Quality Of Service and MObility driven cognitive radio Systems

Flexible Multicarrier PHY Design for Cognitive Radio in White Space

Presented by: Michael Fitch

WP4: PHY architecture

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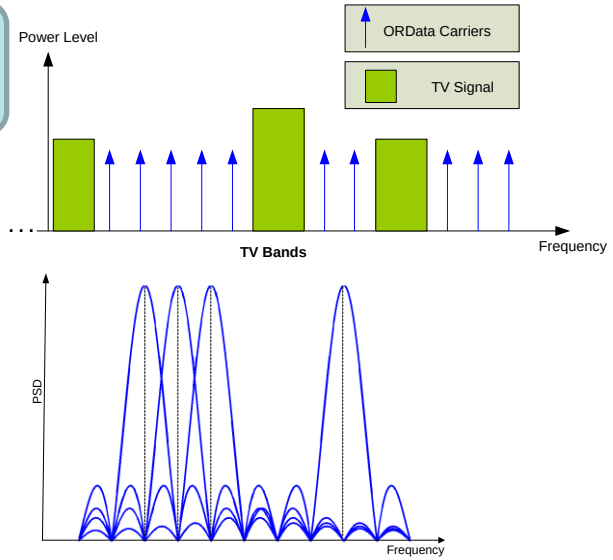
SEVENTH FRAMEWORK PROGRAMME

Content

- Motivation
- Technical Highlights
  - FBMC
  - IA – PFT
  - GFDM
  - Reconfigurable RF
- Conclusion

Motivation for looking Beyond OFDM

FBMC, GFDM and IA-PFT



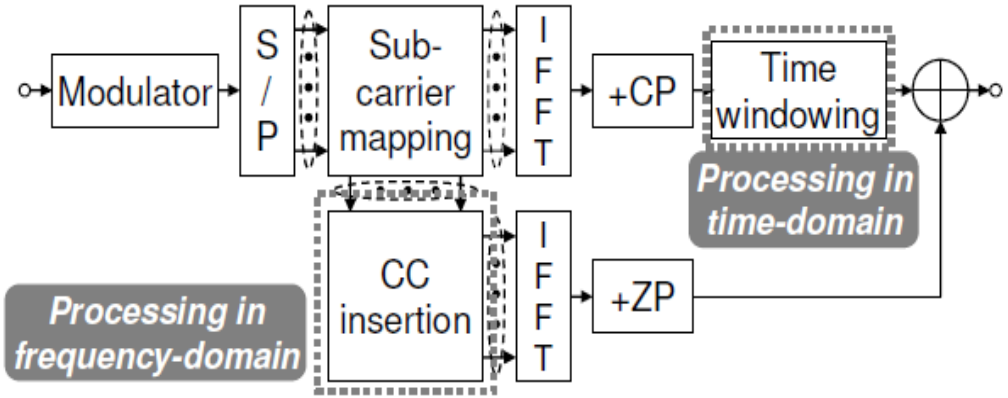
- Fragmented White Space
- Flexible MC approach
- Extremely low out-of-band radiation
- Digital Implementation

- Multi-branch filter bank approach
- Adjustable out-of-band radiation
- Lesser CP compared to OFDM
- Simple Equalization → Performance is as good as OFDM
- Reconfigurable RF front – end for flexibility of the architecture

