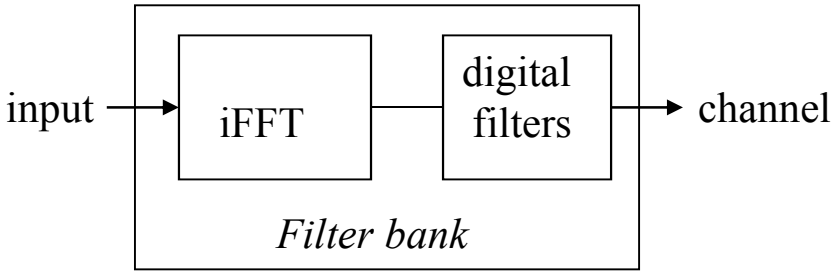
- Based on the filter bank multicarrier (FBMC) technique
  - high bit rate and efficient use of the spectrum
  - high resolution real time spectrum analysis/synthesis
- Independence of sub-channels
  - flexible spectrum access by unsynchronized users
- Features for cognitive radio
  - efficient spectrum sharing (minimum distance between users)
  - guaranteed separation of users (essential for coexistence)
  - simultaneous spectrum sensing and transmission

Principle of FBMC

- OFDM transmitter



- Filter bank based multicarrier (FBMC) transmission

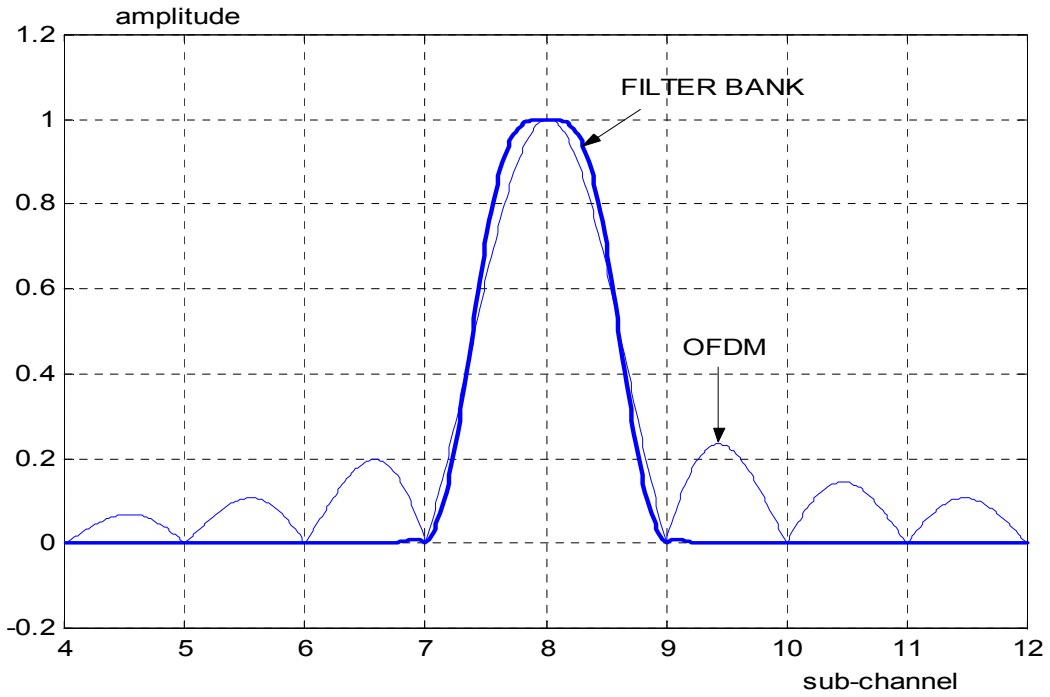


→ FBMC characteristics:

