1 Inner/Outer simulations for FR1

These simulations provide MPR data for inner/outer resource block allocations for bandwidths from 20MHz and up to 100MHz. The inner/outer number of allocated PRBs (L_{crb}) are defined as follows:

1. Start with $RB_{start} = 0$
2. Start with $L_{crb} = 1$
3. Run simulation and check that MPR backoff needed is $\leq 1dB$
4. Increment L_{crb} until MPR backoff needed is $> 1dB$
5. Check that $L_{crb} < \frac{L_{max}}{2}$
6. Pick L_{crb} that satisfies both item number 3 and 5 for the given bandwidth.

Given these criterias in determining inner/outer allocations the following are the alloted values for the bandwidths.

Definition 1.1. Inner resource allocation An inner resource block allocation which satisfies equation 1

$$RB_{start} \geq \left\lfloor \frac{L_{crb}}{2} \right\rfloor \tag{1}$$

Table 1: Inner/outer number of PRBs (L_{crb}) and start values (RB_{start}).

Bandwidth [MHz]	**30kHz Subcarrier Spacing**		**60kHz Subcarrier Spacing**	
	Outer:	Inner:	Outer:	Inner:
20	24RB0	24RB12	12RB0	12RB6
25	24RB0	24RB12	15RB0	15RB7
40	30RB0	30RB15	20RB0	20RB10
50	40RB0	40RB20	24RB0	24RB12
60	40RB0	40RB20	24RB0	24RB12
80	45RB0	45RB22	25RB0	25RB12
100	75RB0	75RB37	30RB0	30RB15

1.1 20MHz Bandwidth

1.1.1 30kHz Subcarrier Spacing

Table 2: Outer allocation 24RB0

Precoding:	Modulation:	Back-off (dB):	Limitation:	Remark:
DFT-SPREAD	$\pi/2$-BPSK			
	QPSK	1	NR ACLR	
	QAM16	1.6	NR ACLR	
	QAM64	1.7	NR ACLR	
	QAM256	3.2	EVM	
CP-OFDM	$\pi/2$-BPSK	3.0	NR ACLR	
	QPSK	2.9	NR ACLR	
	QAM16	3.0	NR ACLR	
	QAM64	3.0	NR ACLR	
	QAM256	5.3	EVM	

Table 3: Inner allocation 24RB12

Precoding:	Modulation:	Back-off (dB):	Limitation:	Remark:
DFT-SPREAD	$\pi/2$-BPSK			
	QPSK			No backoff needed
	QAM16			No backoff needed
	QAM64	1.5	EVM	
	QAM256	3.6	EVM	
CP-OFDM	$\pi/2$-BPSK			
	QPSK	2.1	NR ACLR	
	QAM16	2.0	NR ACLR	
	QAM64	2.9	EVM	
	QAM256	4.2	EVM (4.2%)	Marginally lower with more back-off

1.1.2 60kHz Subcarrier Spacing

Table 4: Outer allocation 12RB0

Precoding:	Modulation:	Back-off (dB):	Limitation:	Remark:
DFT-SPREAD	$\pi/2$-BPSK			
	QPSK	1	NR ACLR	
	QAM16	1.1	NR ACLR	
	QAM64	1.3	NR ACLR	
	QAM256	3.4	EVM	
CP-OFDM	$\pi/2$-BPSK			
	QPSK	2.6	NR ACLR	
	QAM16	2.6	NR ACLR	
	QAM64	2.8	EVM	
	QAM256	5.7	EVM	

Table 5: Inner allocation 12RB6

Precoding:	Modulation:	Back-off (dB):	Limitation:	Remark:
DFT-SPREAD	$\pi/2$-BPSK			
	QPSK			No backoff needed
	QAM16			No backoff needed
	QAM64	1.3	EVM	
	QAM256	5.0	EVM (3.7%)	Does not get lower with more back-off
CP-OFDM	$\pi/2$-BPSK			
	QPSK	1.9	NR ACLR	
	QAM16	2.0	NR ACLR	
	QAM64	2.9	EVM	
	QAM256	6.1	EVM (4.26%)	Marginally lower with more back-off

1.2 25MHz Bandwidth

1.2.1 30kHz Subcarrier Spacing

Table 6: Outer allocation 24RB0

Precoding:	Modulation:	Back-off (dB):	Limitation:	Remark:
DFT-SPREAD	$\pi/2$-BPSK			
	QPSK	1		
	QAM16	1.6	NR ACLR	
	QAM64	1.7	NR ACLR	
	QAM256	3.2	EVM	
CP-OFDM	$\pi/2$-BPSK			
	QPSK	3.0	NR ACLR	
	QAM16	3.0	NR ACLR	
	QAM64	3.0	NR ACLR	
	QAM256	5.4	EVM	

