High Rate - Ultra Wide Band (UWB) Background

Promise of a UWB Physical Layer

Data rates:

- *Scalable data rates from 55 Mb/s to 480 Mb/s.*
- *110 Mb/s at 10 meters in realistic multi-path environments.*
- *200 Mb/s at greater than 4 meters in realistic multi-path environments.*
- *480 Mb/s at 2 meters in realistic multi-path environments.*

Low cost solutions.

Low power PHY solutions:

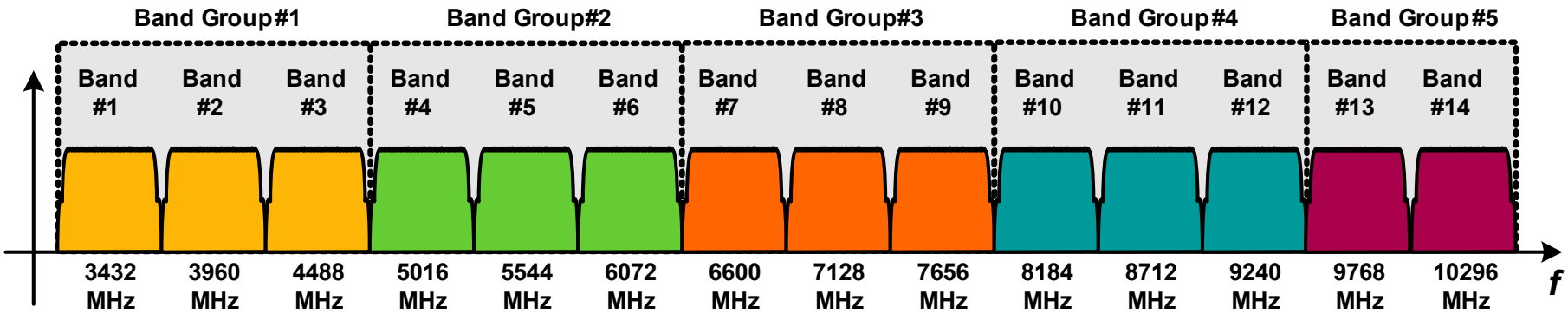
Integrated CMOS solution ⇒ Single chip solutions ⇒ Small form factors.

Coexistence with current and future devices.

Overview of Multi-band OFDM

Central Idea #1:

- *Divide the spectrum into bands that are 528 MHz wide.*

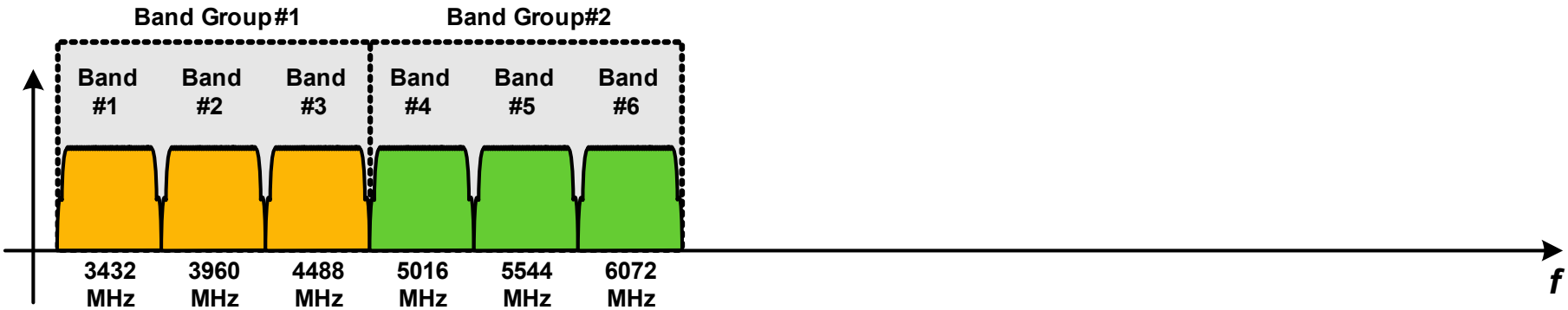


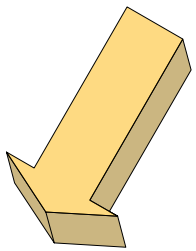
Advantages:

- *Transmitter and receiver process smaller bandwidth signals.*
- *Instantaneous processing BW = 528 MHz.*

Exploiting the Band Plan

Exploit range of band group's to separate applications:

