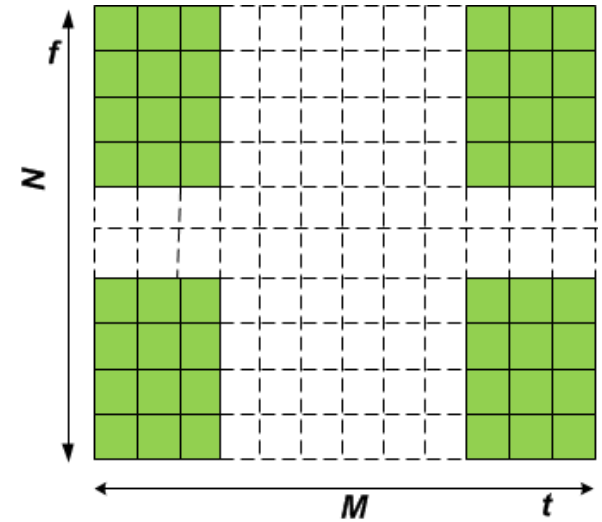


Resource Blocks for EPoC Considerations

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RB Size – Current Status in 802.3bn

- Size in number of symbols (M)
 - Configurable and TBD
- Size in number of subcarriers (N)
 - Three options are specified: 1,4,8
 - Configurable
- Pilot spacing
 - Configurable 1,2,4,8
- This presentation proposes values for the number of symbols and pilot patterns



- Data is written horizontally (subcarrier by subcarrier) and read vertically (symbol by symbol)
- Time interleaving of codewords

Number of OFDMA Symbols in a RB

- Considerations
 - To increase number of symbols
 - Performance with burst noise
 - Improves with longer interleaver
 - Pilots overhead
 - Pilots are transmitted on two symbols in the RB
 - Increasing the number of symbols reduces latency
 - To decrease number of symbols
 - Latency
 - Granularity overhead
 - Granularity overhead is a function of both number of symbols and number of subcarriers
 - For a specific number of subcarriers more symbols means higher overhead

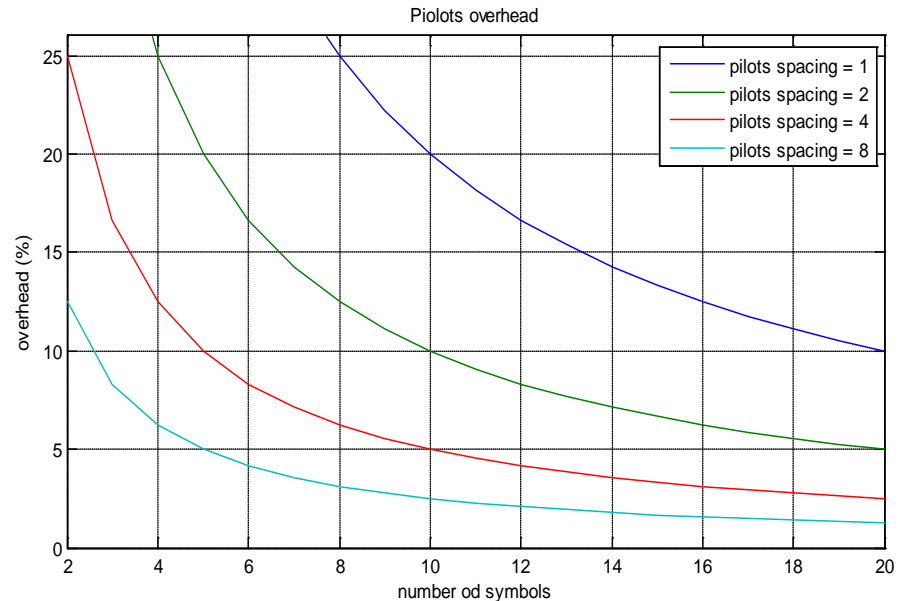
Performance with Burst Noise

- Table shows burst noise durations and levels to be considered
 - Assumed to represent worst case conditions in the upstream
- With simulated burst noise an Interleaver depth of 16 with 20uSec symbols and 11 with 40 uSec is required
- Corresponding Interleaver latency (CP size = 2.0 uSec) is 374 uSec and 462 uSec for 20u and 40u symbols