Table 7: Inner allocation 24RB12

Precoding:	Modulation:	Back-off (dB):	Limitation:	Remark:
DFT-SPREAD	$\pi/2$-BPSK			
	QPSK			No backoff needed
	QAM16			No backoff needed
	QAM64	1.5	EVM	
	QAM256	3.6	EVM	
CP-OFDM	$\pi/2$-BPSK			
	QPSK	1.8	NR ACLR	
	QAM16	2.0	NR ACLR	
	QAM64	2.7	EVM	
	QAM256	6.0	EVM	

1.2.2 60kHz Subcarrier Spacing

Table 8: Outer allocation 15RB0

Precoding:	Modulation:	Back-off (dB):	Limitation:	Remark:
DFT-SPREAD	$\pi/2$-BPSK			
	QPSK	1	NR ACLR	
	QAM16	1.3	NR ACLR	
	QAM64	1.5	NR ACLR	
	QAM256	3.5	EVM	
CP-OFDM	$\pi/2$-BPSK			
	QPSK	2.9	NR ACLR	
	QAM16	2.9	NR ACLR	
	QAM64	2.9	NR ACLR	
	QAM256	5.6	EVM	

Table 9: Inner allocation 15RB7

Precoding:	Modulation:	Back-off (dB):	Limitation:	Remark:
DFT-SPREAD	$\pi/2$-BPSK			
	QPSK			No backoff needed
	QAM16			No backoff needed
	QAM64	1.5	EVM	
	QAM256	4.6	EVM (3.86%)	Marginally lower with more back-off
CP-OFDM	$\pi/2$-BPSK			
	QPSK	2.0	NR ACLR	
	QAM16	2.0	NR ACLR	
	QAM64	2.9	EVM	
	QAM256	6.1	EVM (3.96%)	Marginally lower with more back-off

1.3 40MHz Bandwidth

1.3.1 30kHz Subcarrier Spacing

Table 10: Outer allocation 30RB0

Precoding:	Modulation:	Back-off (dB):	Limitation:	Remark:
DFT-SPREAD	$\pi/2$-BPSK			
	QPSK	1	NR ACLR	
	QAM16	1.5	NR ACLR	
	QAM64	1.5	NR ACLR	
	QAM256	3.4	EVM	
CP-OFDM	$\pi/2$-BPSK			
	QPSK	3.0	NR ACLR	
	QAM16	3.0	NR ACLR	
	QAM64	3.1	NR ACLR	
	QAM256	5.4	EVM	

Table 11: Inner allocation 30RB15

Precoding:	Modulation:	Back-off (dB):	Limitation:	Remark:
DFT-SPREAD	$\pi/2$-BPSK			
	QPSK			No backoff needed
	QAM16			No backoff needed
	QAM64	1.3	EVM	
	QAM256	3.3	EVM	
CP-OFDM	$\pi/2$-BPSK			
	QPSK	2.0	NR ACLR	
	QAM16	2.1	NR ACLR	
	QAM64	2.8	EVM	
	QAM256	5.6	EVM	

1.3.2 60kHz Subcarrier Spacing

Table 12: Outer allocation 20RB0

Precoding:	Modulation:	Back-off (dB):	Limitation:	Remark:
DFT-SPREAD	$\pi/2$-BPSK			
	QPSK	1	NR ACLR	
	QAM16	1.3	NR ACLR	
	QAM64	1.5	NR ACLR	
	QAM256	3.5	EVM	
CP-OFDM	$\pi/2$-BPSK			
	QPSK	3.0	NR ACLR	
	QAM16	3.0	NR ACLR	
	QAM64	3.1	NR ACLR	
	QAM256	5.3	EVM	

Table 13: Inner allocation 20RB10

Precoding:	Modulation:	Back-off (dB):	Limitation:	Remark:
DFT-SPREAD	$\pi/2$-BPSK			
	QPSK			No backoff needed
	QAM16			No backoff needed
	QAM64	1.3	EVM	
	QAM256	4.4	EVM	
CP-OFDM	$\pi/2$-BPSK			
	QPSK	1.8	NR ACLR	
	QAM16	1.7	NR ACLR	
	QAM64	2.9	EVM	
	QAM256	6.1	EVM (3.78%)	Marginally lower with more back-off