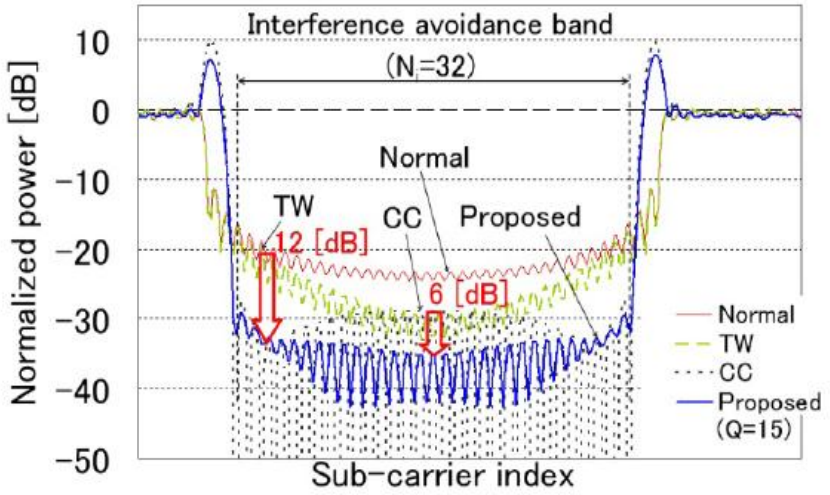
SEVENTH FRAMEWORK PROGRAMME

Interference Avoidance Transmission (IA-PFT)

- An OFDM-based-transmitter capable of suppressing out-of-band emission for opportunistic spectrum access in White Space
- Parallel concatenation of partitioned frequency-domain (Cancellation Carriers) and time-domain (windowing) processing
- 6-12 dB of suppression gain in power spectral density



IA-PFT transmitter

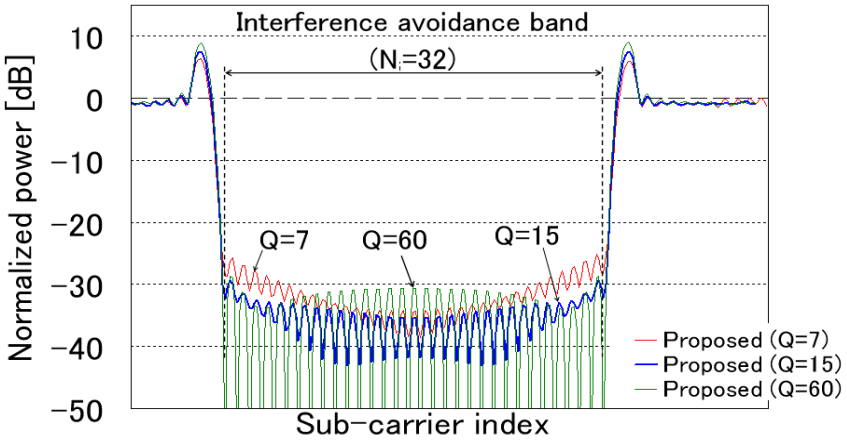


Power spectral density

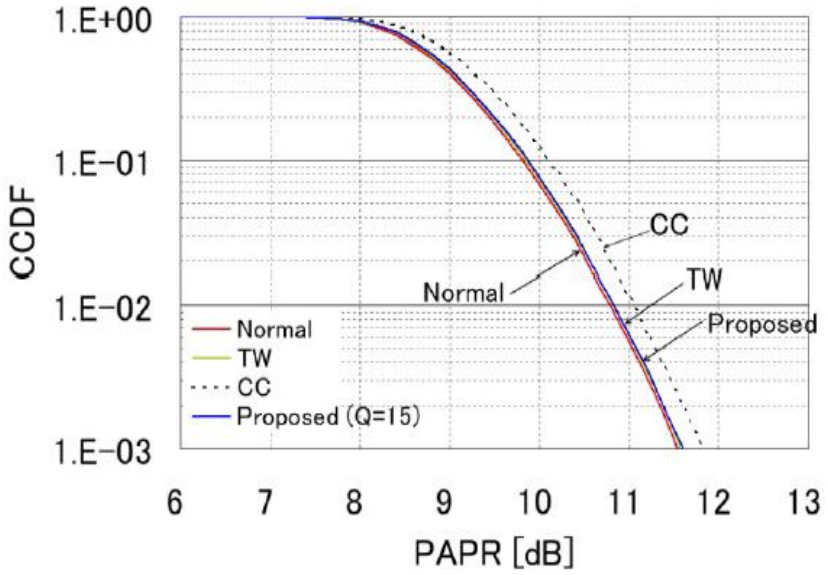
IA-PFT: Interference Avoidance transmission by Partitioned Frequency- and Time-domain processing