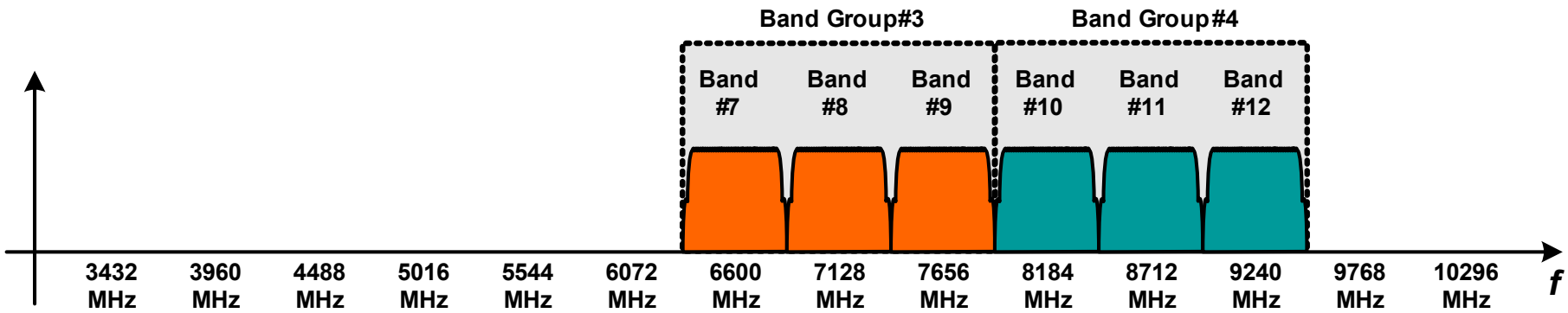


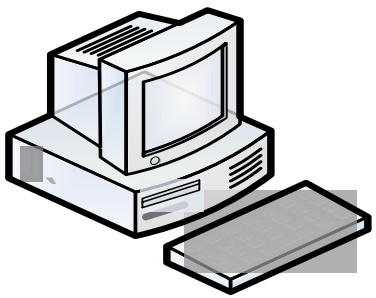


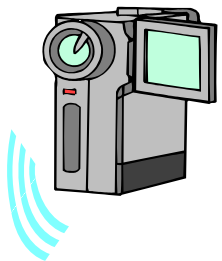
Longer Range Apps
Use BG #1 and #2

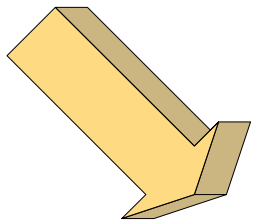
Exploiting the Band Plan

Exploit range of band group's to separate applications:







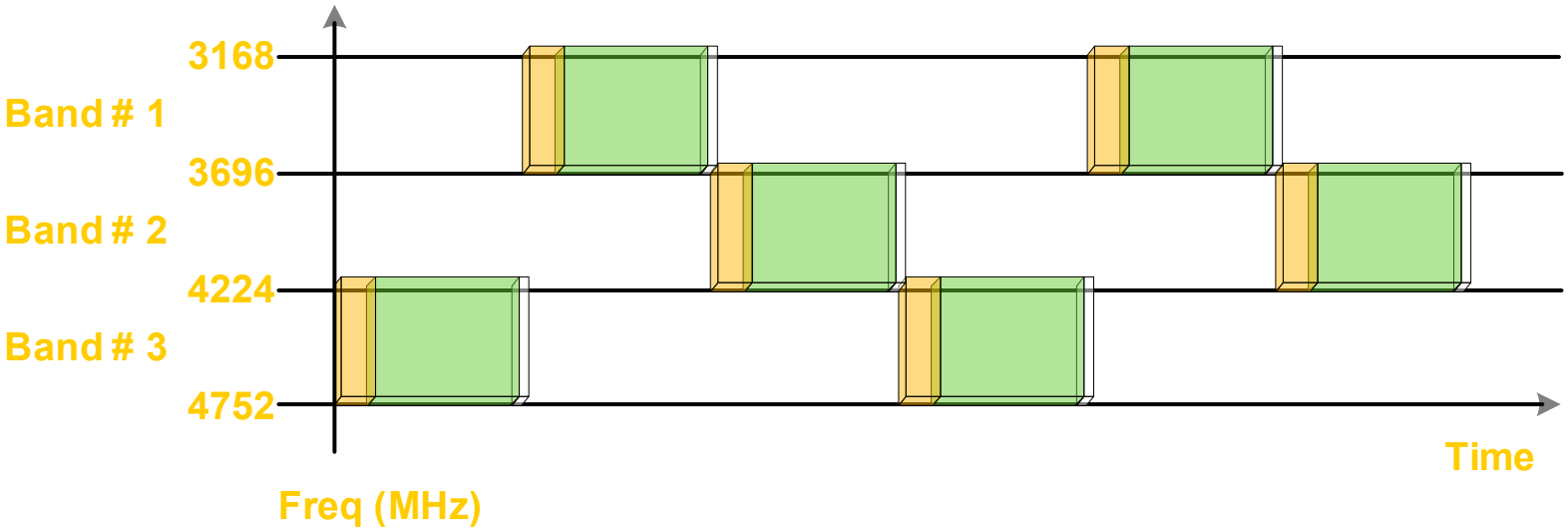


Shorter Range Apps
Use BG #3 and #4

Overview of Multi-band OFDM

Central Idea #2:

