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Title	**Sampling rate change for OFDM**
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Source(s)	Naftali Chayat, Tal Kaitz Alvarion Ltd. 21a Habarzel St., Tel Aviv 69710 Israel Voice: + 972 3 6456273/262 Fax: + 972 3 6456222/290 mailto: tal.kaitz@alvarion.com naftali.chayat@alvarion.com
Re:	Support material for comment in Letter Ballot 4a
Abstract	It is proposed to change the over-sampling ratio in OFDM mode from 7/6 to 8/7
Purpose	
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Sampling rate change

Tal Kaitz, Naftali Chayat

Alvarion

1. Introduction

The D2 standard draft, the sampling ratio, namely the ratio between the channel bandwidth BW and the sampling rate Fs, can take either the value of 8/7 or 7/6. We propose to use only the value of 8/7.

This submission addresses comments #1027, #1029 , #1030 #1031 in letter Ballot 4a.

2. Discussion

According to D2 draft, the sampling ratio, Fs/BW can take two values

- Fs/BW= 8/7. This value is used for 2K OFDMA as well as 256 OFDM in the license exempt band.
- Fs/BW=7/6. This value is used for 256OFDM in the licensed bands.

We propose to use the value of Fs/BW=8/7 for all modes. Our considerations are as follows:

A. The change will allow harmonization of the standard, where the same parameter is used for all modes.

B. For the 8/7 parameter, the channel spacing becomes an integer multiple of subcarrier spacings, making adjacent sub channels orthogonal to each other. This will result in increased adjacent channel interference immunity and may simplify implementation in base station and CPE.

C. For many regulatory bands, the 7/6 parameter results in strange sampling rates. For instance, in ETSI bands, where the channel raster is 1.75MHz*n the sampling rate with 7/6 is 2.04166667MHz*n. With the 8/7 parameter the sampling rate is just 2MHz*n.

D. An alternative to use the strange sampling rate is to use digital sampling rate conversion. However, this increases the complexity of the implementation.

E. Changing the ration to 8/7 will result in a loss of usable bandwidth of only 2%. This capacity loss is marginal when compared to the to the advantages listed above. The 2% loss can be used for addition of pilot carriers. This is discussed in the next section.

3. Increasing the number of pilots.

When going from 7/6 to 8/7 we can use the 2% reduction in bandwidth to increase the number of pilots.
This issue is brought here for consideration***, however it may be considered independently of the issue of sampling rate change.***

The number of pilots can be increased from 8 to 12 or 16 pilots, resulting in a total of 204 or 208 subcarriers. The effect of this on the spectral density is shown in Figure 1, where the spectrum of an OFDM waveform with Fs/BW=8/7 consisting of 200, 204 and 208 carriers is shown. It is assumed that a power amplifier with 8 dB back-off was used. The ETSI TDMA type E-G masks are also shown for reference.

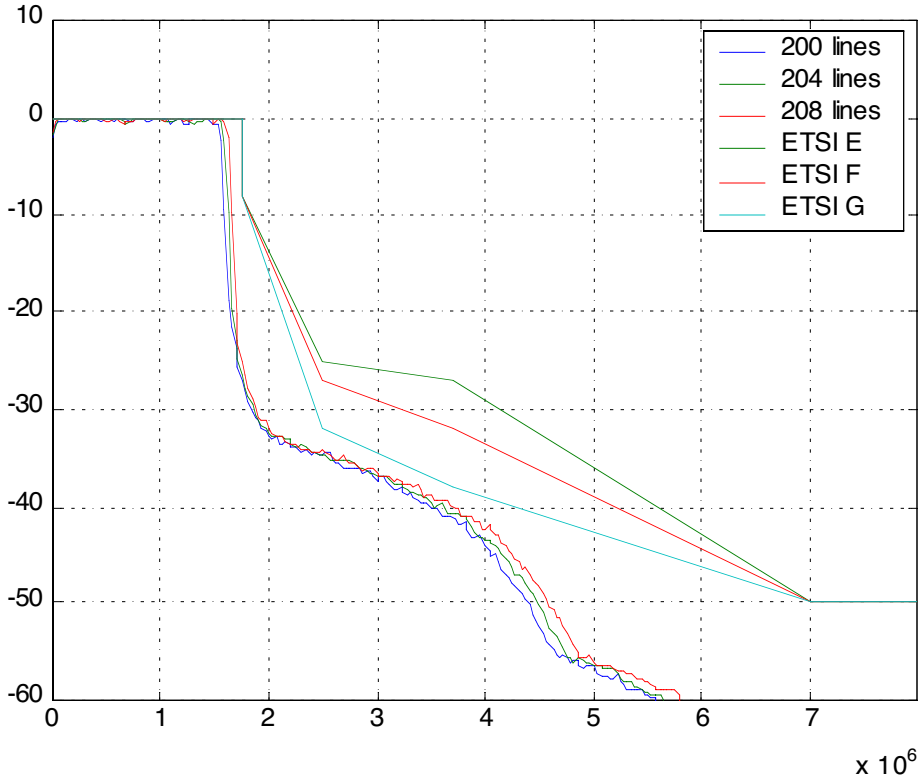

Figure 1 PSD with 8/7 over-sampling ratio

It is shown the even with 208 carriers there is still margin for frequency errors.

The increased number of pilots may be used for improved phase tracking performance, or to enable sub-channelization.

4. Conclusion

The 8/7*BW sampling rate provides numerous implementation and system level advantages. It has just a marginal implication on spectral masks.

Independently, it allows increasing the number of pilots – a feature which is important for the subchannelization being currently discussed.