IA-PFT: BLER and PAPR Performance

- IA-PFT achieves almost the same BLER as those of conventional CC and TW schemes in multipath fading channels
- Negligible level of increase in PAPR confirmed



Power spectrum density of IA-PFT with variable *Q*

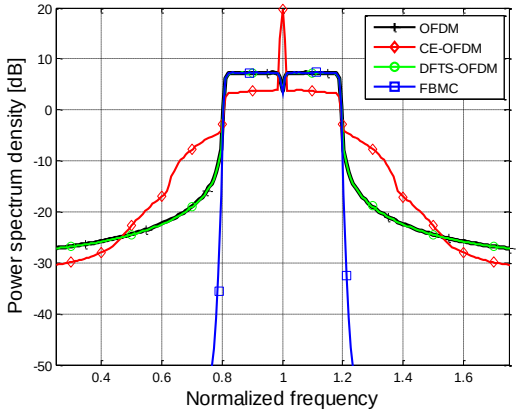


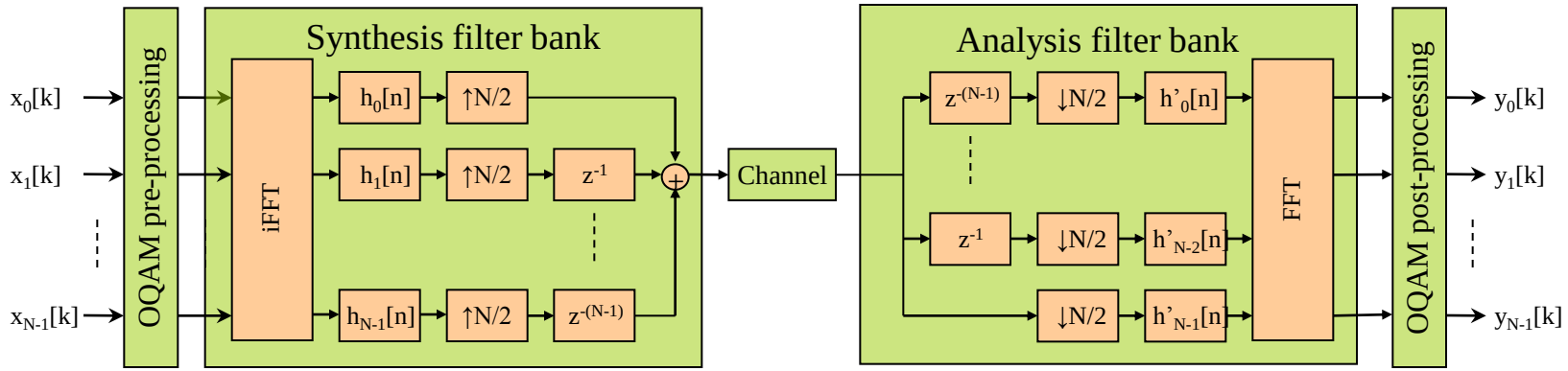
PAPR performance (QPSK)

CC: Cancellation Carrier TW: Time Windowing

Filter Bank Multi Carrier System

- FBMC / OQAM OFDM is being considered
- Motivations for FBMC have been presented
  - Frequency transition bands are sharper
  - Benefits in terms of spectral efficiency have been measured
  - Larger complexity of implementation
- FBMC DSP Architecture

