# Reconciliation proposal for joint OFDM-SC 802.16a PHY

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Purpose:

To present a consolidated OFDM based PHY proposal for 802.16.3 TG3

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# Reconciliation proposal for joint OFDM-SC 802.16a PHY

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# Assumptions

- There’s general agreement that on DL the performance of OFDM and SC is very similar
- On UL, there’s an agreement that SC has an advantage in PA utilization, especially in low-level modulations (QPSK, OQPSK?)
- OFDMA provides advantages in terms of resource allocation flexibility, power concentration, wideband diversity and intercell interference

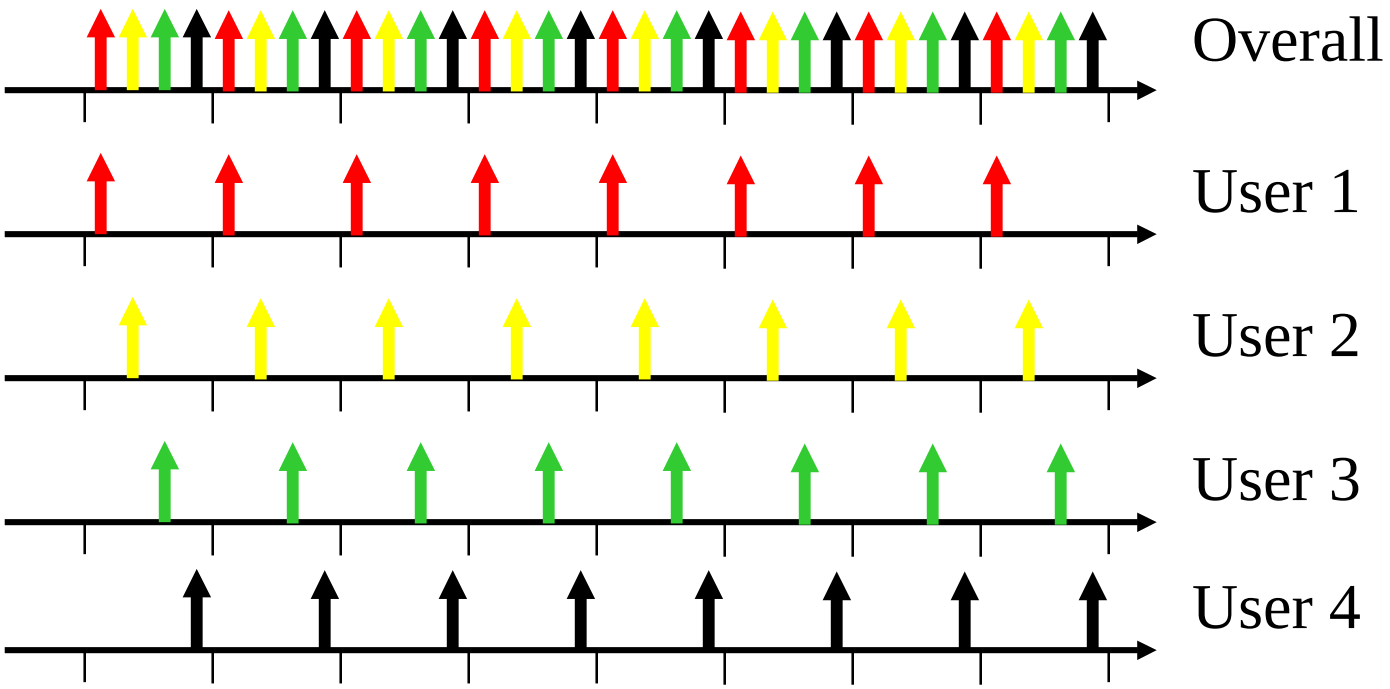
# Consolidation proposal

- OFDM/A Downlink
- Single Carrier & OFDM on UL.
  - I’ll address the mandatory/optional issue at the end
- Incorporation of the SC within an OFDMA scheme so that SC also enjoys
  - Wideband frequency diversity
  - Bandwidth allocation flexibility
  - Simultaneous coexistence with OFDMA uplinks