1.4 50MHz Bandwidth

1.4.1 30kHz Subcarrier Spacing

Table 14: Outer allocation 40RB0

Precoding:	Modulation:	Back-off (dB):	Limitation:	Remark:
DFT-SPREAD	$\pi/2$-BPSK			
	QPSK	1	NR ACLR	
	QAM16	1.4	NR ACLR	
	QAM64	1.5	NR ACLR	
	QAM256	3.5	EVM	
CP-OFDM	$\pi/2$-BPSK			
	QPSK	3.0	NR ACLR	
	QAM16	3.0	NR ACLR	
	QAM64	3.0	NR ACLR	
	QAM256	5.3	EVM	

Table 15: Inner allocation 40RB20

Precoding:	Modulation:	Back-off (dB):	Limitation:	Remark:
DFT-SPREAD	$\pi/2$-BPSK			
	QPSK			No backoff needed
	QAM16			No backoff needed
	QAM64	1.3	EVM	
	QAM256	3.4	EVM	
CP-OFDM	$\pi/2$-BPSK			
	QPSK	2.0	NR ACLR	
	QAM16	2.0	NR ACLR	
	QAM64	2.9	EVM	
	QAM256	5.6	EVM	

1.4.2 60kHz Subcarrier Spacing

Table 16: Outer allocation 24RB0

Precoding:	Modulation:	Back-off (dB):	Limitation:	Remark:
DFT-SPREAD	$\pi/2$-BPSK			
	QPSK	1	NR ACLR	
	QAM16	1.7	NR ACLR	
	QAM64	1.8	NR ACLR	
	QAM256	3.2	EVM	
CP-OFDM	$\pi/2$-BPSK			
	QPSK	3.0	NR ACLR	
	QAM16	3.0	NR ACLR	
	QAM64	3.0	NR ACLR	
	QAM256	5.6	EVM	

Table 17: Inner allocation 24RB12

Precoding:	Modulation:	Back-off (dB):	Limitation:	Remark:
DFT-SPREAD	$\pi/2$-BPSK			
	QPSK			No backoff needed
	QAM16			No backoff needed
	QAM64	1.5	EVM	
	QAM256	3.6	EVM	
CP-OFDM	$\pi/2$-BPSK			
	QPSK	1.8	NR ACLR	
	QAM16	1.9	NR ACLR	
	QAM64	2.7	EVM	
	QAM256	5.6	EVM	

1.5 60MHz Bandwidth

1.5.1 30kHz Subcarrier Spacing

Table 18: Outer allocation 40RB0

Precoding:	Modulation:	Back-off (dB):	Limitation:	Remark:
DFT-SPREAD	$\pi/2$-BPSK			
	QPSK	1	NR ACLR	
	QAM16	1.3	NR ACLR	
	QAM64	1.6	NR ACLR	
	QAM256	3.5	EVM	
CP-OFDM	$\pi/2$-BPSK			
	QPSK	3.1	NR ACLR	
	QAM16	3.1	NR ACLR	
	QAM64	3.1	NR ACLR	
	QAM256	5.5	EVM	

Table 19: Inner allocation 15RB7

Precoding:	Modulation:	Back-off (dB):	Limitation:	Remark:
DFT-SPREAD	$\pi/2$-BPSK			
	QPSK			No backoff needed
	QAM16			No backoff needed
	QAM64	1.3	EVM	
	QAM256	3.5	EVM	
CP-OFDM	$\pi/2$-BPSK			
	QPSK	2.1	NR ACLR	
	QAM16	2.2	NR ACLR	
	QAM64	2.8	EVM	
	QAM256	5.4	EVM	

1.5.2 60kHz Subcarrier Spacing

Table 20: Outer allocation 24RB0

Precoding:	Modulation:	Back-off (dB):	Limitation:	Remark:
DFT-SPREAD	$\pi/2$-BPSK			
	QPSK	1	NR ACLR	
	QAM16	1.6	NR ACLR	
	QAM64	1.8	NR ACLR	
	QAM256	3.1	EVM	
CP-OFDM	$\pi/2$-BPSK			
	QPSK	2.9	NR ACLR	
	QAM16	3.0	NR ACLR	
	QAM64	3.0	NR ACLR	
	QAM256	5.1	EVM	

Table 21: Inner allocation 24RB12

Precoding:	Modulation:	Back-off (dB):	Limitation:	Remark:
DFT-SPREAD	$\pi/2$-BPSK			
	QPSK			No backoff needed
	QAM16			No backoff needed
	QAM64	1.5	EVM	
	QAM256	3.2	EVM	
CP-OFDM	$\pi/2$-BPSK			
	QPSK	1.9	NR ACLR	
	QAM16	1.9	NR ACLR	
	QAM64	2.7	EVM	
	QAM256	5.3	EVM	