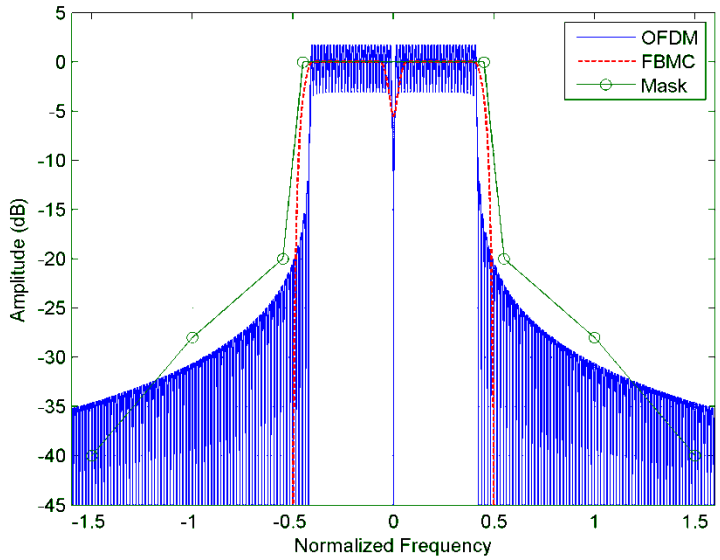




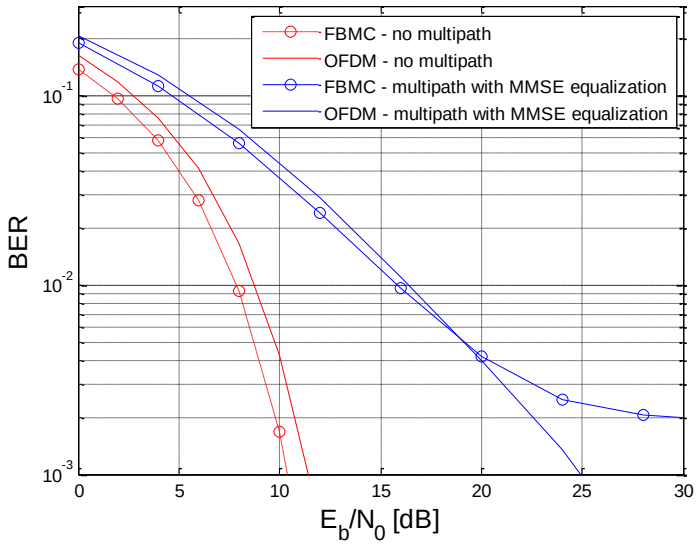
Structure of the FBMC modulation and demodulation

Channel equalization in FBMC

- For small delay spread: channel equalization using MMSE channel equalization
- Larger delays introduce error floor in the BER
- Novel iterative equalization scheme for FBMC to achieve better performance



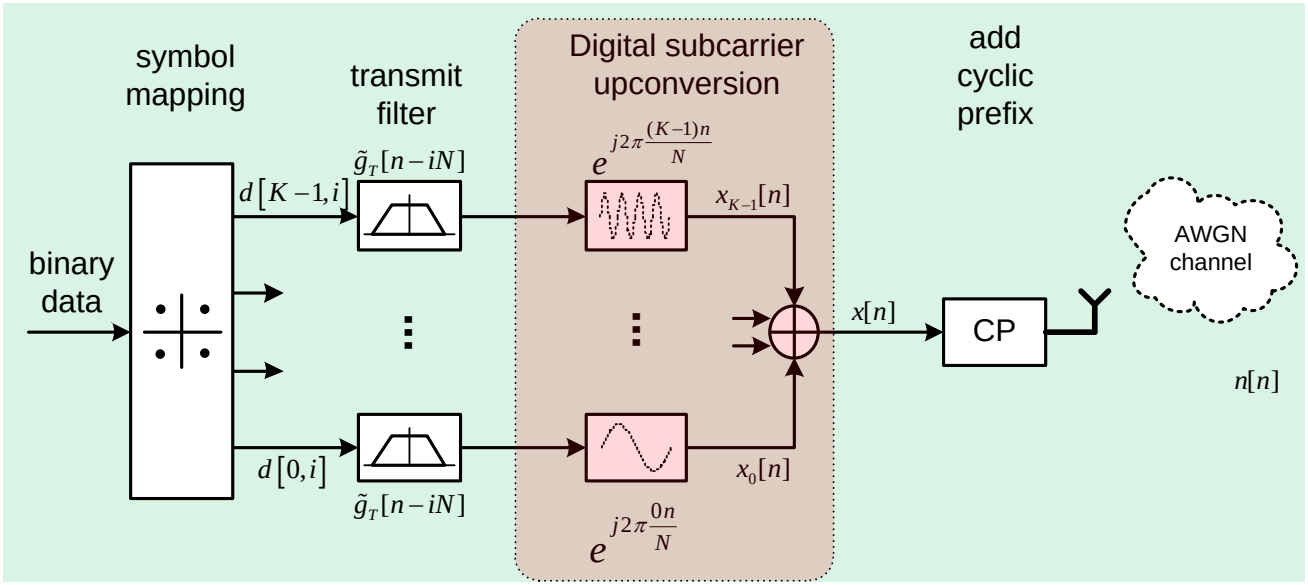
Power spectral density comparison in IEEE 802.11a/g