- no guard time (no cyclic prefix)
- high spectral resolution

Comparing OFDM and FBMC

Sub-channel frequency response



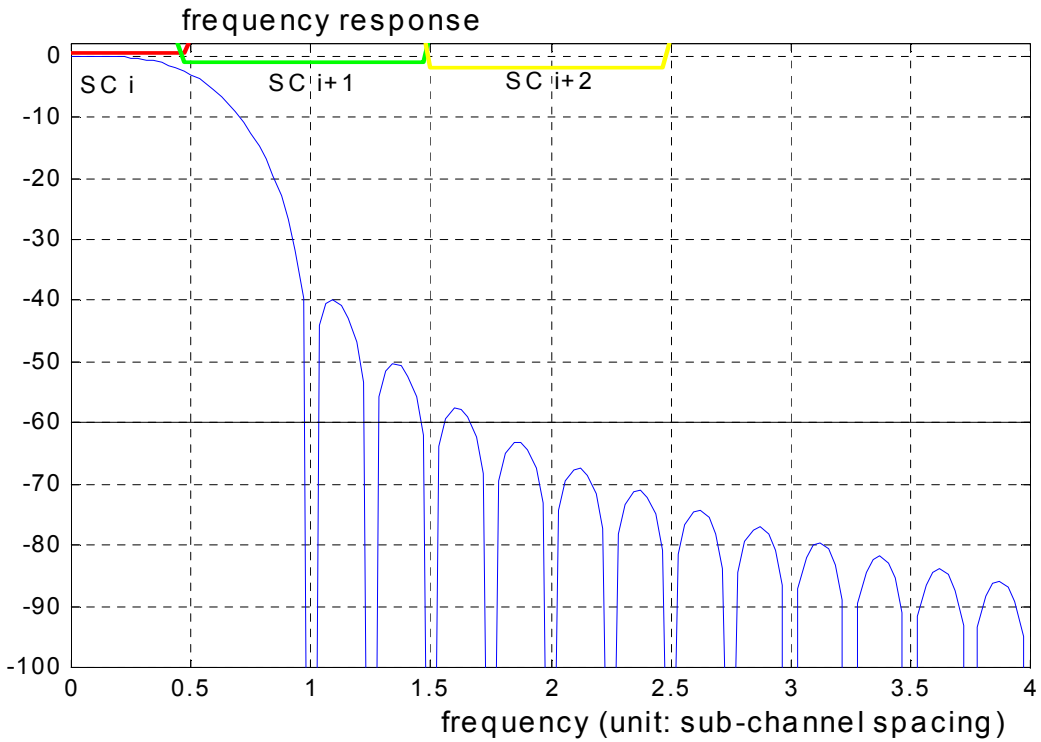
→ no sidelobes with the filter bank

→ no cyclic prefix : increased spectral efficiency

Prototype filter

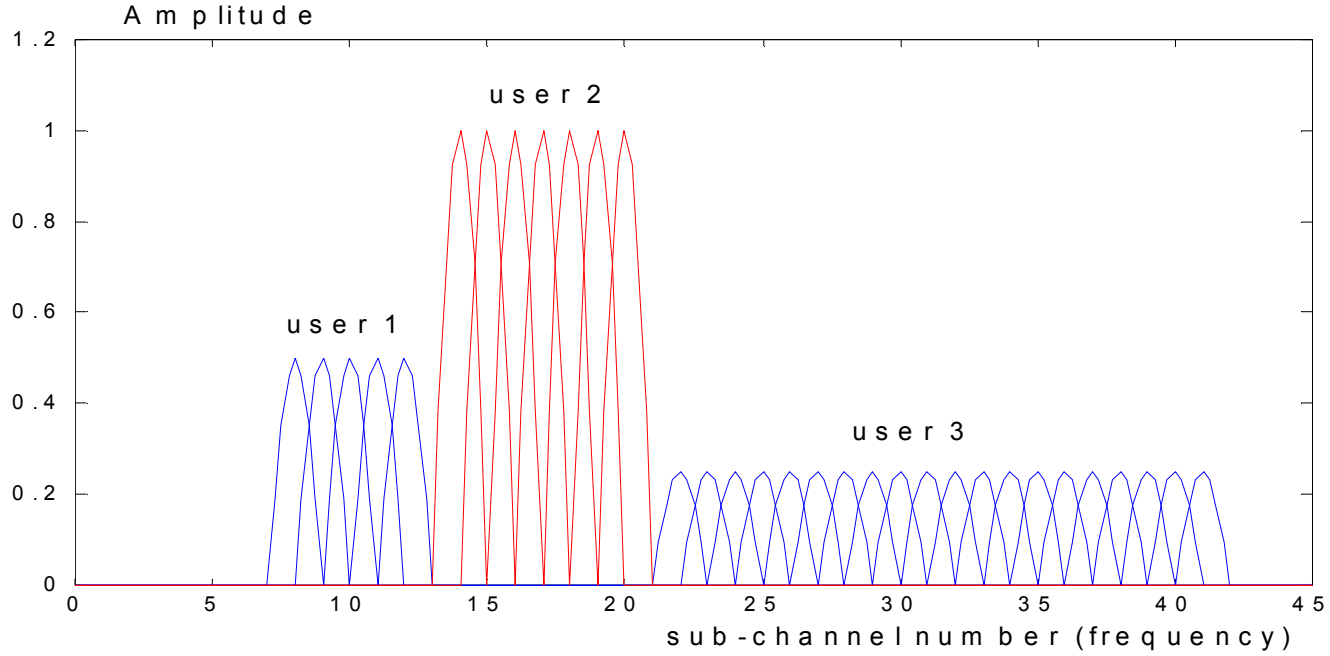
- Coefficients: (Overlap factor K=4 - filter length=4xFFT size)