# OFDMA subcarrier allocation strategies discussion

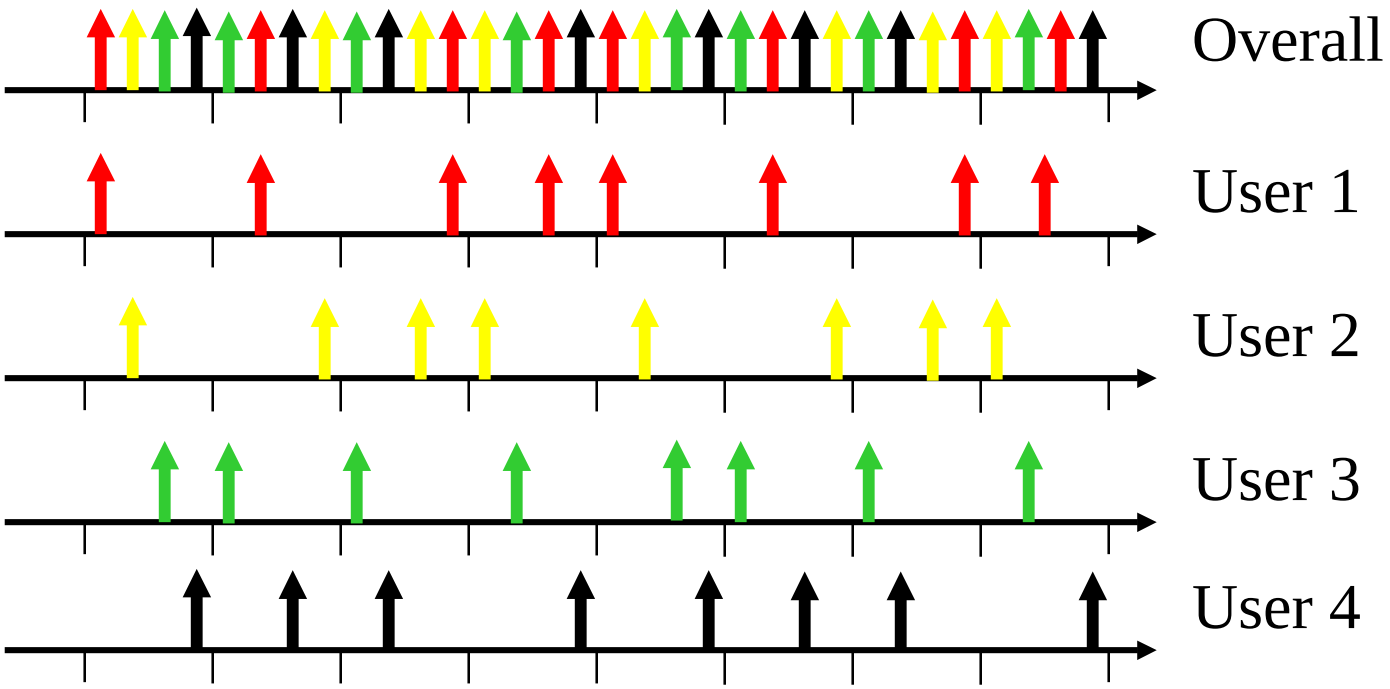
# Regularly interleaved subcarriers

- Enables simplified transmitter implementation
  - Repetition based



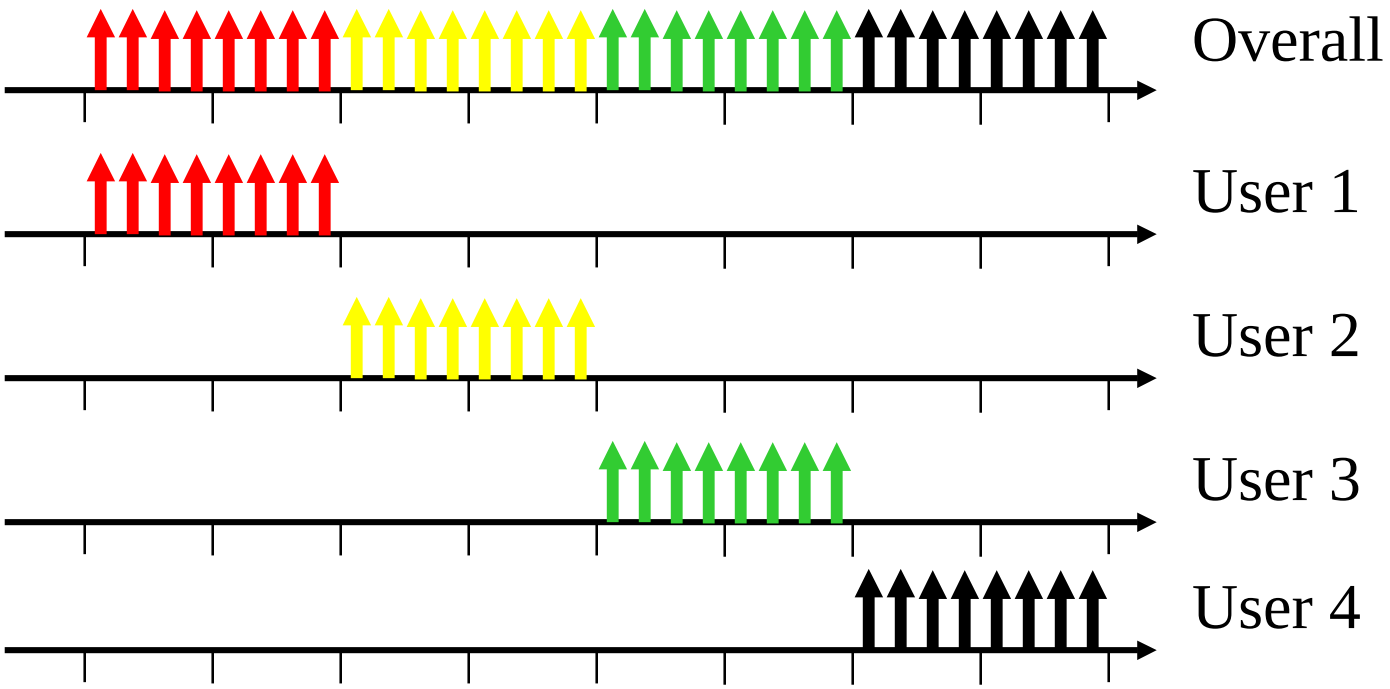
# Permuted location allocation

- Permutations vary from cell to cell
  - Changes the interference scenario from “channels collide” to “some of the subcarriers collide”



# Channelized (clustered) subcarrier allocations

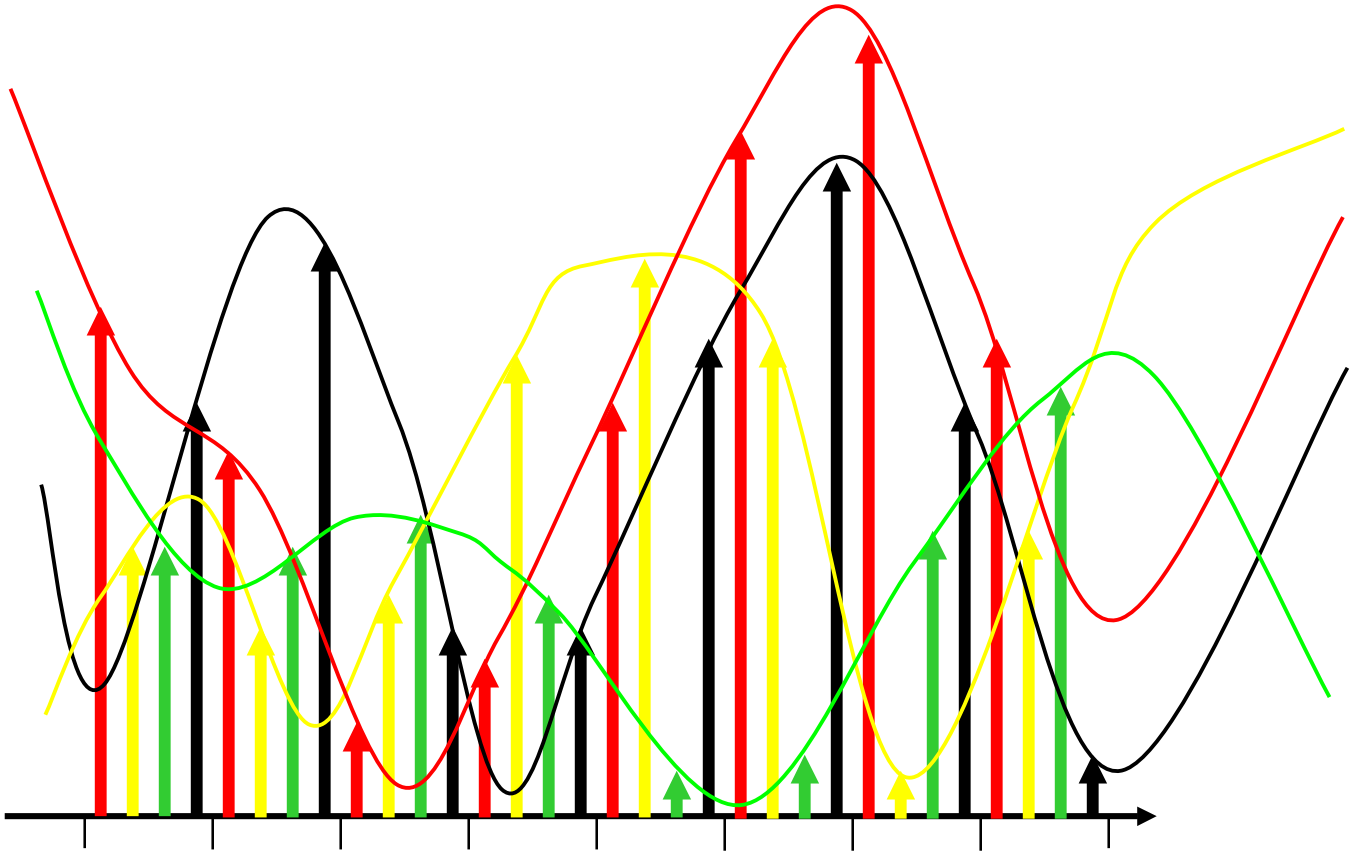
- Interference remains low with time shift
- Less multipath diversity due to spectral concentration



