# Stabilization of THz generation in THz over fiber system

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Terahertz (THz)-based communication and sensing is emerging as a key technology in future wireless systems [1]. In the context of wireless communications, the wide bandwidth available in the THz range enables ultra-high data rates of up to 100 Gbit/s. Meanwhile, THz sensing leverages the absorption spectra of molecular vibrations to analyze material composition. Additionally, the low invasiveness and moderate penetration depth of THz signals make them suitable for non-destructive imaging in applications such as historical artifact analysis, medicine identification and drug detection through packaging, and concealed object detection at security checkpoints. These capabilities stem from the inherent broadband nature and short wavelengths of THz waves. However, conventional electric and electronic technologies alone struggle to generate broad THz bandwidths with a fractional bandwidth exceeding 30%. To overcome this limitation, photonic approaches—particularly optical heterodyne techniques—offer a viable solution for generating THz signals. Consequently, efficient THz signal generation and its transmission over optical fiber networks are critical for the advancement of future THz applications.

In optical heterodyne systems, a THz signal is typically generated by coupling two optical signals and feeding them into an optoelectronic (O/E)converter. The frequency of the THz output is determined by the wavelength separation between these optical signals. For efficient conversion, the polarization states of the two optical components must be aligned parallelly. To achieve this, both optical signals are transmitted together over fiber from the transmitter to the converter. However, this configuration reduces wavelength utilization efficiency in the fiber, as a frequency separation of 300 GHz requires approximately 2.5 nm of wavelength bandwidth. To enhance spectral efficiency, an optical local oscillator (LO) is located at the converter side (Fig. 1). However, this setup introduces polarization fluctuations due to fiber-related environmental perturbations, such as vibrations and polarization mode dispersion [2, 3].

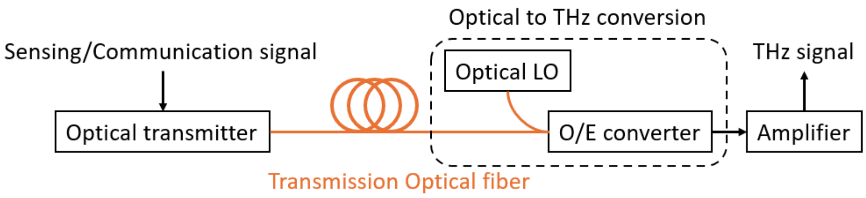


**Figure 1.** THz over fiber system with the converter including the optical LO.

To address this challenge, we propose and preliminarily demonstrate a THz-over-fiber system incorporating polarization stabilization techniques. Furthermore, we introduce an optical and THz power stabilization method to enhance signal generation efficiency. In this presentation, we will provide an overview of the system, discuss key research areas, and share progress updates.

## References

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