Burst noise	Duration (uSec)	SNR (dB)	Interleaver Depth (20uS symbols)	Interleaver Depth (40uS symbols)
Upstream	10	10	16	11
	1	0	16	8

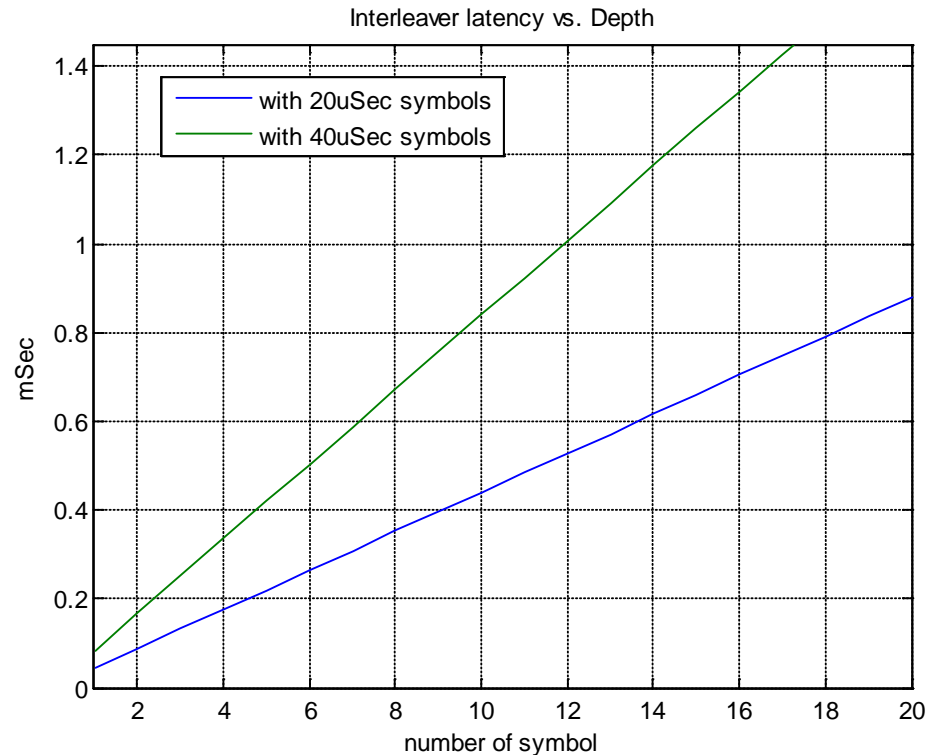
Overhead due to Pilots

- Assume pilots every 1,2,4 or 8 subcarriers with 20 uSec symbols
- Two pilots in a subcarrier with pilots to protect against burst noise
- Overhead vs. number of symbols equals $2/L$
 - L is the multiplication of the pilot spacing with the number of symbols
- With a pilots spacing of 8 subcarriers
 - Overhead with 8 symbols is 3.1%
 - Overhead with 12 symbols is 2%
 - Overhead with 16 symbols is 1.5%
 - Below 8 symbols overhead becomes significant, in particular with the more dense pilot patterns



Additional Latency due to Interleaver Depth

- Assume additional latency due to Interleaving is twice the Interleaver depth
- With 20 uSec symbols additional latency is:
 - ~ 350 uSec with 8 symbols
 - ~ 530 uSec with 12 symbols
 - ~ 750 uSec with 16 symbols