- *Interleave OFDM symbols across all bands.*

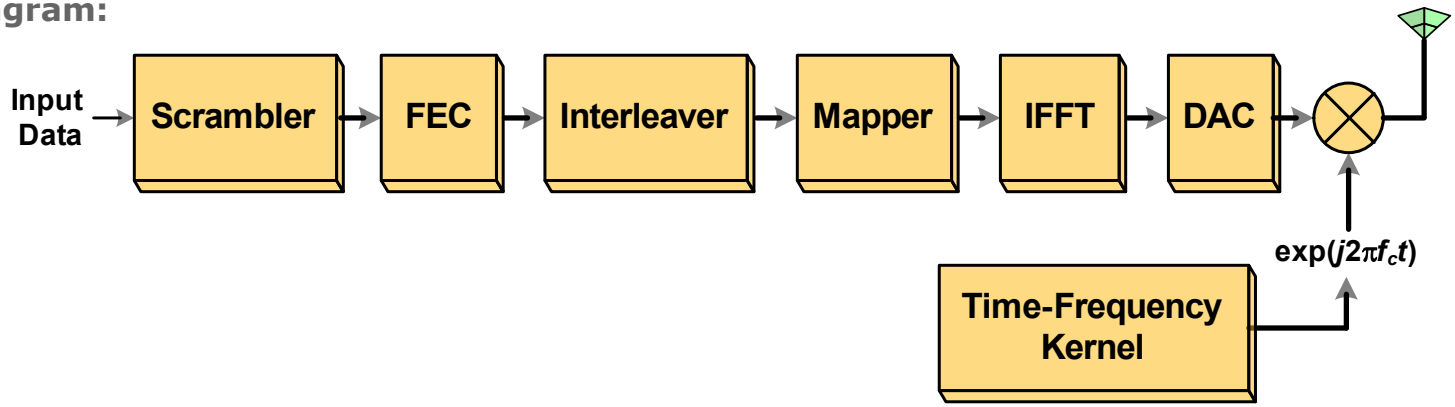


Advantages:

- *Exploits frequency diversity.*
- *Provide robustness against multi-path / interference.*
- *Same transmit power as if the entire band is used.*

Transmitter Architecture

Block Diagram:



Architecture is similar to that of a conventional/proven OFDM system.

Major Differences:

1. *Time-Frequency kernel specifies the frequency for next OFDM symbol.*
2. *Constellation size is limited to QPSK (limits size of IFFT/FFT, DAC/ADC).*
3. *For rates less than 80 Mb/s, the input to the IFFT is conjugate symmetric.*
   - **Need to only implement the "I" portion of TX analog chain.**
   - **As a result, only half the analog die size of a full "I/Q" transmitter is needed.**
4. *Zero-padded prefix instead of cyclic prefix.*

Conclusions

Inherent robustness to multi-path in all expected environments.

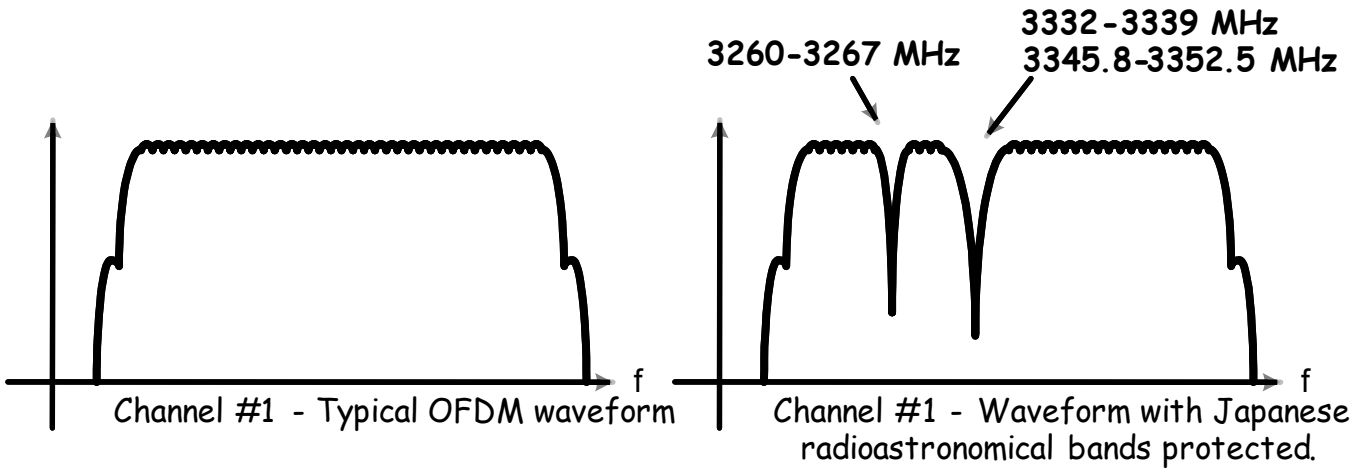
Excellent robustness to U-NII and other generic narrowband interference.

Ability to comply with worldwide regulations:

- *Channels and tones can be turned on/off dynamically to comply with changing regulations.*
- *Can arbitrarily shape spectrum because the tones resolution is ~4 MHz.*

Example: Radio-astronomy bands in Japan.

- *Only need to zero out a few tones in order to protect these services.*



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