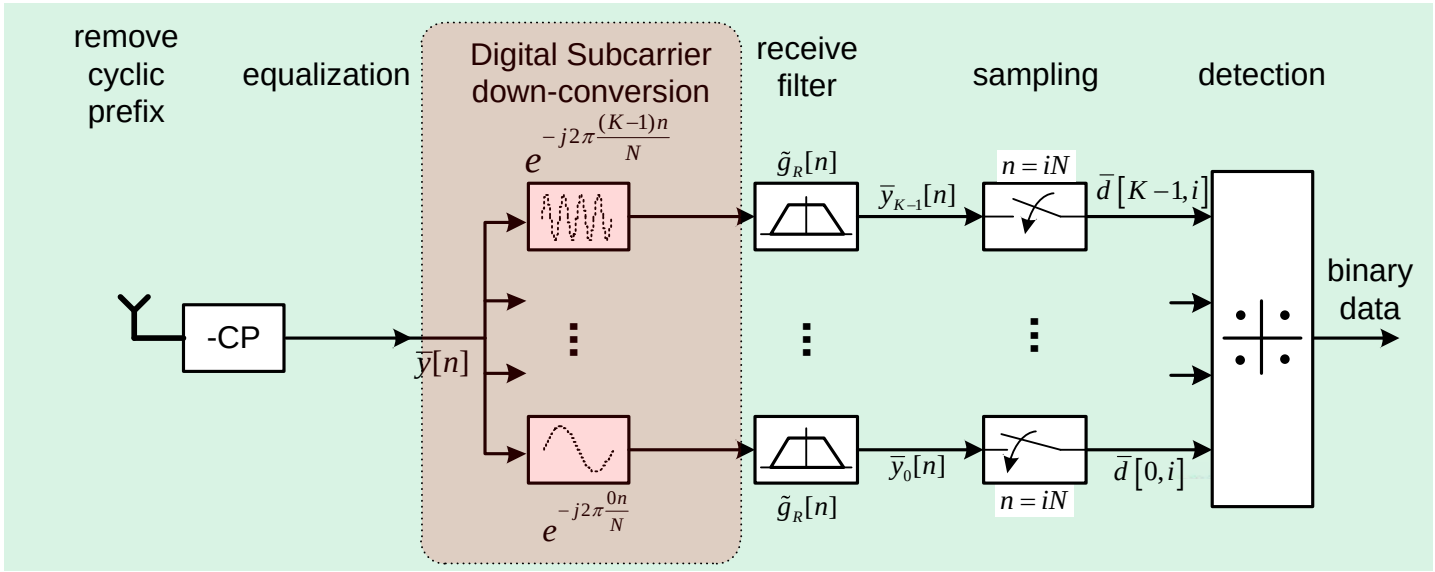


FBMC and OFDM MMSE, AWGN and multipath channels

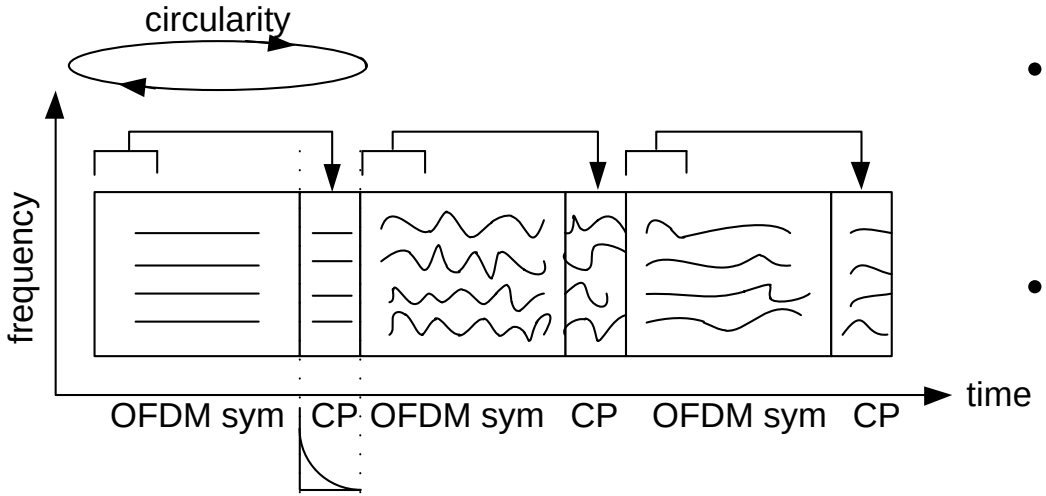
Standard	Spectral Efficiency Gain relative to OFDM		