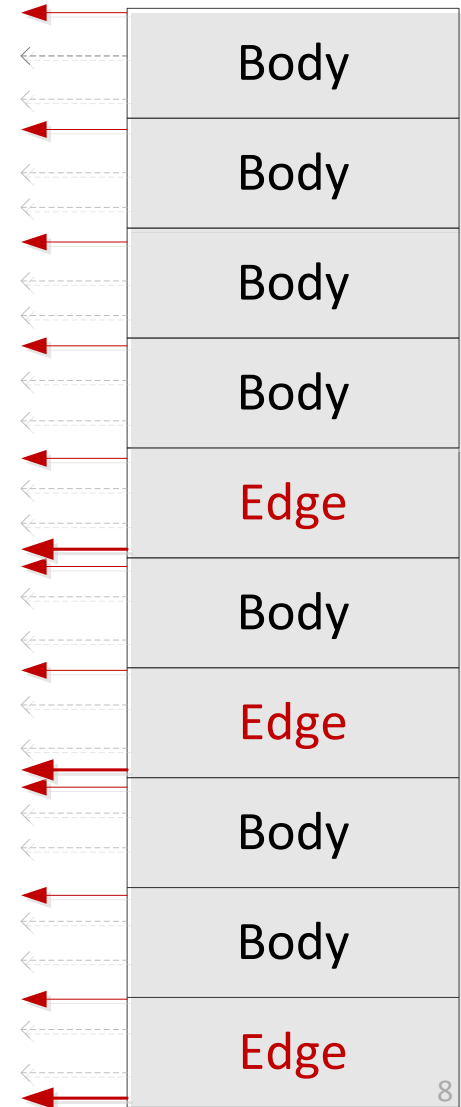


Proposal for Number of Symbols in a Resource Block

- Allow three configurable options for the number of symbols (M) in a Resource Block
- Allow operators to trade-off between latency/overhead and performance with burst noise propose
- M values with 20 uSec symbols
 - M= 8 for low latency, burst noise support is weak
 - M=16 to protect against high level/long burst noise
 - M=12 lower latency, burst noise support is mild
 - Protect well against lower level burst noise
- All RBs in an OFDMA channel must have the same number of symbols

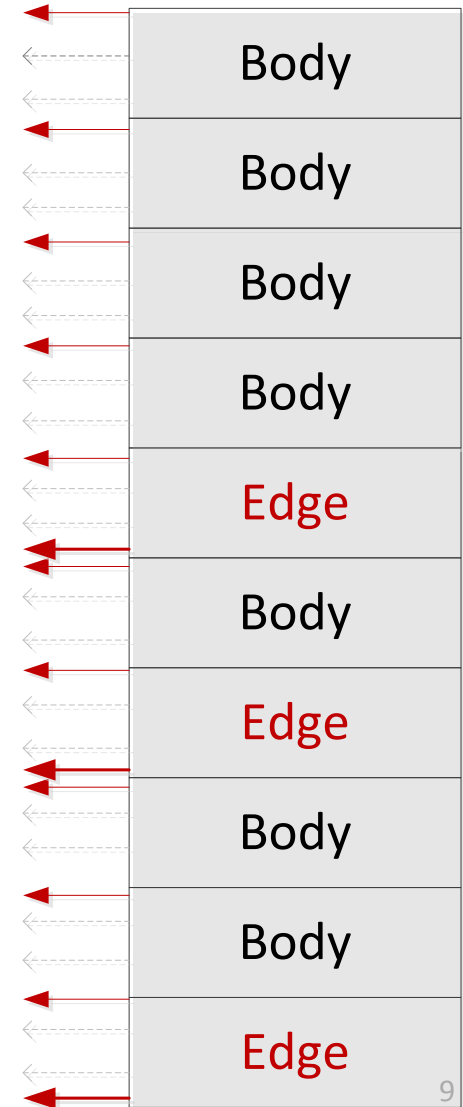
Pilot Patterns (1)

- Pilot patterns are defined for the different RB sizes
- Pilot spacing (per current decision)
 - Pilot every 1,2,4 or 8 subcarriers
 - Less patterns is possible with cost in overhead or in robustness to frequency response variations
- Use edge and body pilot patterns
 - To avoid extrapolation every burst starts with a pilot and ends with a pilot
 - Every RB after exclusion starts with a pilot
- Two pilots used on every subcarrier with pilots to protect against burst noise that hit a symbol with pilots

