Lösting software

CELEOS

Multi-orbit satellite channel emulator

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Concentrating on Essential Markets

Designed for mobile network operators, satellite network operators, R&D centers, user equipment manufacturers, and academia, CELEOS is the go-to solution for advanced satellite communication testing.

Empowering the New Age of Satellite Communications

Offering an affordable yet high-performance channel emulator, CELEOS excels in multi-orbit constellations and next-generation connectivity.

Leveraging Unique Advantages

Setting a new benchmark in satellite communication testing, CELEOS combines affordability, portability, and industry-leading performance.

Enhancing Competitive Edges

Providing a cost-effective and feature-rich approach tailored for the unique challenges of satellite communications.

Overcoming Industry Challenges

Making advanced satellite testing accessible and practical, removing barriers to realistic, real-time performance validation.

Showcasing Versatile Use Cases

From seamless handover testing and TLE synchronization to supporting diverse waveforms, CELEOS is built to enable comprehensive, real-world NTN testing.

The Future of Satellite Communication Testing

INTRODUCTION

CELEOS is a **software-based satellite channel emulator (CE)** designed for deployment on a wide range of hardware platforms.

The core architecture of the Channel Emulator leverages a Software Defined Radio (SDR) for analog-to-digital (A/D) and digital-to-analog (D/A) conversion of Radio Frequency (RF) signals. Additionally, it utilizes off-the-shelf Graphics Processing Units (GPUs) for efficient signal processing. The software is hardware-agnostic, ensuring compatibility with various SDRs and GPUs.

The **CELEOS CE system** consists of two primary components:

1. **SDR device** – Handles the RF signal reception, downconverts it to baseband, and forwards it to the host computer.
2. **Host computer** – Performs Digital Signal Processing (DSP) and Channel Parameter Calculation, computing the channel's electrical characteristics based on geometric satellite orbital parameters.

MAIN SPECIFICATIONS

CELEOS' bandwidth characteristics depend on the SDR model, host computer hardware (GPU, CPU), and the SDR interface (USB, Ethernet, SFP+).

The values below are based on a configuration using a USRP X300 with SFP+ connectivity to a host computer equipped with an NVIDIA RTX 4070 GPU and an AMD Ryzen 9 (16-core) CPU. However, performance scales with more powerful hardware configurations.

Parameter	Specification
Bandwidth	• Up to 150 MHz using USRPs (16/16-bit IQ sampling) • Up to 400 MHz over DIFI (8/8-bit IQ sampling)
Frequency	• RF operating frequency of USRP: Near DC – sub-6 GHz (X300, most USRP models) • Simulation frequency (for channel modeling): Near DC – 50 GHz
Number of Independent Channels	• 4 on this specific USRP (dependent on available physical ports) • Each channel can emulate a different satellite, terminal position, or channel model

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Why CELEOS?

CELEOS is a highly flexible and scalable satellite channel emulator, designed to bridge the gap between theoretical modeling and real-world satellite communications testing. By leveraging software-defined processing and off-the-shelf hardware, it provides a cost-effective yet high-fidelity solution for validating NTN scenarios, including LEO, MEO, and GEO communications.

Supporting special features, such as **DiFi** (ensuring interoperability with the DiFi ecosystem), **SigMF data recording** (offering the possibility to record input and output as SigMF, as well as the ability to import/export recordings), or the **integrated Digital Spectrum Analyzer** (facilitate the ease of work for the engineers using CELEOS), makes CELEOS the ideal enabler for a successful R&D process.

With support for high-bandwidth signals, real-time Doppler shift modeling, and dynamic interference generation, CELEOS enables accurate emulation of next-generation 5G NTN networks, DVB systems, and custom satellite communication protocols. Its hardware-agnostic architecture allows seamless integration with various SDRs and GPUs, ensuring adaptability to evolving test requirements.

CELEOS is designed for telecommunications researchers, satellite network operators, equipment manufacturers, and regulatory bodies looking to:

- Validate NTN waveform performance under real-world conditions.
- Test hybrid terrestrial-satellite connectivity in 5G NTN environments.
- Develop and optimize satellite-enabled IoT, mobility, and broadband solutions.
- Model complex RF environments, including weather-induced fading and multi-satellite interference.