# Multipath effect on different subcarrier allocation strategies

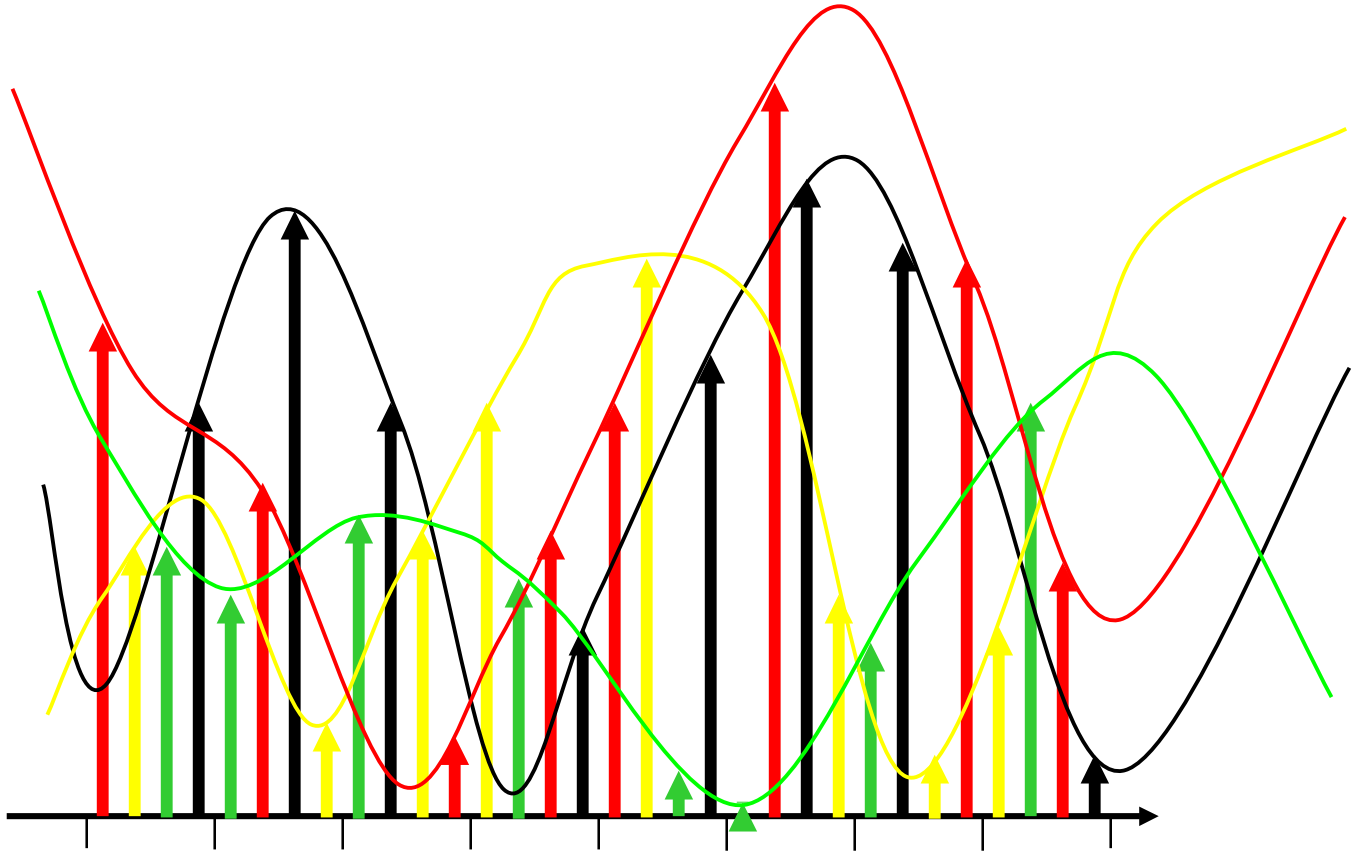
# Regularly interleaved subcarriers

- Enables simplified transmitter implementation
  - Repetition bases



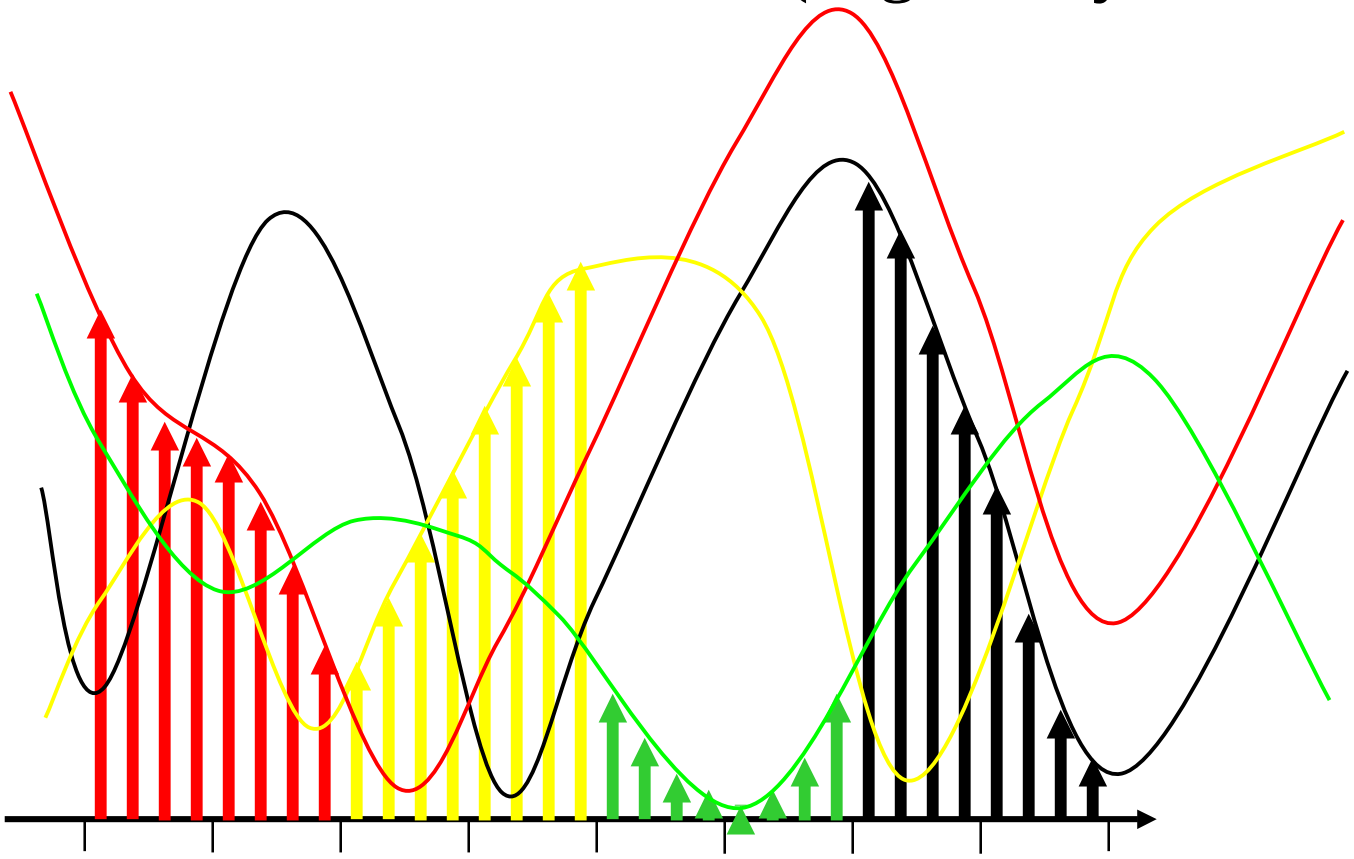
