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Optoelectronic Oscillator for mm-Wave generation

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The development of high-speed communications has led to the integration of optoelectronic devices into communication systems. The broad band capability, low power consumption and the implementation of optical multiplexing techniques has made microwave photonics an ubiquitous subject [1]–[3]. The deployment of 5G networks has challenged engineers to find the way to provide synchronized high-frequency radio access to users. According to GSMA [4], the EM spectrum bands of interest for cellular networks are 24.25 GHz – 27.5 GHz, 37 GHz – 43.5 GHz, 45.5 GHz – 47 GHz, and 47.2 GHz – 48.2 GHz. These bands, known as mm-Wave bands are of special interest for indoor radio access and applications in urban areas.

The radio access interface for 5G network requires high frequency stability to avoid carrier drifting and channel overlapping. Optical signal distribution based on optoelectronic oscillators to synchronize radio access stations has been proposed considering their high spectral purity [5]. The carrier generation has been traditionally implemented using electronic oscillators based on frequency multiplication. The advantage of microwave photonics oscillators is their ability of high frequency generation without requiring any multiplication technique, enabling the generation of low noise carriers.

In this work, authors present the implementation of an optoelectronic oscillator for mm-Wave signal generation at 30 GHz based on a delay-line architecture [6]. This implementation uses telecommunication wavelength single mode laser source (DFB laser) with high-speed intensity modulation and a single mode optical fiber spool as resonant cavity. In the configuration shown in Figure 1, frequency comb are generated in optical and electrical domain, and can then be filtered optically or electrically to choose an oscillation mode with high-spectral purity.

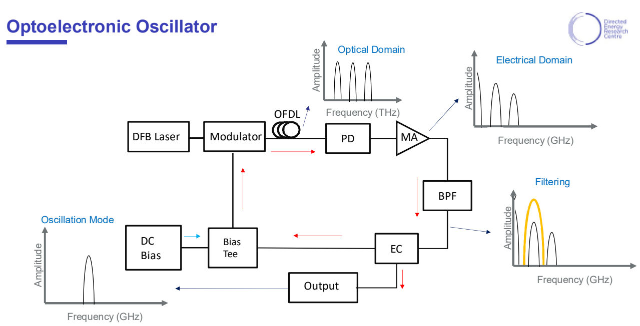

Figure 1. mm-Wave optoelectronic oscillator setup. OFDL: optical fiber delay line, MA: Microwave amplifier, BPF: bandpass filter, EC: electrical coupler

As result of this research work, a parametric characterization of the mm-Wave optoelectronic oscillator is performed under ISO 7 cleanroom conditions. Frequency stability of the mm-Wave optoelectronic oscillator will be presented for several laser source configurations and resonant element adjustments, and several strategies will be proposed with regards to the future development of 5G signal processing capabilities.

References

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