

**Source:** Siemens  
**Title:** BS and UE Frequency Stability for TDD mode  
**For:** Discussion and Approval

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## Introduction

The frequencies of the BS and UE have to be accurate within a specific range to ensure an acceptable degradation of the overall performance.

This document proposes frequency stability requirements for the UE and BS.

## Requirement for BS

The BS frequency error only affect the mobile station when it is trying to lock to a new base. At initial synchronisation the frequency error for the mobile station is usually dominating. However, when the mobile is locked to one BS and shall identify another for e. g. hand-over, only the difference between the two frequency errors as received at the mobile is important. The frequency error received at the mobile station consists of the base station error and the Doppler shift. For the rural outdoor environment a maximum speed of 500 km/h for the UE is considered [1]. This corresponds to a frequency error of approximately 0.46 PPM. A frequency accuracy of 0.05 PPM for the BS is negligible with respect to the frequency error due to the Doppler shift. A frequency stability of 0.05 PPM is also used for the FDD mode.

## Text proposal for TS25.105 6.3.1 Minimum Requirement”

The modulated carrier frequency of the BS shall be accurate to within  $\pm 0.05$  PPM for RF frequency generation.

## Requirement for UE

The reference oscillator in the UE shall lock to the received frequency from the BS. The received signal will have an apparent error due to BS frequency error and Doppler shift. Due to noise or interference in the received signal the local reference in the UE will vary. The received signal must be averaged over sufficient time to reduce fluctuations.

Figure 1 shows the BER as a function of the frequency error for different SNR. In the case of perfect synchronisation between BS and UE a BER of  $10E-3$  is obtained at SNR of about 0.6 dB. Assuming a degradation of 0.5 dB in the SNR due to a frequency error is acceptable, a frequency offset of 200 Hz for the UE can be tolerated. This corresponds to a frequency stability of 0.1 PPM. The same value is used for the FDD mode.

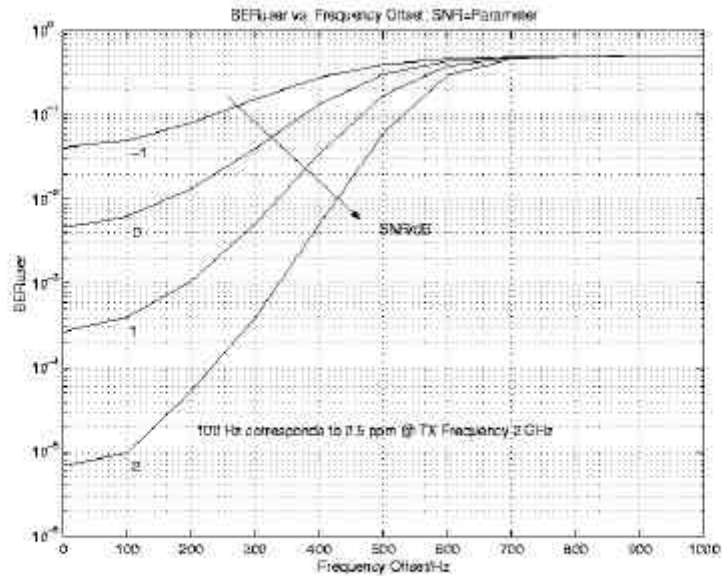


Figure 1 BER vs frequency offset

### Text proposal for TS25.101 6.3 Frequency stability”

The UE modulated carrier frequency shall be accurate to within  $\pm 0.1$  PPM compared to carrier frequency received from the BS. These signals will have an apparent error due to BS frequency error and Doppler shift. In the later case, signals from the BS must be averaged over sufficient time that errors due to noise or interference are allowed for within the above  $\pm 0.1$  PPM figure.

AFC	Frequency stability
ON	Within $\pm 0.1$ PPM

### Conclusion

Requirements for the frequency stability of the BS and UE have been proposed to be used in TS25.105 and TS25.101, respectively.

### References

[1] UMTS 30.01 UMTS Baseline Document