# Permuted location allocation

- Good inter-user interaction (few adjacent subcarrier)



# Channelized (clustered) subcarrier allocations

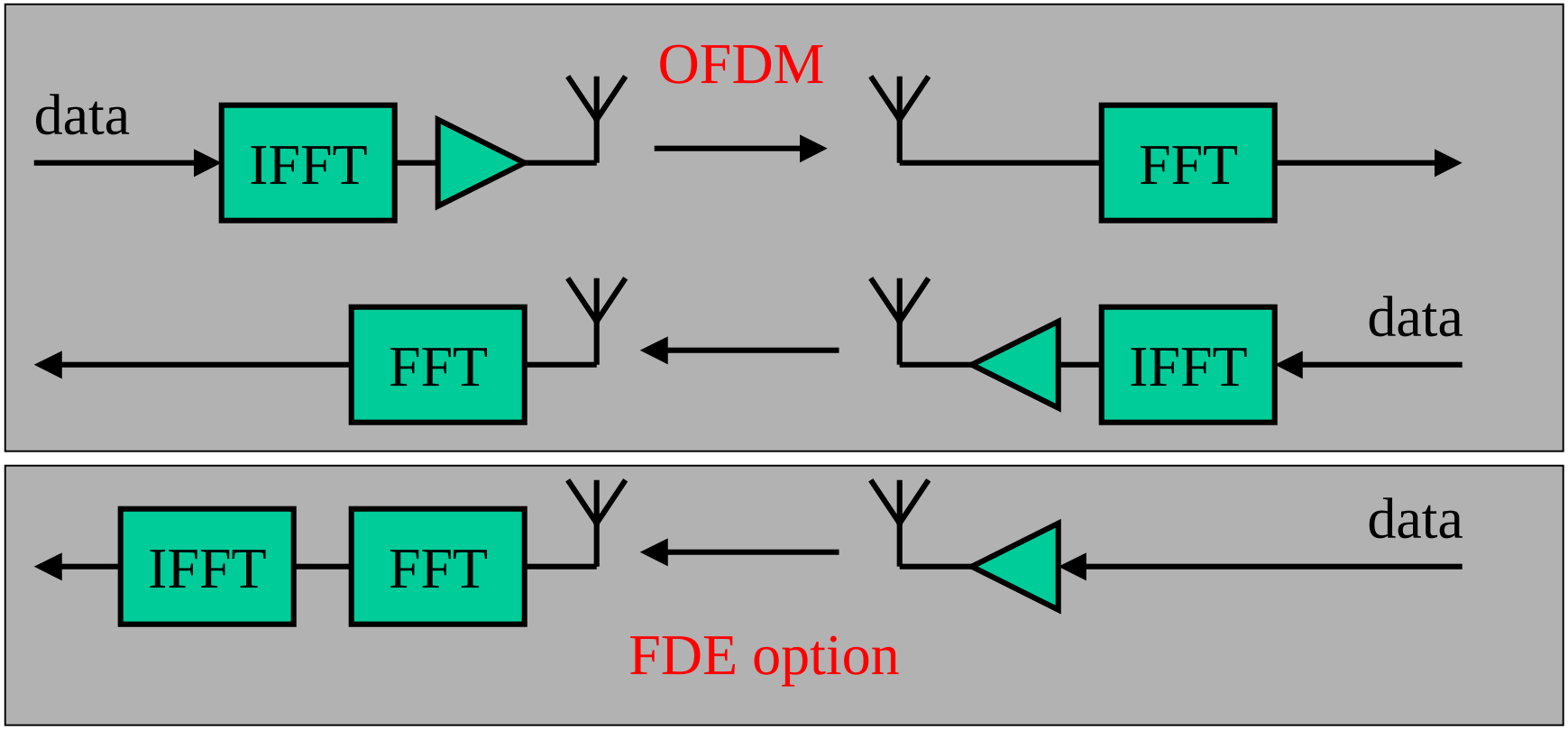
- Users have reduced multipath diversity
- Better inter-user interference (edges only interact)