  h_i=1-1.94392cos(πi/512)+1.414cos(πi/256)-0.47029cos(πi3/512) ; i=1,….,1023
- Frequency response



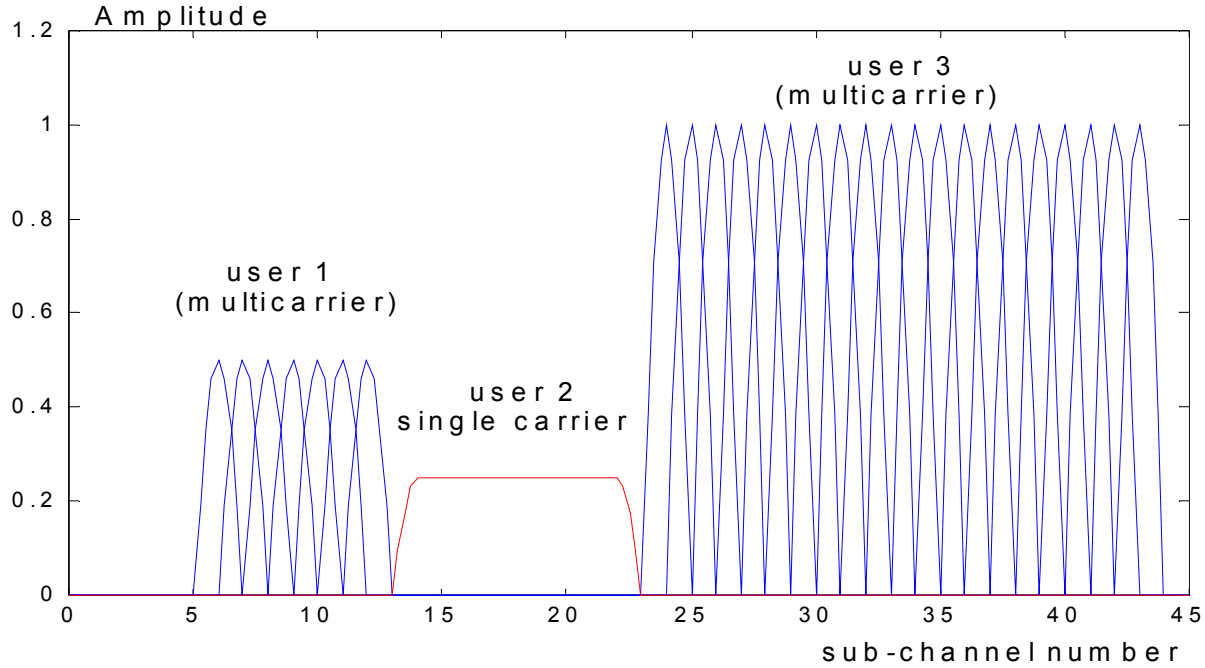
Multi-user multicarrier transmission

- FBMC: independence of subchannels - disjoint user spectra
- Several users can have different transmission parameters