	Frequency Domain	Time Domain	Total Gain
DVB-T	10 %	3 %	13 %
IEEE 802.11a/g	3.8 %	15.8 %	19.6 %

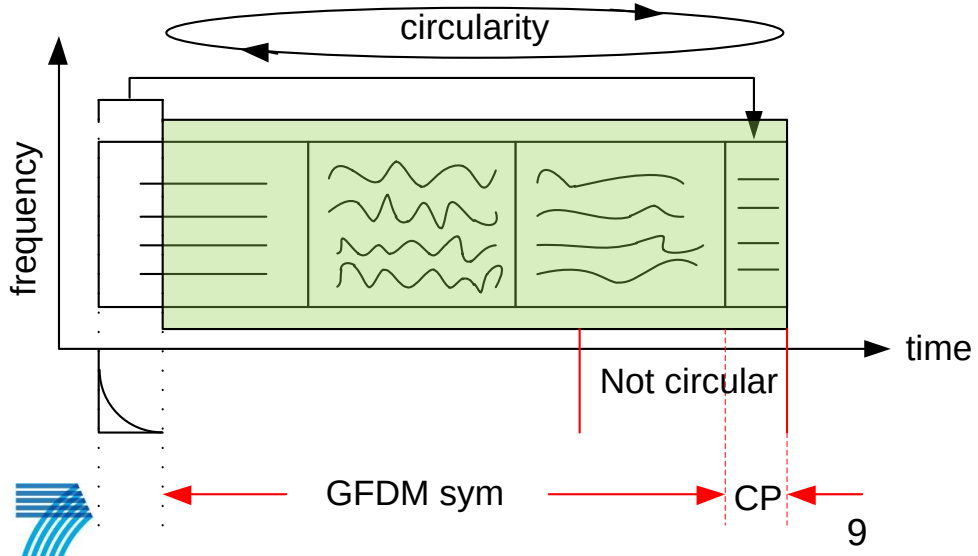
Generalized Frequency Division Multiplexing