# Capability to accommodate Single Carrier uplinks

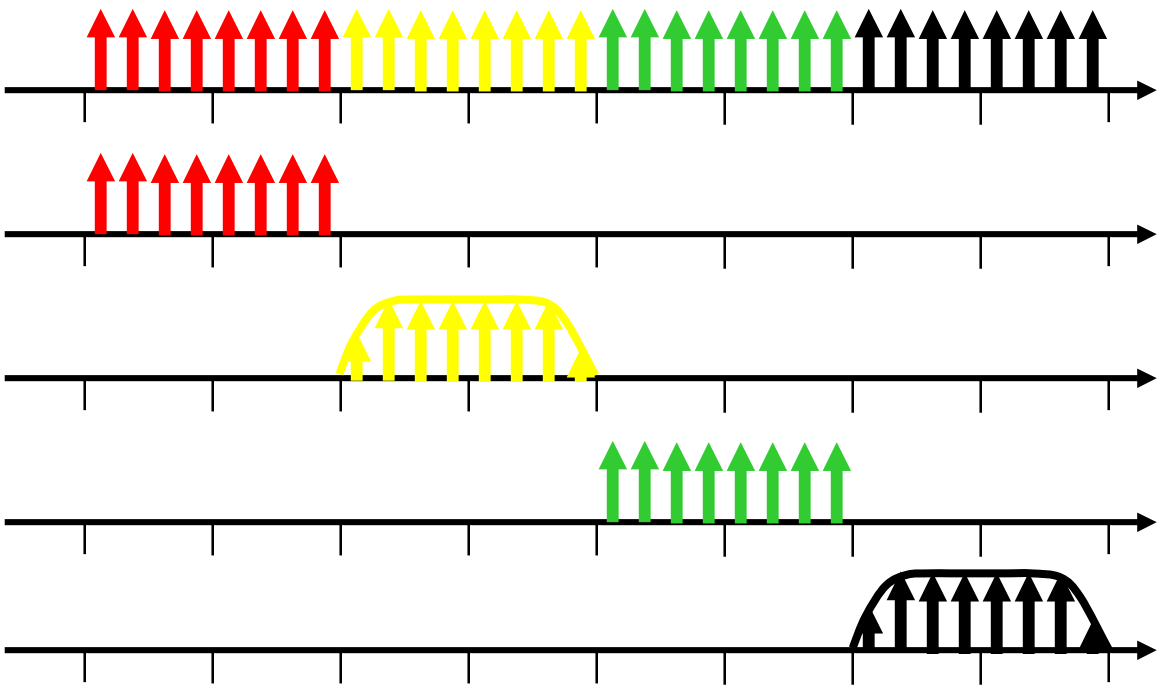
# Freq. Domain.Equ – do it on Uplink

- The CPEs have the most to gain at PA
- The processing burden is at BST
- Frees CPE chip manufacturers to work



