

Multi-G

Enabling Waveform Innovation in 6G

Extensive Academic Research on Waveforms

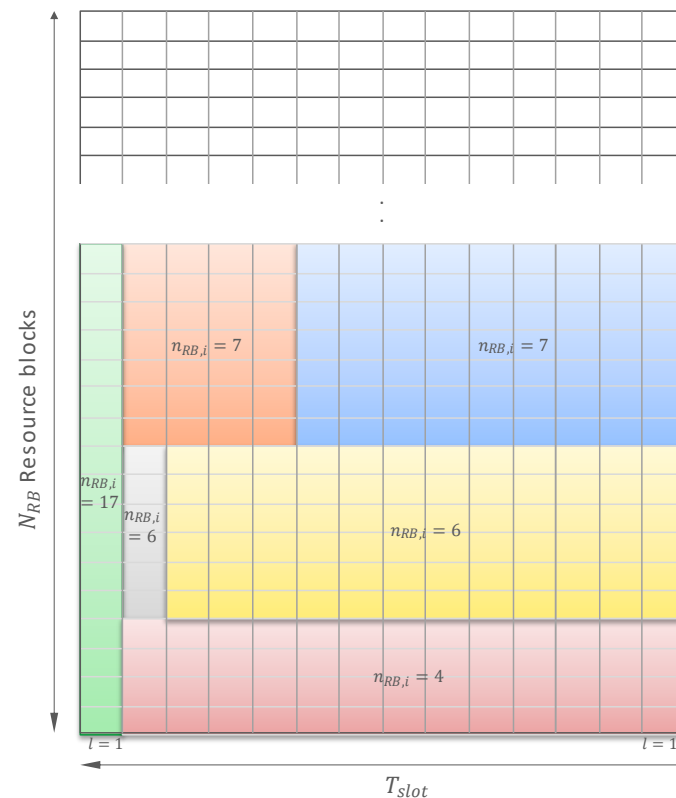
- ◉ Thousands of global publications on post-OFDM waveforms
 - Over 1,500 on OTFS alone!
 - Performance and use case advantages theoretically proven and documented for Zak-OTFS
- ◉ 6G must not shut the door on continuous innovation
- ◉ 3GPP should study new waveforms and define open interfaces to enable future innovation at the physical layer

Zak-OTFS

- ⦿ MC-OTFS submitted into 3GPP 5G in 2016
 - Proposal attempted to minimize changes to OFDM (using Symplectic Fourier Transform)
 - This **limited the performance advantages**
- ⦿ Zak-OTFS (Zak transform between *delay-Doppler* and *time*) shows significant performance advantages in doubly-spread channels
- ⦿ Academic study and acceptance of Zak-OTFS is well established

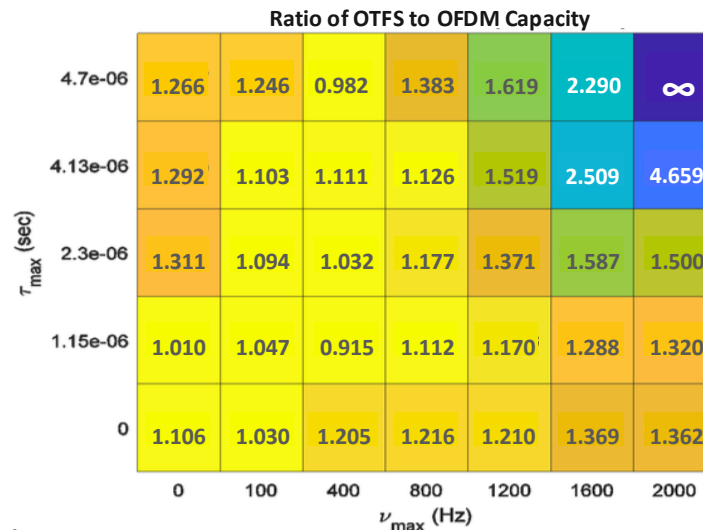
Multi-User Zak-OTFS Compatible with 5G Numerology

- Packet Scheduling is done in t - f with same PRB and TTI structure compatible with 5G upper layers
- Delay-Doppler parameters selected on a per-packet or user basis to support channel characteristics
- QAM symbols assigned in the d - D domain
- Signal Zak-transformed to the time domain and mapped onto the t - f grid
- 3GPP Compatibility - Seamless alignment with resource allocation numerology



Zak-OTFS Benefits Extend Beyond Raw Performance

- ⦿ Performance Advantages
 - In doubly spread channels
 - Spectrum Utilization – More efficient PRB packing
- ⦿ Architecture Flexibility
 - Packet-based parameterization optimized to user mobility and channel
 - TDMA-like mode (low PAPR) with less complexity than OFDM
- ⦿ New Use Cases / Spectrum
 - NTN, FR3, THz
 - AI (compact, predictable channel for training)



Conclusion for 6G

- ⦿ 3GPP *MUST* include new waveforms in the 6G study item
 - Anything less would be giving up on physical layer innovations
 - Zak-OTFS should be one of the waveforms studied
- ⦿ 3GPP *MUST* support a future-compatible open interface between the PHY/MAC and higher layers to enable continuous lower-layer innovation