Tail-biting CP

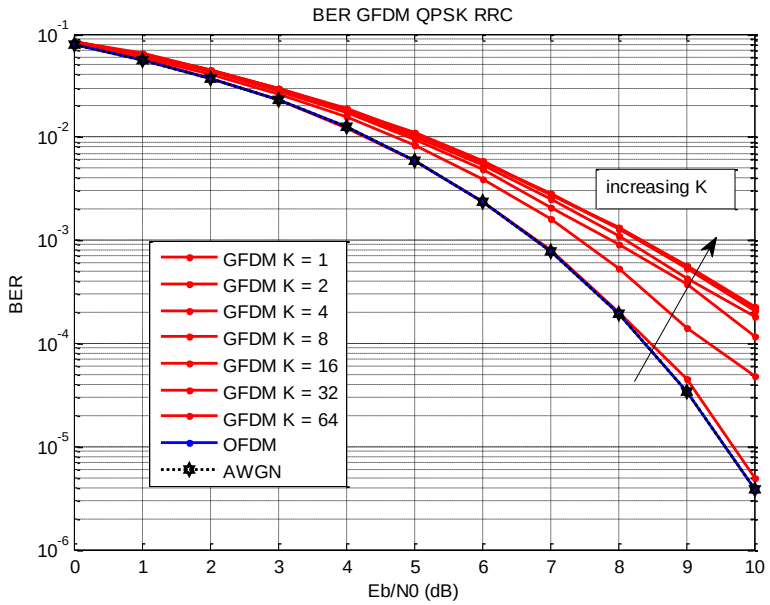


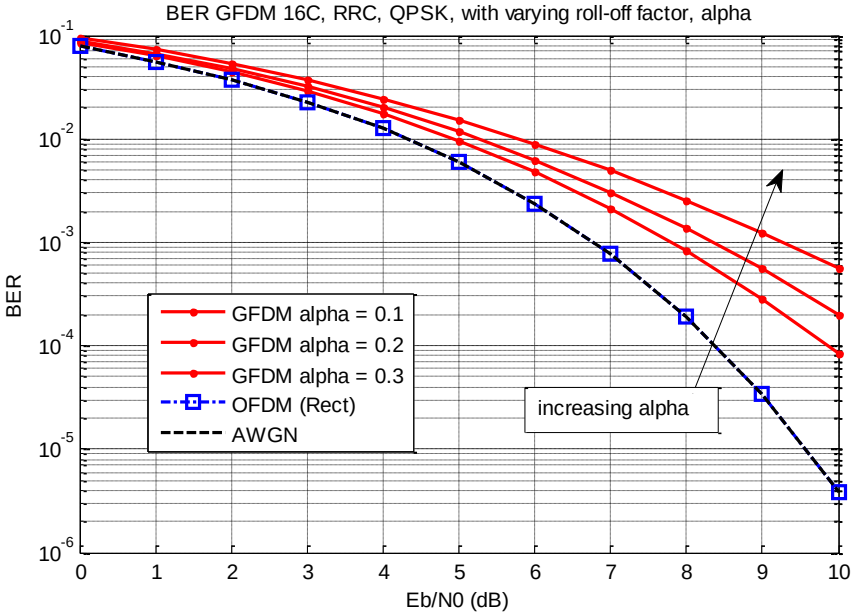


- In OFDM we have 1 CP for every OFDM sym Block
- In GFDM, we have for M-sym blocks, 1 CP
- If we have frequency selective Channel, the influence of CP on $\frac{E_B}{N_0}$