Mixing multi/single carrier

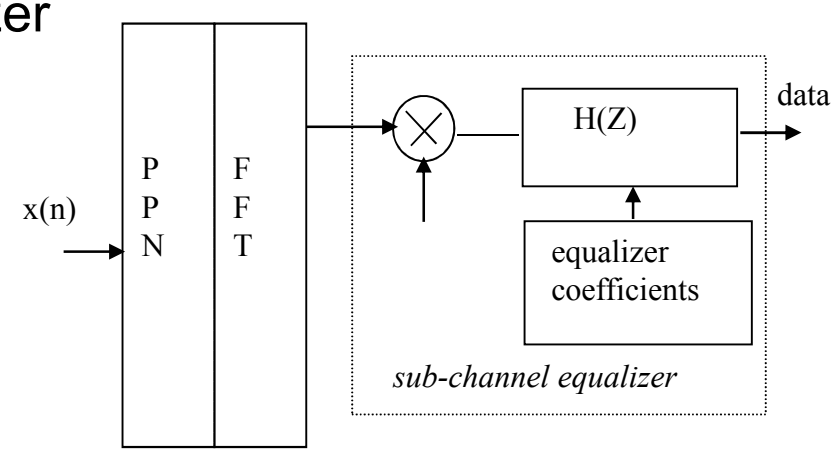
- PAPR (peak to average power ratio) may be critical in some situations: uplink, distance from BS, peer-to-peer, …
- Advantages of single carrier modulation: robustness, low power
- With FBMC modulations can be mixed



Equalization capability

With FBMC, time and frequency alignment of the distant user is not a prerequisite to begin transmission

Sub-channel equalizer



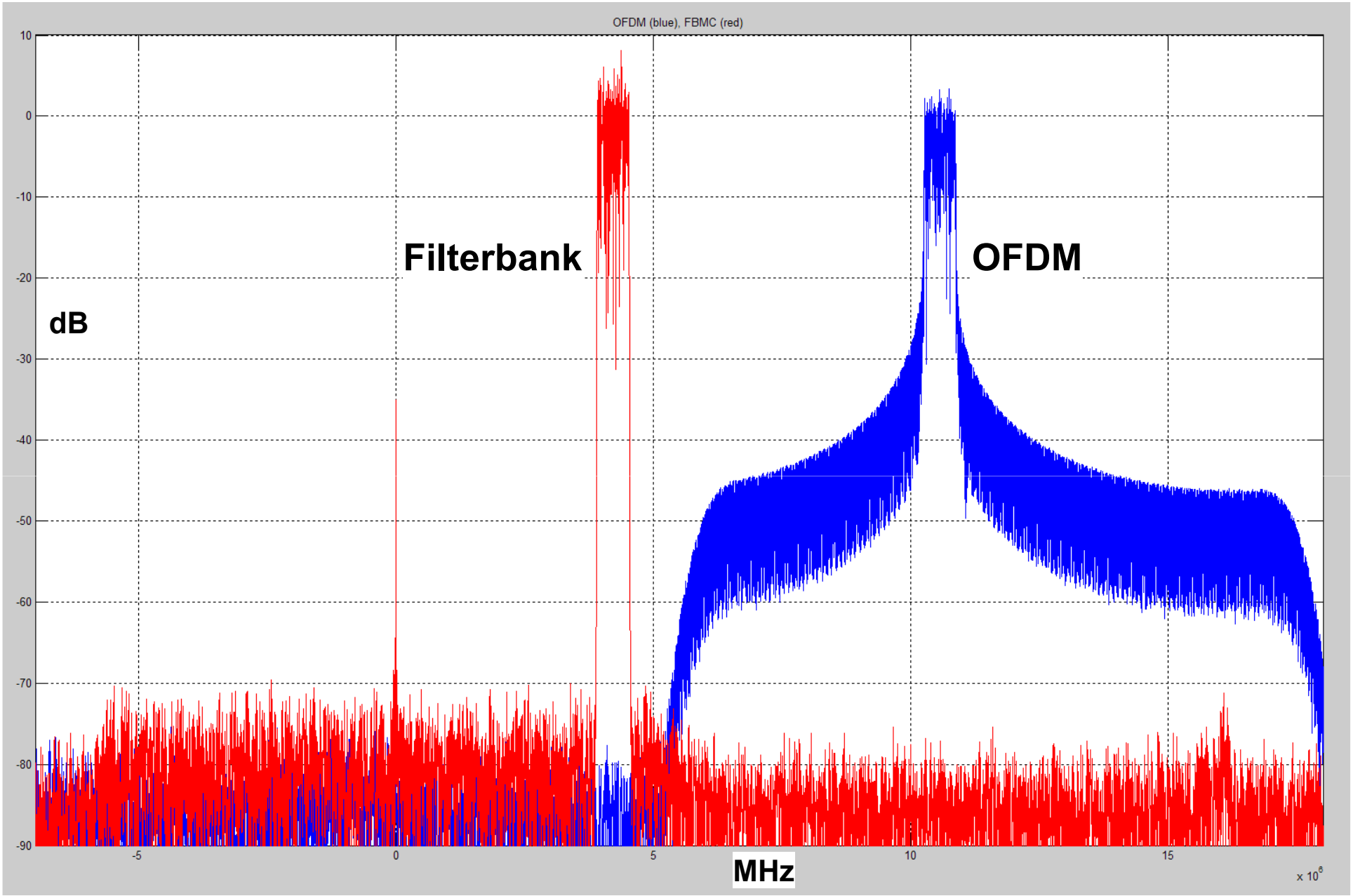
- frequency offset compensation
- fractionally spaced transversal equalizer
  (channel distortion, timing offset compensation)