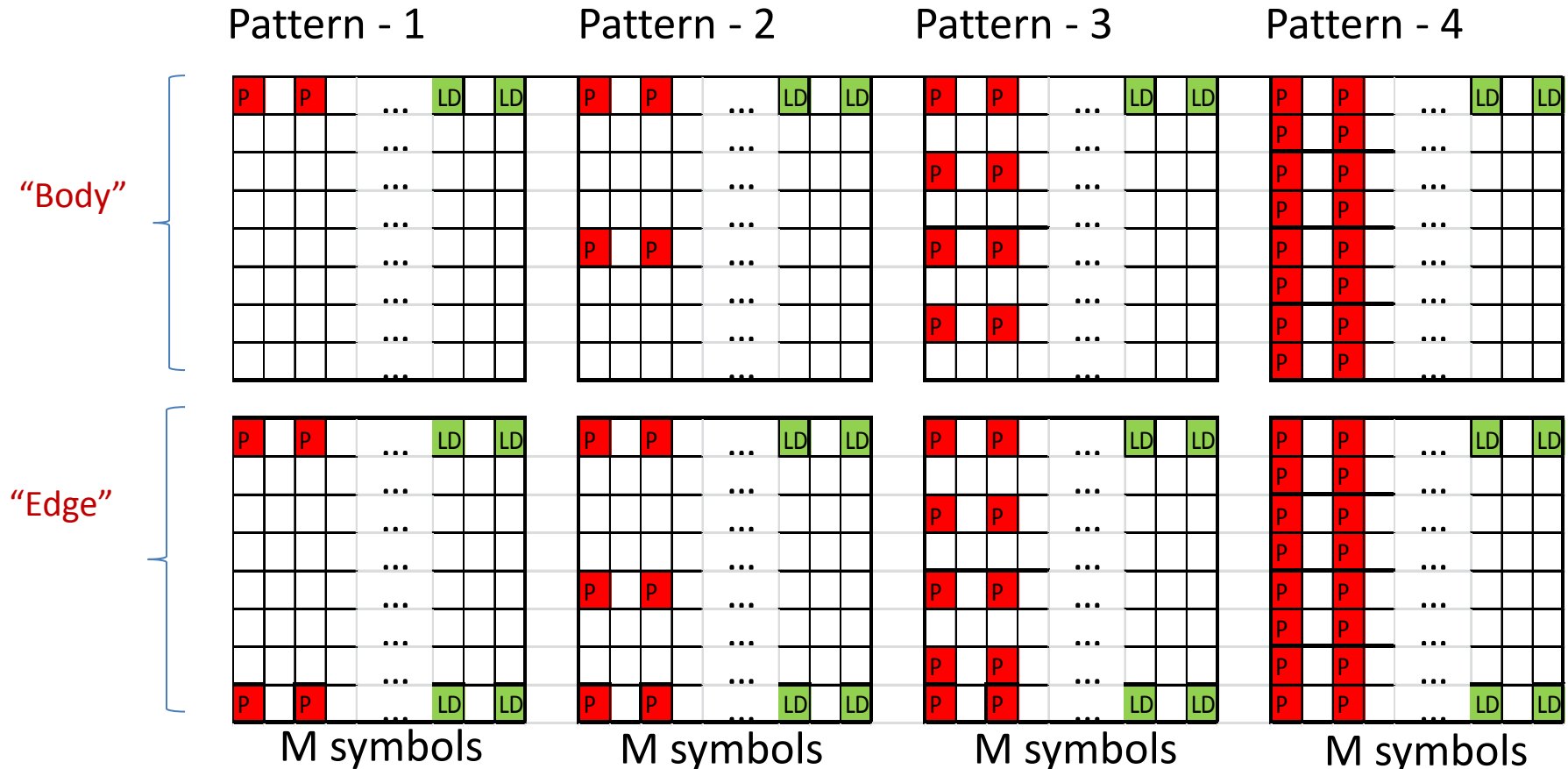


Pilot Patterns (2)