$$10\log_{10}\left(\frac{T_{data}+T_{CP}}{T_{data}}\right)$$

GFDM performance

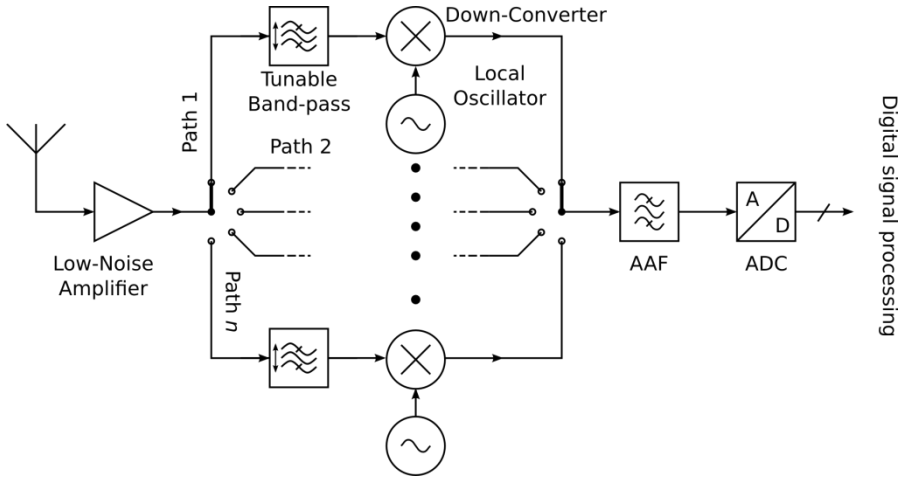




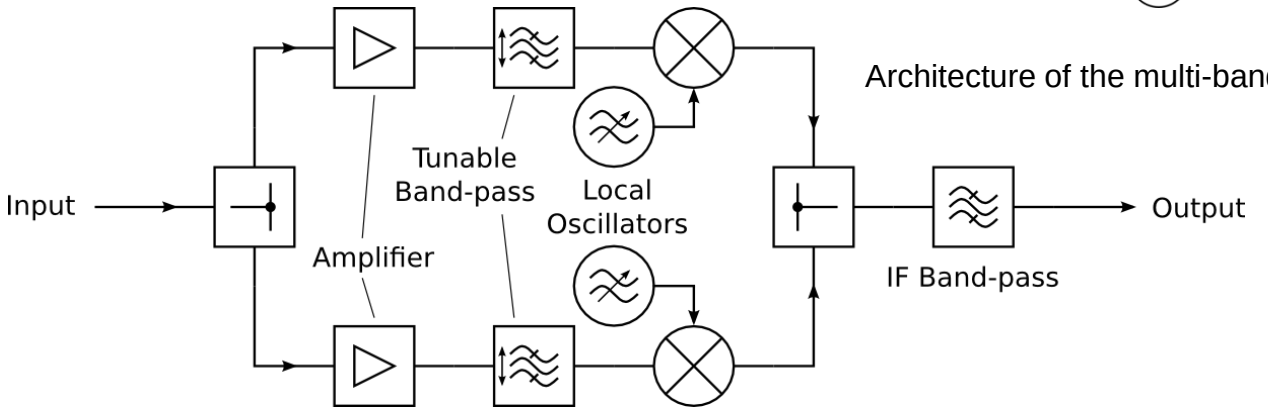
Flexible RF Transceiver Front-End

Main objectives:

- Flexible spectrum exploitation
- Supporting spectrum aggregation



Architecture of the multi-band RF receiver front-end



Frequency selection and conversion for spectrum aggregation

Conclusion

- State of the art architectures have been studied.
- Parameter and system requirements have been researched.
- A flexible PHY design is being researched; with several options identified.
- Simulations going on in FBMC, GFDM, IA-PFT etc. etc.
- Performance of these PHY techniques are being studied and simulated.
- Reconfigurable RF front-end is being researched.

The ThanQ Slide

Tack själv

obrigado

Danke schön

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감사합니다

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Thank You!!

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شکرا

merci

grazie

Vielen Dank

gracias

با تشکر از شما

謝謝

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