

Article Overview

A digital coherent optical receiver is an advanced optical receiver that uses coherent detection combined with digital signal processing (DSP) to recover amplitude, phase, and polarization information from optical signals, enabling high-speed, spectrally efficient data transmission.

Overview

A digital coherent optical receiver captures both the amplitude and phase of an incoming optical signal by mixing it with a stable local oscillator laser in a process called coherent detection. Unlike traditional direct-detection receivers, which only measure signal intensity, coherent receivers preserve the full optical field information, allowing the use of advanced modulation formats such as QPSK, BPSK, and QAM for higher spectral efficiency and data rates .

Key Components and Functionality

- o Optical Front-End: The incoming signal is split into orthogonal polarization components and combined with a local oscillator. Balanced photodetectors convert the optical interference into electrical signals .
- o Analog-to-Digital Conversion (ADC): The electrical signals are sampled at high speed to digitize the received waveform for processing .
- o Digital Signal Processing (DSP): DSP algorithms perform multiple critical tasks:
 - o Chromatic dispersion and polarization mode dispersion compensation to correct fiber impairments.
 - o Polarization demultiplexing to separate multiplexed polarization channels.
 - o Frequency and phase recovery to correct laser phase noise and frequency offsets.
 - o Symbol decision and demodulation to recover transmitted data .
- o Advanced Features: Modern digital coherent receivers can also perform modulation format recognition and impairment mitigation using adaptive algorithms, enabling flexible operation across different network conditions .

Advantages

- o High spectral efficiency: Supports multi-level modulation formats for higher data throughput per wavelength.
- o Improved sensitivity: Coherent detection allows better signal-to-noise ratio compared to direct detection.
- o Compensation of fiber impairments: DSP enables adaptive correction of chromatic dispersion, polarization mode dispersion, and some nonlinear effects.
- o Scalability: Supports high-speed long-haul and metro optical networks, with data rates reaching hundreds of Gb/s per channel .

Applications

Digital coherent optical receivers are widely used in long-haul, metro, and data center interconnect networks, where high capacity, long-distance transmission, and spectral efficiency are critical. They form the core of modern coherent optical modules and are essential for achieving multi-terabit per second transmission in wavelength-division multiplexed (WDM) systems. In summary, a digital coherent optical receiver combines coherent optical detection with ultrafast DSP to enable high-speed, robust, and spectrally efficient optical communication, overcoming limitations of traditional direct-detection systems.

Optical transmitters and receivers, key elements in generating and detecting the modulated signal, are the interfaces at

The CORX - Coherent Optical IQ Receiver is a fully integrated, high-performance reception module for coherent optical signals in

This paper reviews the history of research and development related to coherent optical communications and describes

As coherent reception technology continues to move downstream the optical telecommunication infrastructure, the

As coherent optical communications made a comeback with the advancement in digital signal processing, researchers also explored

The transition to coherent optics for shorter links--around 10 km or less--is underway with the development of Coherent-Lite

SUMMARY Digital coherent receivers have gained significant attention in the last decade. The reason for this is that coherent

In this paper, we first review coherent detection technique employed in the receiver as well as the required receiver structure.

We discuss the digital coherent receiver, which can cope with any multi-level optical modulation format. The carrier

Electrical out Optical in Local Oscillator Analog-to-Digital Converters for real-time processing Real-time

What is a digital coherent optical receiver

Oscilloscope Coherent

Homodyne signal spectrum. The local oscillator is tuned so that it matches the optical frequency obtaining a baseband

Digital coherent receivers have caused a revolution in the design of optical transmission systems, due to the subsystems and

This paper reviews the history of coherent optical communications, the principle of coherent detection, and the concept of the digital

Abstract and Figures Digital filters underpin the performance of coherent optical receivers which exploit digital signal

In this tech info, we will provide background and features of digital coherent DSP and silicon photonics technology,

Fundamentals of Coherent Optical Fiber Communications Kazuro Kikuchi, Fellow, IEEE, Fellow, OSA (Tutorial Review)

Web: <https://morwarreconst.co.za>