Sensing / monitoring with FBMC

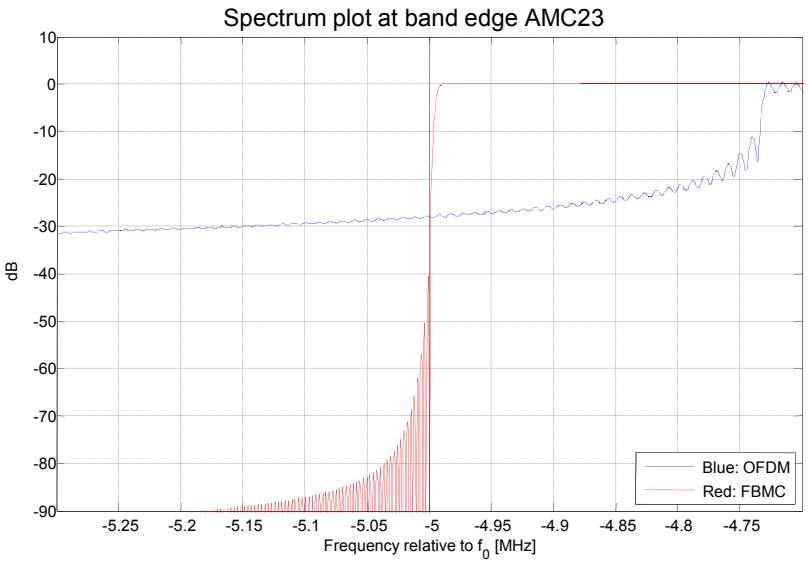
- Performance determined by the prototype filter
- Sensing techniques applied at sub-channel level
  (energy detection, …..)
- Continuous monitoring
  (3 subchannels left idle → the center subchannel can sense during transmission)

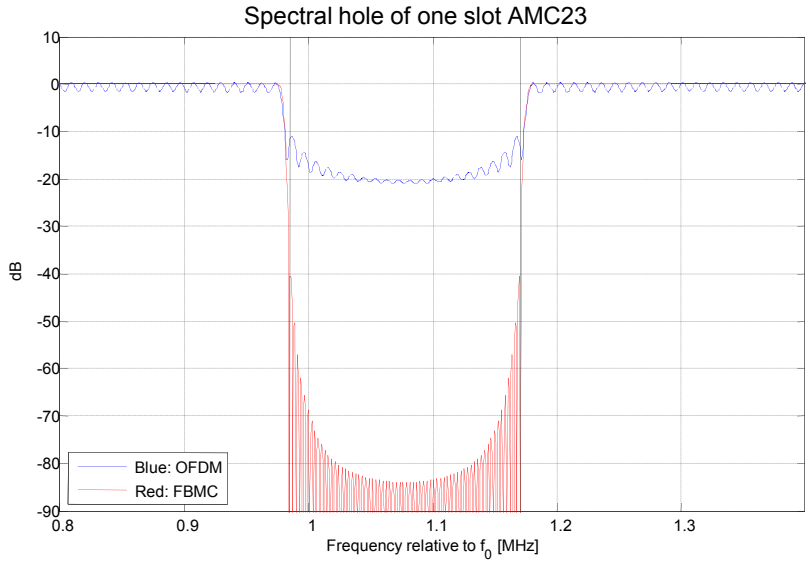
Emitted spectrum

Output of hardware transmitter
provided by SINTEF-NO
(WiMAX)


OFDM (blue), FBMC (red)
Filterbank
OFDM
dB
MHz
x 10^6
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-5
0
5
10
15

Increased spectral efficiency





- FBMC has increased frequency utilization due to better exploitation at band edges
- FBMC can make spectral holes. Suitable for cognitive radios.
- FBMC can support unsynchronised stations in a multiuser environment

Project website

www.ict-phydyas.org