1.6 80MHz Bandwidth

1.6.1 30kHz Subcarrier Spacing

Table 22: Outer allocation 45RB0

Precoding:	Modulation:	Back-off (dB):	Limitation:	Remark:
DFT-SPREAD	$\pi/2$-BPSK			
	QPSK	1	NR ACLR	
	QAM16	1.6	NR ACLR	
	QAM64	1.6	NR ACLR	
	QAM256	3.2	EVM	
CP-OFDM	$\pi/2$-BPSK			
	QPSK	3.0	NR ACLR	
	QAM16	3.0	NR ACLR	
	QAM64	3.0	NR ACLR	
	QAM256	5.5	EVM	

Table 23: Inner allocation 45RB22

Precoding:	Modulation:	Back-off (dB):	Limitation:	Remark:
DFT-SPREAD	$\pi/2$-BPSK			
	QPSK			No backoff needed
	QAM16			No backoff needed
	QAM64	1.4	EVM	
	QAM256	3.3	EVM	
CP-OFDM	$\pi/2$-BPSK			
	QPSK	2.1	NR ACLR	
	QAM16	2.1	NR ACLR	
	QAM64	2.9	EVM	
	QAM256	5.5	EVM	

1.6.2 60kHz Subcarrier Spacing

Table 24: Outer allocation 25RB0

Precoding:	Modulation:	Back-off (dB):	Limitation:	Remark:
DFT-SPREAD	$\pi/2$-BPSK			
	QPSK	1	NR ACLR	
	QAM16	1.5	NR ACLR	
	QAM64	1.8	NR ACLR	
	QAM256	3.2	EVM	
CP-OFDM	$\pi/2$-BPSK			
	QPSK	3.0	NR ACLR	
	QAM16	3.0	NR ACLR	
	QAM64	3.0	NR ACLR	
	QAM256	5.2	EVM	

Table 25: Inner allocation 25RB12

Precoding:	Modulation:	Back-off (dB):	Limitation:	Remark:
DFT-SPREAD	$\pi/2$-BPSK			
	QPSK			No backoff needed
	QAM16	0.3	NR ACLR	
	QAM64	1.6	EVM	
	QAM256	3.2	EVM	
CP-OFDM	$\pi/2$-BPSK			
	QPSK	2.0	NR ACLR	
	QAM16	2.0	NR ACLR	
	QAM64	2.8	EVM	
	QAM256	5.2	EVM	

1.7 100MHz Bandwidth

1.7.1 30kHz Subcarrier Spacing

Table 26: Outer allocation 75RB0

Precoding:	Modulation:	Back-off (dB):	Limitation:	Remark:
DFT-SPREAD	$\pi/2$-BPSK			
	QPSK	1	NR ACLR	
	QAM16	1.6	NR ACLR	
	QAM64	1.7	NR ACLR	
	QAM256	4.0	EVM	
CP-OFDM	$\pi/2$-BPSK			
	QPSK	2.9	NR ACLR	
	QAM16	2.9	NR ACLR	
	QAM64	3.4	EVM	
	QAM256	6.2	EVM (3.88%)	Marginally lower with more back-off

Table 27: Inner allocation 75RB37

Precoding:	Modulation:	Back-off (dB):	Limitation:	Remark:
DFT-SPREAD	$\pi/2$-BPSK			
	QPSK			No backoff needed
	QAM16	0.3	NR ACLR	
	QAM64	1.6	EVM	
	QAM256	3.3	EVM	
CP-OFDM	$\pi/2$-BPSK			
	QPSK	2.0	NR ACLR	
	QAM16	2.1	NR ACLR	
	QAM64	3.0	EVM	
	QAM256	5.7	EVM	

1.7.2 60kHz Subcarrier Spacing

Table 28: Outer allocation 30RB0

Precoding:	Modulation:	Back-off (dB):	Limitation:	Remark:
DFT-SPREAD	$\pi/2$-BPSK			
	QPSK	1	NR ACLR	
	QAM16	1.4	NR ACLR	
	QAM64	1.6	NR ACLR	
	QAM256	3.3	EVM	
CP-OFDM	$\pi/2$-BPSK			
	QPSK	3.1	NR ACLR	
	QAM16	3.4	NR ACLR	
	QAM64	3.4	NR ACLR	
	QAM256	5.8	EVM	

Table 29: Inner allocation 30RB15

Precoding:	Modulation:	Back-off (dB):	Limitation:	Remark:
DFT-SPREAD	$\pi/2$-BPSK			
	QPSK			No backoff needed
	QAM16			No backoff needed
	QAM64	1.3	EVM	
	QAM256	3.5	EVM	
CP-OFDM	$\pi/2$-BPSK			
	QPSK	1.9	NR ACLR	
	QAM16	1.9	NR ACLR	
	QAM64	2.9	EVM	
	QAM256	5.3	EVM	