- Two pilots used on every subcarrier with pilots to protect against burst noise that hit a symbol with pilots
- Low density pilots are data REs with a lower order modulation
 - Can be used to improve initial frequency and phase correction



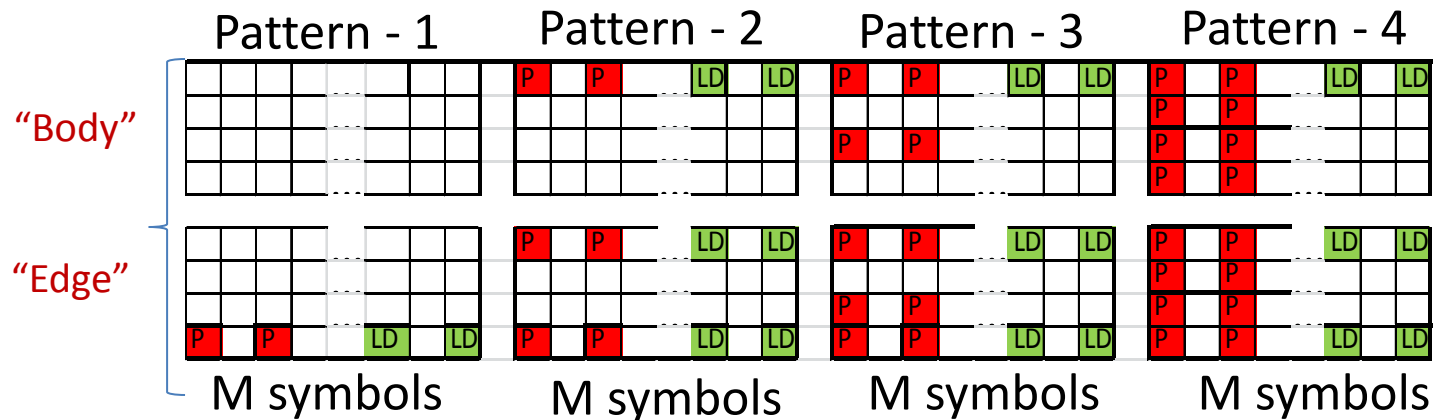
Pilot Patterns for 8-subcarrier RBs



- M can equal 8,12 or 16
- P – Pilots LD – Low Density pilots , blank RE for data

Pilot Patterns for 4-subcarrier RBs

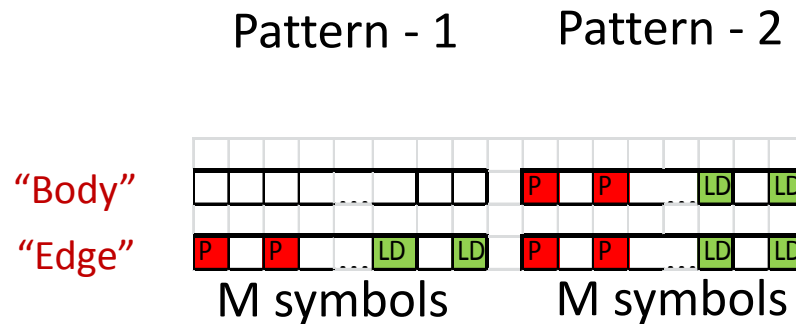
- Four pilot patterns are available



- M can equal 8,12 or 16
- P – Pilots LD – Low Density pilots , blank RE for data

Pilot Patterns for a single subcarrier RBs

- Two pilot patterns are available



- M can equal 8,12 or 16
- P – Pilots LD – Low Density pilots , blank RE for data

Proposed Motion (1)

Move to:

Specify three options for the number of symbols in a Resource Block: 8, 12 and 16

Moved:

Seconded:

Proposed Motion (2)

Move to:

Specify edge and body pilot patterns as described in slides 10-12 for EPoC FDD Upstream

Moved:

Seconded: