

Sample Rates in OFDM PHY

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None.

Purpose:

Demonstrate Effect of Changes of Rounding Fs on the Number of Samples and PS per Second and Per Frame.

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Truncation of Fs to 8 kHz Causes problems with the number of PS per frame.

David Castelow
Airspan Communications

The following slides illustrate the cases of no truncation, truncation to 8 kHz and to 32 kHz respectively.

Orange coloured cells are non-integer. A good combination has no orange cells.

This presentation supports Comments 414 (Jon Labs) and 464 (Don Leimer) and modifications made during the meeting.

There are no additional problems in the bandwidths > 12 MHz (not shown in the slides): the recommended changes work just as well in these cases.

Truncation to 8 kHz

	User Editable Fields in Blue	Bandwidth (MHz)										
Bandwidth (MHz)	Coloured fields are non-integer	1.5	1.75	2.5	3	3.5	5	6	7	10	10	12
Channel Type		licensed	licensed	licensed	licensed	licensed	licensed	licensed	licensed	licensed	unlicensed	licensed
Nused (subcarriers)		192	192	192	192	192	192	192	192	192	192	192
n (sampling factor)		7/6	8/7	7/6	7/6	8/7	7/6	7/6	8/7	7/6	8/7	7/6
Nfft	Trunct 8	256	256	256	256	256	256	256	256	256	256	256
Fs (sampling frequency) (MHz)		6.8125	7.8125	11.375	13.65625	15.625	22.78125	27.34375	31.25	45.5625	44.625	54.6875
Tb (useful symbol time) (us)		1.74	2.00	2.91	3.50	4.00	5.83	7.00	8.00	11.66	11.42	14.00
Sample time (us)		146.789	128.000	87.912	73.227	64.000	43.896	36.571	32.000	21.948	22.409	18.286
		0.573	0.500	0.343	0.286	0.250	0.171	0.143	0.125	0.086	0.088	0.071

Bandwidth (MHz)			1.5	1.75	2.5	3	3.5	5	6	7	10	10	12
Channel Type			licensed	licensed	licensed	licensed	licensed	licensed	licensed	licensed	licensed	unlicensed	licensed
Samples per Second			1744000	2000000	2912000	3496000	4000000	5832000	7000000	Samples per Second			
PS per Second			436000	500000	728000	874000	1000000	1458000	1750000	2000000	2916000	2856000	3500000
	FPS	msec	Samples per Frame										
Samples per Frame, 2.5 ms frame	400	2.5	4360	5000	7280	8740	10000	14580	17500	20000	29160	28560	35000
Samples per Frame, 4 ms frame	250	4	6976	8000	11648	13984	16000	23328	28000	32000	46656	45696	56000
Samples per Frame, 5 ms frame	200	5	8720	10000	14560	17480	20000	29160	35000	40000	58320	57120	70000
Samples per Frame, 8 ms frame	125	8	13952	16000	23296	27968	32000	46656	56000	64000	93312	91392	112000
Samples per Frame, 10 ms frame	100	10	17440	20000	29120	34960	40000	58320	70000	80000	116640	114240	140000
Samples per Frame, 15.625 ms frame	64	15.625	27250	31250	45500	54625	62500	91125	109375	125000	182250	178500	218750
Samples per Frame, 20 ms frame	50	20	34880	40000	58240	69920	80000	116640	140000	160000	233280	228480	280000
	FPS	msec	PS per Frame										
PS per Frame, 2.5 ms frame	400	2.5	1090	1250	1820	2185	2500	3645	4375	5000	7290	7140	8750
PS per Frame, 4 ms frame	250	4	1744	2000	2912	3496	4000	5832	7000	8000	11664	11424	14000
PS per Frame, 5 ms frame	200	5	2180	2500	3640	4370	5000	7290	8750	10000	14580	14280	17500
PS per Frame, 8 ms frame	125	8	3488	4000	5824	6992	8000	11664	14000	16000	23328	22848	28000
PS per Frame, 10 ms frame	100	10	4360	5000	7280	8740	10000	14580	17500	20000	29160	28560	35000
PS per Frame, 15.625 ms frame	64	15.625	6812.5	7812.5	11375	13656.25	15625	22781.25	27343.75	31250	45562.5	44625	54687.5
PS per Frame, 20 ms frame	50	20	8720	10000	14560	17480	20000	29160	35000	40000	58320	57120	70000

Spectrum Usage		91.74%	90.18%	91.91%	91.95%	90.18%	92.04%	92.06%	90.18%	92.04%	90.14%	92.06%
		92.06%	90.18%	92.06%	92.06%	90.18%	92.06%	92.06%	90.18%	92.06%	90.18%	92.06%
	Delta	99.66%	100.00%	99.84%	99.89%	100.00%	99.98%	100.00%	100.00%	99.98%	99.96%	100.00%

Truncation to 32 kHz

Äf (subcarrier spacing) (kHz)	Bandwidth (MHz)	Channel Type	Nused (subcarriers)	n (sampling factor)	Nfft	Bandwidth (MHz)											
						1.5	1.75	2.5	3	3.5	5	6	7	10	10	12	
						licensed	licensed	licensed	licensed	licensed	licensed	licensed	licensed	licensed	unlicensed	licensed	
						192	192	192	192	192	192	192	192	192	192	192	
						7/6	8/7	7/6	7/6	8/7	7/6	7/6	8/7	7/6	8/7	7/6	
						256	256	256	256	256	256	256	256	256	256	256	
						6.75	7.75	11.375	13.625	15.625	22.75	27.25	31.25	45.5	44.625	54.625	
						1.73	1.98	2.91	3.49	4.00	5.82	6.98	8.00	11.65	11.42	13.98	
						148.148	129.032	87.912	73.394	64.000	43.956	36.697	32.000	21.978	22.409	18.307	
						0.579	0.504	0.343	0.287	0.250	0.172	0.143	0.125	0.086	0.088	0.072	

User Editable Fields in Blue

Coloured fields are non-integer

Trunct
32

Bandwidth (MHz)			1.5	1.75	2.5	3	3.5	5	6	7	10	10	12
Channel Type			licensed	licensed	licensed	licensed	licensed	licensed	licensed	licensed	licensed	unlicensed	licensed
Samples per Second			1728000	1984000	2912000	3488000	4000000	5824000	6976000	8000000	11648000	11424000	13984000
PS per Second			432000	496000	728000	872000	1000000	1456000	1744000	2000000	2912000	2856000	3496000
	FPS	msec	Samples per Frame										
Samples per Frame, 2.5 ms frame	400	2.5	4320	4960	7280	8720	10000	14560	17440	20000	29120	28560	34960
Samples per Frame, 4 ms frame	250	4	6912	7936	11648	13952	16000	23296	27904	32000	46592	45696	55936
Samples per Frame, 5 ms frame	200	5	8640	9920	14560	17440	20000	29120	34880	40000	58240	57120	69920
Samples per Frame, 8 ms frame	125	8	13824	15872	23296	27904	32000	46592	55808	64000	93184	91392	111872
Samples per Frame, 10 ms frame	100	10	17280	19840	29120	34880	40000	58240	69760	80000	116480	114240	139840
Samples per Frame, 15.625 ms frame	64	15.625	27000	31000	45500	54500	62500	91000	109000	125000	182000	178500	218500
Samples per Frame, 20 ms frame	50	20	34560	39680	58240	69760	80000	116480	139520	160000	232960	228480	279680
	FPS	msec	PS per Frame										
PS per Frame, 2.5 ms frame	400	2.5	1080	1240	1820	2180	2500	3640	4360	5000	7280	7140	8740
PS per Frame, 4 ms frame	250	4	1728	1984	2912	3488	4000	5824	6976	8000	11648	11424	13984
PS per Frame, 5 ms frame	200	5	2160	2480	3640	4360	5000	7280	8720	10000	14560	14280	17480
PS per Frame, 8 ms frame	125	8	3456	3968	5824	6976	8000	11648	13952	16000	23296	22848	27968
PS per Frame, 10 ms frame	100	10	4320	4960	7280	8720	10000	14560	17440	20000	29120	28560	34960
PS per Frame, 15.625 ms frame	64	15.625	6750	7750	11375	13625	15625	22750	27250	31250	45500	44625	54625
PS per Frame, 20 ms frame	50	20	8640	9920	14560	17440	20000	29120	34880	40000	58240	57120	69920

Spectrum Usage			90.90%	89.46%	91.91%	91.74%	90.18%	91.91%	91.74%	90.18%	91.91%	90.14%	91.95%
			92.06%	90.18%	92.06%	92.06%	90.18%	92.06%	92.06%	90.18%	92.06%	90.18%	92.06%
	Delta		98.74%	99.20%	99.84%	99.66%	100.00%	99.84%	99.66%	100.00%	99.84%	99.96%	99.89%

Truncation to 8 kHz, Change 15.625 msec frame to 12.5 msec.

	User Editable Fields in Blue	Bandwidth (MHz)										
Bandwidth (MHz)	Coloured fields	1.5	1.75	2.5	3	3.5	5	6	7	10	10	12
Channel Type	are non-integer	licensed	licensed	licensed	licensed	licensed	licensed	licensed	licensed	licensed	unlicensed	licensed
Nused (subcarriers)		192	192	192	192	192	192	192	192	192	192	192
n (sampling factor)		7/6	8/7	7/6	7/6	8/7	7/6	7/6	8/7	7/6	8/7	7/6
Nfft	Trunct 8	256	256	256	256	256	256	256	256	256	256	256
Fs (sampling frequency) (MHz)		6.8125	7.8125	11.375	13.65625	15.625	22.78125	27.34375	31.25	45.5625	44.625	54.6875
Tb (useful symbol time) (us)		1.74	2.00	2.91	3.50	4.00	5.83	7.00	8.00	11.66	11.42	14.00
Sample time (us)		146.789	128.000	87.912	73.227	64.000	43.896	36.571	32.000	21.948	22.409	18.286
		0.573	0.500	0.343	0.286	0.250	0.171	0.143	0.125	0.086	0.088	0.071

			1.5	1.75	2.5	3	3.5	5	6	7	10	10	12
			licensed	licensed	licensed	licensed	licensed	licensed	licensed	licensed	licensed	unlicensed	licensed
			Samples per Second										
			1744000	2000000	2912000	3496000	4000000	5832000	7000000	8000000	11664000	11424000	14000000
			PS per Second										
			436000	500000	728000	874000	1000000	1458000	1750000	2000000	2916000	2856000	3500000
			Samples per Frame										
	FPS	msec	4360	5000	7280	8740	10000	14580	17500	20000	29160	28560	35000
Samples per Frame, 2.5 ms frame	400	2.5	4360	5000	7280	8740	10000	14580	17500	20000	29160	28560	35000
Samples per Frame, 4 ms frame	250	4	6976	8000	11648	13984	16000	23328	28000	32000	46656	45696	56000
Samples per Frame, 5 ms frame	200	5	8720	10000	14560	17480	20000	29160	35000	40000	58320	57120	70000
Samples per Frame, 8 ms frame	125	8	13952	16000	23296	27968	32000	46656	56000	64000	93312	91392	112000
Samples per Frame, 10 ms frame	100	10	17440	20000	29120	34960	40000	58320	70000	80000	116640	114240	140000
Samples per Frame, 12.5 ms frame	80	12.5	21800	25000	36400	43700	50000	72900	87500	100000	145800	142800	175000
Samples per Frame, 20 ms frame	50	20	34880	40000	58240	69920	80000	116640	140000	160000	233280	228480	280000
			PS per Frame										
	FPS	msec	1090	1250	1820	2185	2500	3645	4375	5000	7290	7140	8750
PS per Frame, 2.5 ms frame	400	2.5	1090	1250	1820	2185	2500	3645	4375	5000	7290	7140	8750
PS per Frame, 4 ms frame	250	4	1744	2000	2912	3496	4000	5832	7000	8000	11664	11424	14000
PS per Frame, 5 ms frame	200	5	2180	2500	3640	4370	5000	7290	8750	10000	14580	14280	17500
PS per Frame, 8 ms frame	125	8	3488	4000	5824	6992	8000	11664	14000	16000	23328	22848	28000
PS per Frame, 10 ms frame	100	10	4360	5000	7280	8740	10000	14580	17500	20000	29160	28560	35000
PS per Frame, 12.5 ms frame	80	12.5	5450	6250	9100	10925	12500	18225	21875	25000	36450	35700	43750
PS per Frame, 20 ms frame	50	20	8720	10000	14560	17480	20000	29160	35000	40000	58320	57120	70000

Spectrum Usage		91.74%	90.18%	91.91%	91.95%	90.18%	92.04%	92.06%	90.18%	92.04%	90.14%	92.06%
		92.06%	90.18%	92.06%	92.06%	90.18%	92.06%	92.06%	90.18%	92.06%	90.18%	92.06%
	Delta	99.66%	100.00%	99.84%	99.89%	100.00%	99.98%	100.00%	100.00%	99.98%	99.96%	100.00%