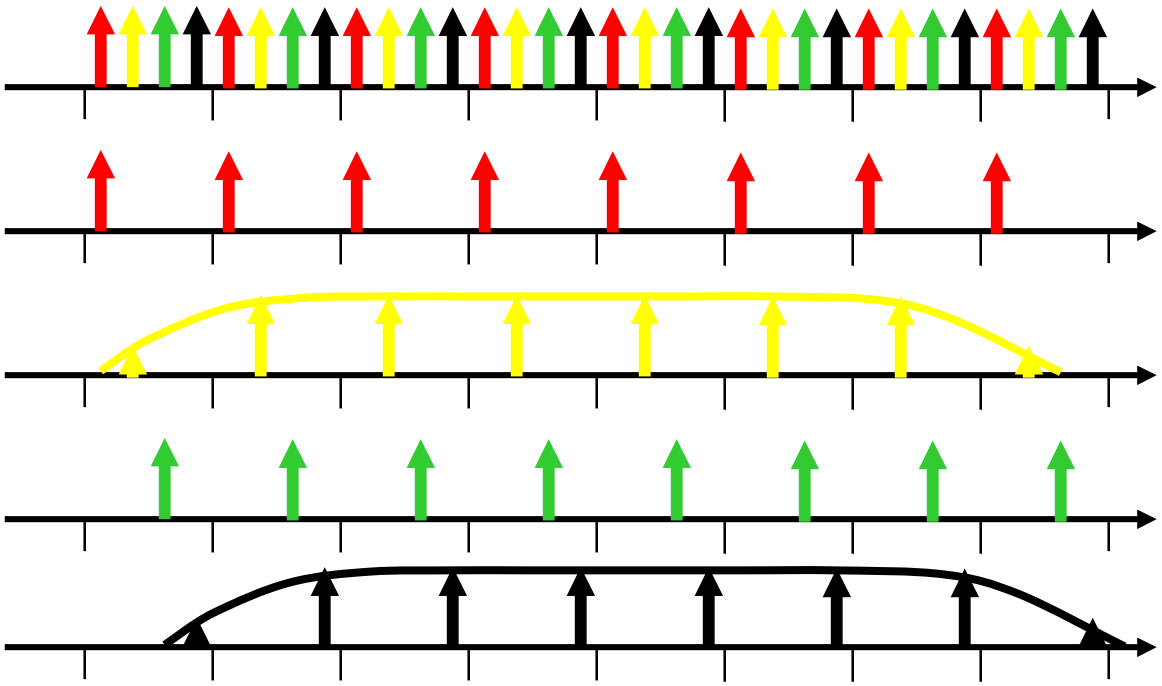
# Clustered subcarrier allocation

- Groups of subcarriers can be naturally replaced by SC signals

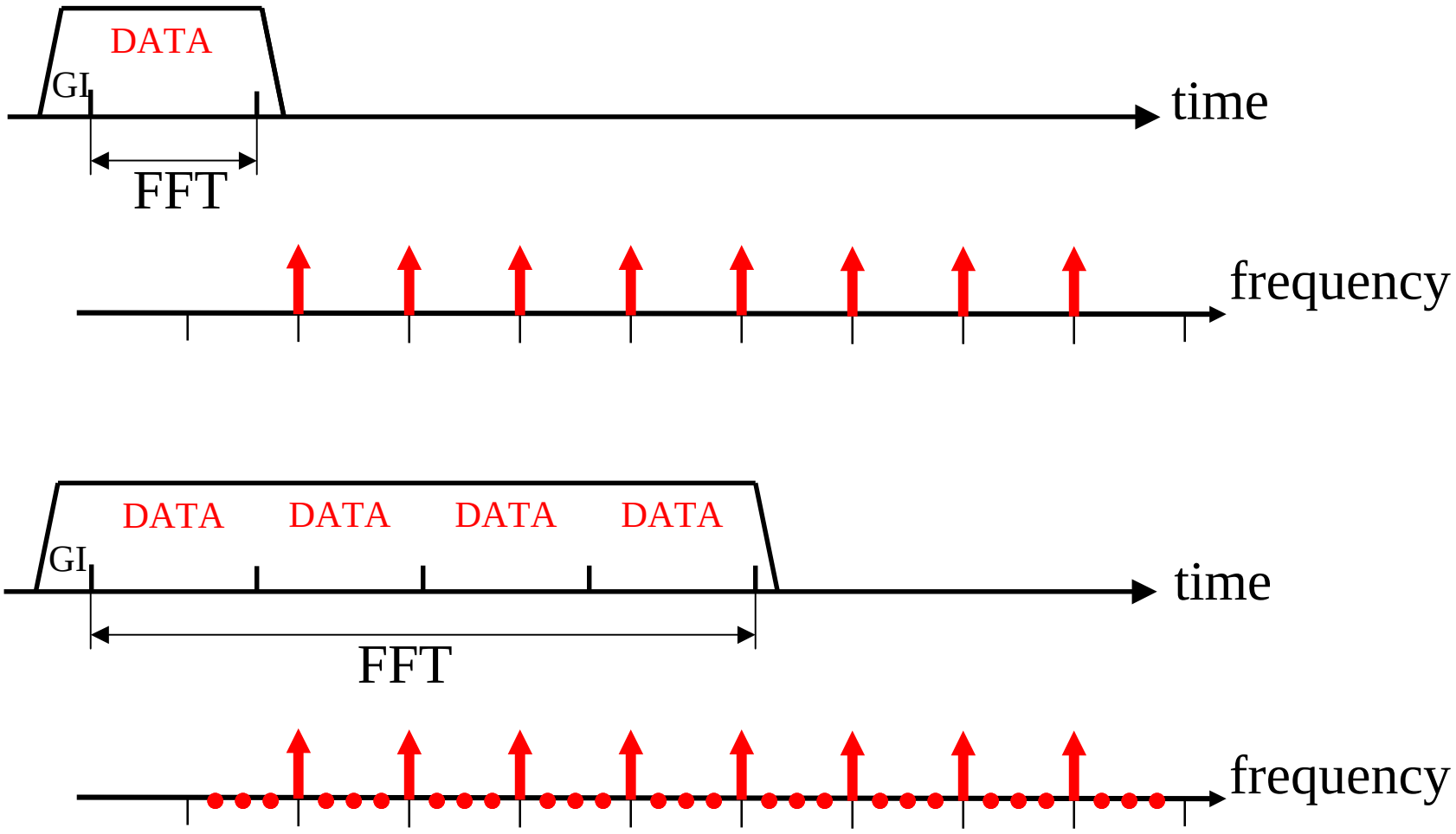


# Regularly interleaved subcarriers

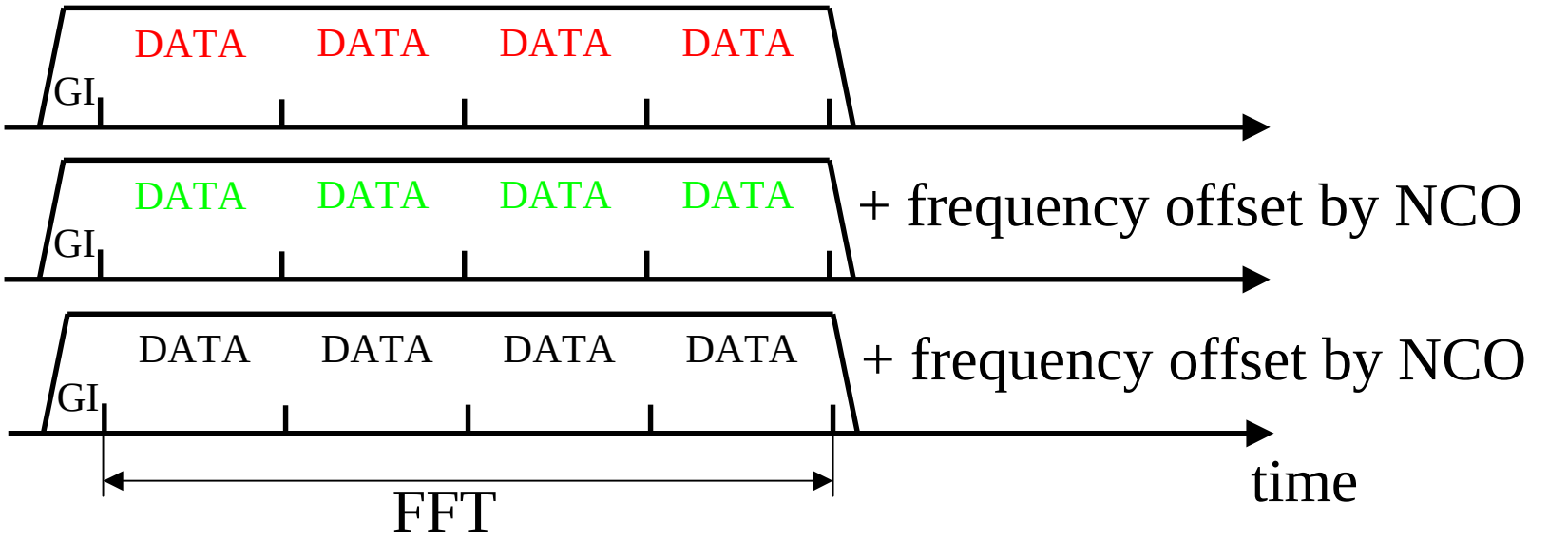
- Enables simplified transmitter implementation
  - Repetition based
  - **Provides Wideband diversity to SC**

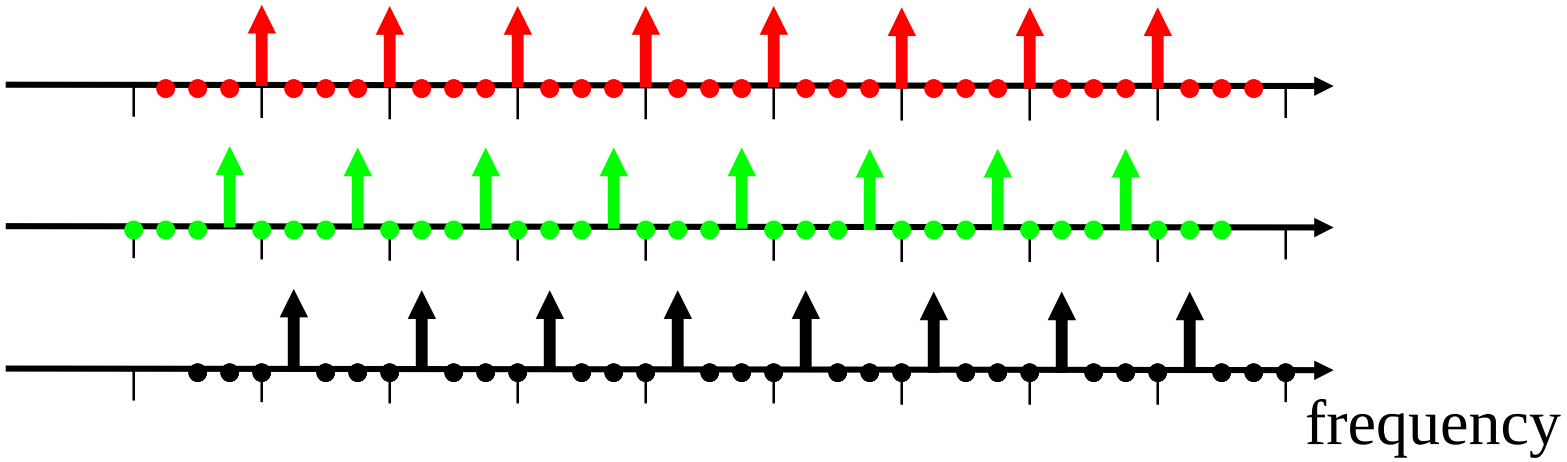


# Fitting SC in regularly spaced OFDMA



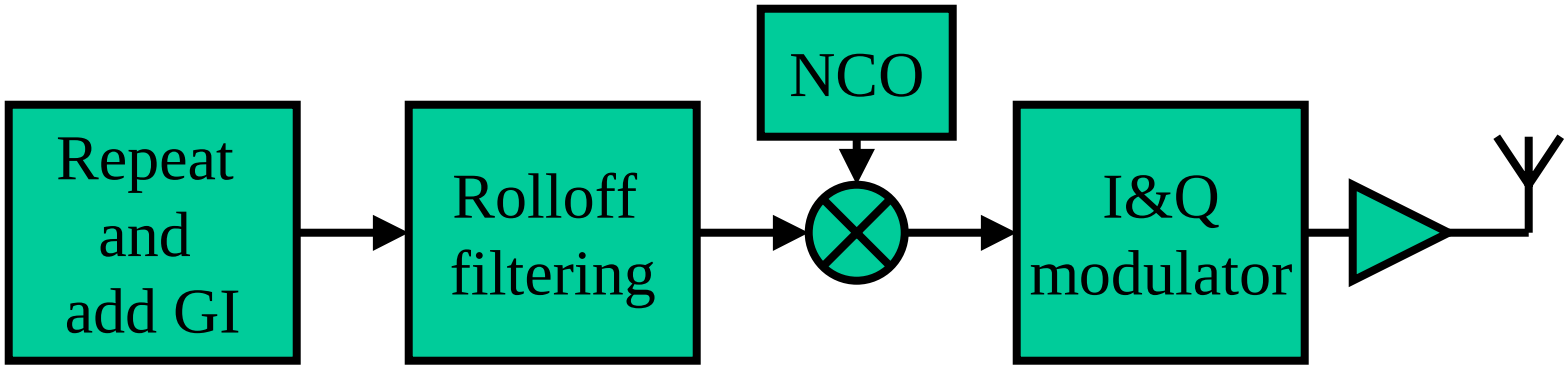
# Fitting SC in regularly spaced OFDMA



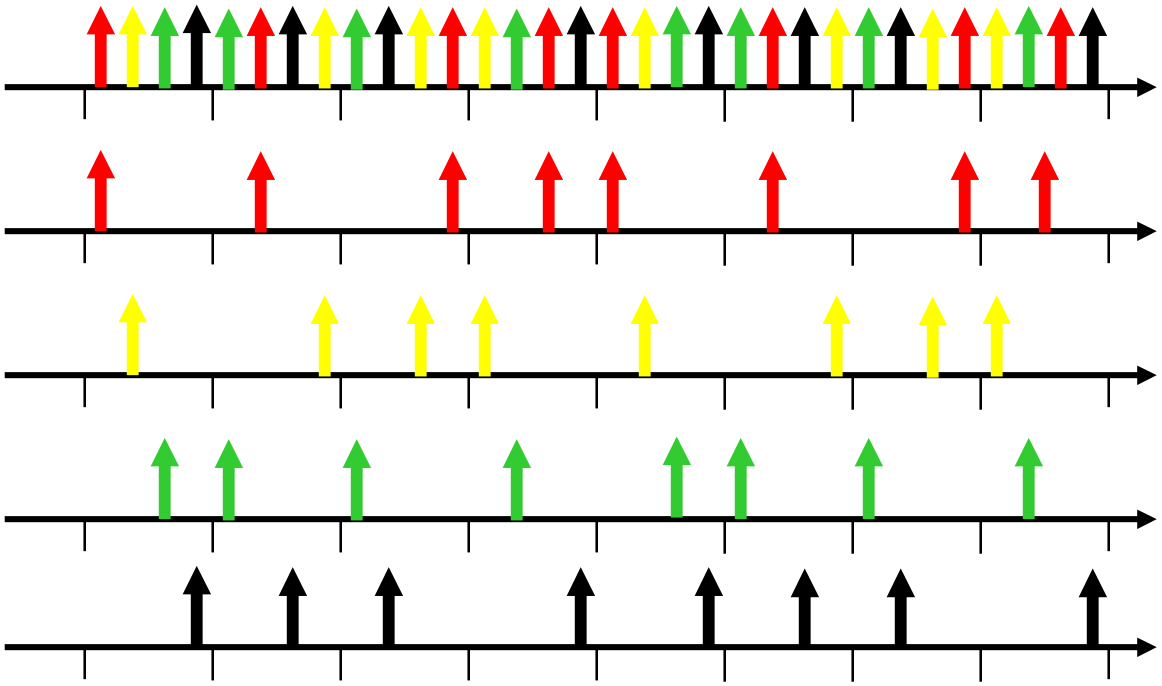
# SC in regularly spaced OFDMA-implementation

- The idea of multiple repetition to create a comb spectrum works also for Single Carrier piece of data.
- The signal can be shifted in frequency to the desired comb location for OFDMA multiplexing
- The PAPR properties of SC are preserved both for repetition and for frequency shifting