Parameter	Specification
Propagation Delay	• 2 ms – 1000 ms (supports LEO, MEO, GEO & beyond) • Down to 1.5 ms for lower bandwidths (<40 MHz)
Doppler Shift	• -2 MHz to +2 MHz, covering expected LEO transit effects up to Ka-band
Noise & Interference	• White Gaussian noise added digitally via live random number generation • 5G-type interference added using pre-recorded signals (SigMF format) • DVB-type interference added using pre-recorded signals (SigMF format)
IQ Sampling	• Signal processing (host computer): 32/32-bit floating point IQ samples • USRP sampling & transport: 16/16-bit integer IQ samples (most USRP models)
RF Power Levels	• Default range (input & output): -100 dBm to -20 dBm • Range can be adjusted (within USRP limits) via manual user calibration
Path Loss (Attenuation)	• Signal attenuation applied based on relative power variations during satellite-ground terminal movement • Implemented digitally, with the only limitation being sampling resolution
Weather Effects	• Power loss due to atmospheric conditions based on ITU-R P.618-13 • Rain rate calculations based on ITU-R P.837
Phase Noise & RF Characteristics	• Defined by the USRP model specifications • Additional digitally simulated phase noise can be added by the emulator

SCALABILITY & FUTURE EXPANSION

As a software-based solution, CELEOS can scale with computational power, supporting larger bandwidths, more independent channels, and higher-frequency simulations with improved hardware configurations. Future updates will continue to expand its capabilities to meet the growing demands of next-generation NTN and satellite communications.

GET IN TOUCH

For technical inquiries, demonstrations, or integration discussions, contact Lasting Software to explore how CELEOS can enhance your satellite communication testing and development.

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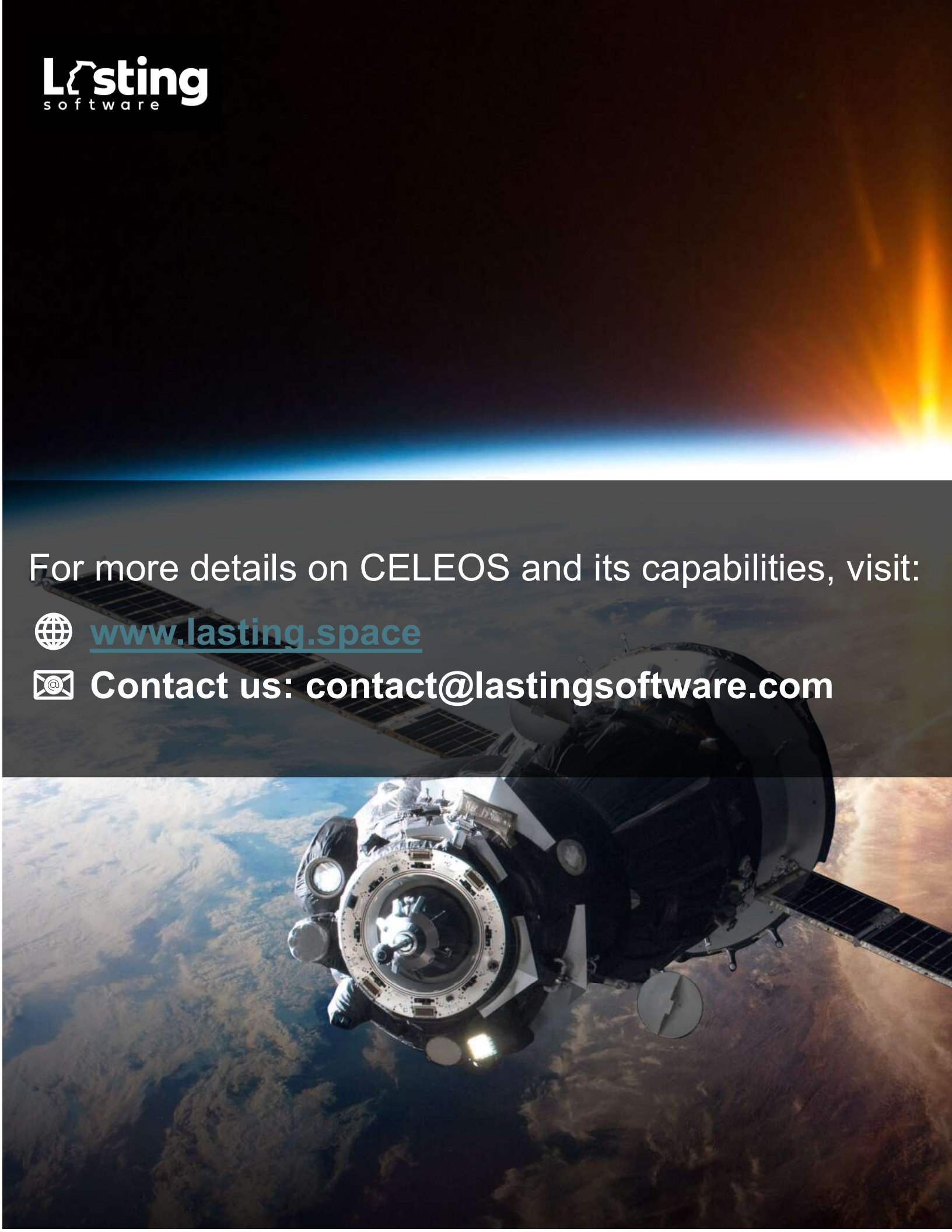

For more details on CELEOS and its capabilities, visit:

www.lasting.space

Contact us: contact@lastingsoftware.com