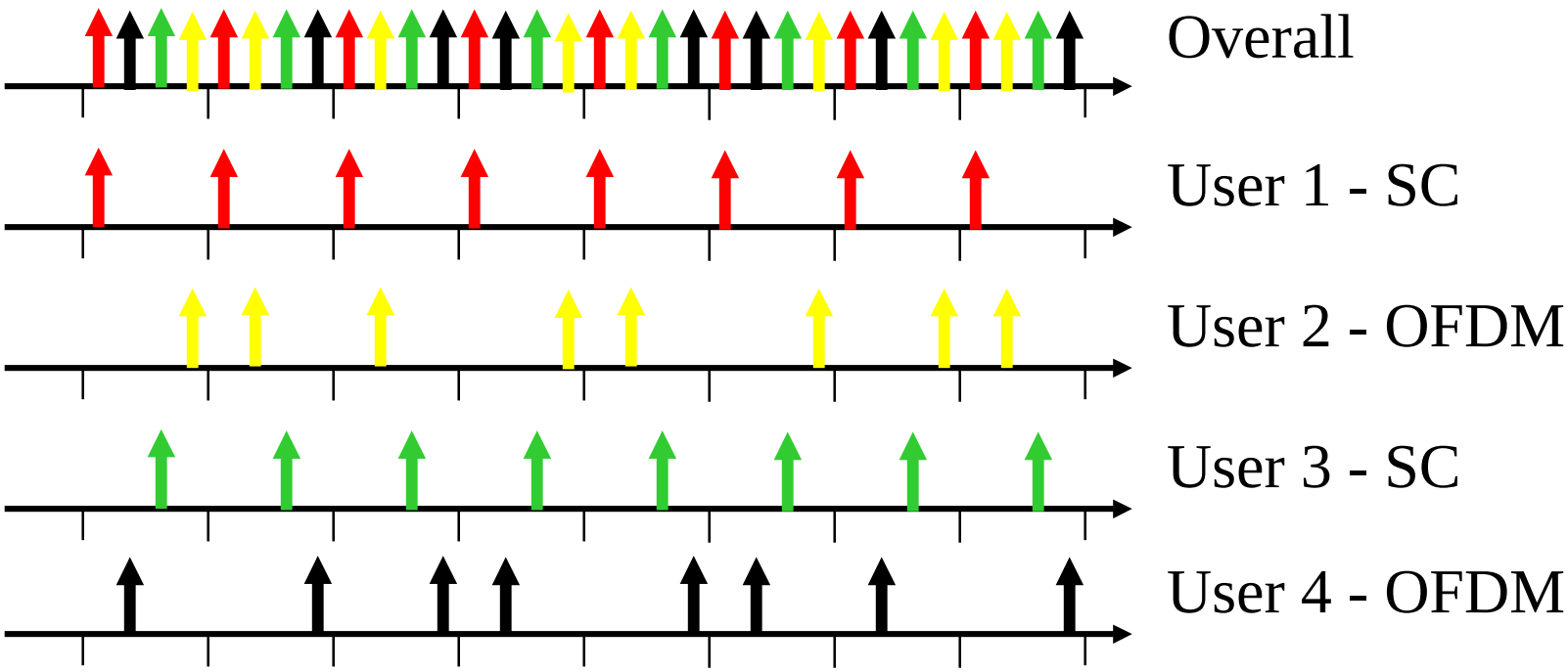
# SC and Permuted allocation

- We’re not aware of any way to combine SC within permuted subcarrier location scheme directly



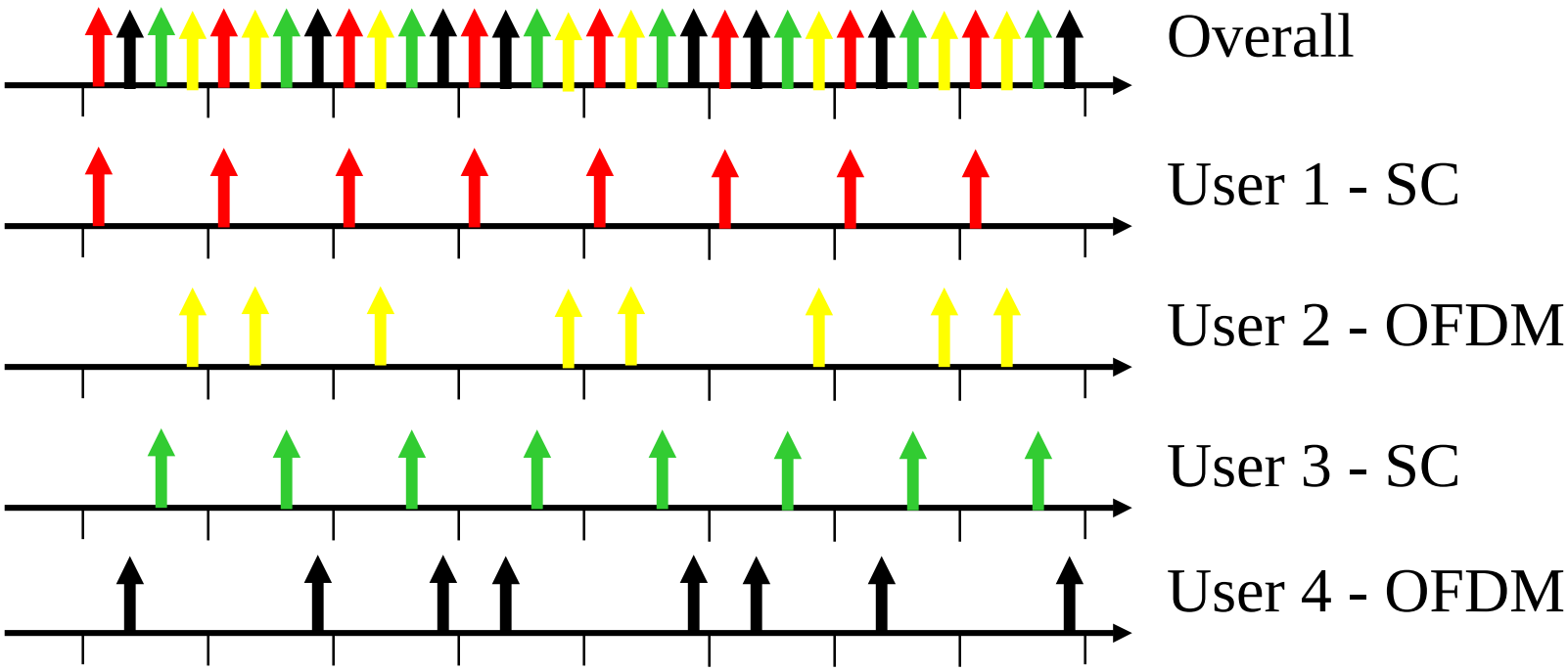
# Regular + Permuted allocation

- Create pool of regularly spaced subcarriers, and do permuted allocation over the rest
- E.g.: odd subcarriers SC, even – permuted OFDMA



# Regular+ Permuted allocation (2)

- ODD-EVEN allocation creates better SC-SC isolation
- SC enjoys reduced interference from permuted OFDMA



# Programmable subcarrier permutation solution

- Define a permutation function:

F(n): (0 .. N-1) → (0 .. N-1)

  - Each user is assigned a subrange ($n_1$ .. $n_2$)
  - Uses subcarriers ($F(n_1)$, $F(n_1+1)$, .. , $F(n_2)$)
- Different permutation can be assigned per BS
  - Supports Runcom's "partial overlap"
- May covers RunCOM mode, Intersil mode (bit reversal), Channelized mode (subranges), regularly interleaved mode.
- May cover combination of modes!!

# QAM or OQAM for SC mode??

- Raze's contribution advocates OQPSK in that it provides even higher PAPR advantage.
- In the past, OQAM was proposed for 802.11a [BreezeCOM, NEC] advocating same point – gain the most at OQPSK, improve at OQAM
- Processing in SC is probably anyway done at double rate, providing the samples and mid-samples – exactly what's needed for OQAM

# SUMMARY

- OFDM/A Downlink
- Single Carrier AND OFDM Uplink
- I’m willing to accept any precedence of mandatory/optional for the SC and OFDM/A

- Suggest that the group considers this way to move forward