idw - Informationsdienst Wissenschaft
Nachrichten, Termine, Experten

Press release

Fraunhofer-Institut für Photonische Mikrosysteme (IPMS)
Anne-Julie Zichner

06/12/2025
http://idw-online.de/en/news853667

Research projects, Transfer of Science or Research
Electrical engineering, Information technology, Physics / astronomy
transregional, national

Energy-efficient solution for real-time data transmission developed by Fraunhofer IPMS

The energy consumption of modern telecommunications infrastructure is growing rapidly. To cope with this increase, future network technologies such as 6G must be designed with a strong focus on energy efficiency. In this context, Fraunhofer IPMS has developed an advanced testbed for Time-Sensitive Networking (TSN). This platform not only enables precise analysis and optimization of energy usage in real-time networks but also demonstrates successful wireless TSN data transmission via Li-Fi, a breakthrough for mobile industrial applications such as autonomous robots or machinery in factory automation.

TSN, or Time-Sensitive Networking, enables the real-time transmission of time-critical information, which is essential for the next stage of digital transformation. In combination with Li-Fi, an optical wireless communication technology, Fraunhofer IPMS has implemented a wireless TSN real-time connection. This not only reduces costs by eliminating the need for extensive cabling but also opens up new possibilities for mobile applications.

“We tested three of our Li-Fi links and all three offer high data rates, reliability and low latency,” explains Dr. René Kirrbach, Group Manager at Fraunhofer IPMS. “This allows us to provide wireless real-time connections that have not been possible with previous wireless technologies, not even with 5G. We are reaching the next level of digitalization and enabling applications that depend on cable-free, real-time data transmission, such as autonomous robots in factory automation.”

For mobile applications, energy efficiency is particularly critical, as it directly affects operating time. Until now, there have been no practical benchmarks for the energy consumption of TSN systems. The testbed developed by Fraunhofer IPMS now provides the first such benchmark. Ongoing research efforts focus on further improving the energy efficiency of TSN technology.

Modular, realistic test environment for TSN systems

The TSN testbed supports several key TSN standards, including IEEE 802.1AS gPTP, IEEE 802.1Qbv-2015, and IEEE 802.1Qbu-2016. These standards are essential for precise time synchronization and ensure redundant data transmission. If a data path fails due to an interrupted network connection or a defective connector data is still transmitted without delay. This avoids downtime, increases reliability, and is especially crucial in safety-critical applications.

Thanks to its modular structure, the testbed is suitable for both point-to-point connections and complex networks with multiple components such as endpoints and switches. It is based on Fraunhofer IPMS’s extensive portfolio of TSN IP core technologies, supporting data rates of 1 Gbit/s, 10 Gbit/s, and 25 Gbit/s.

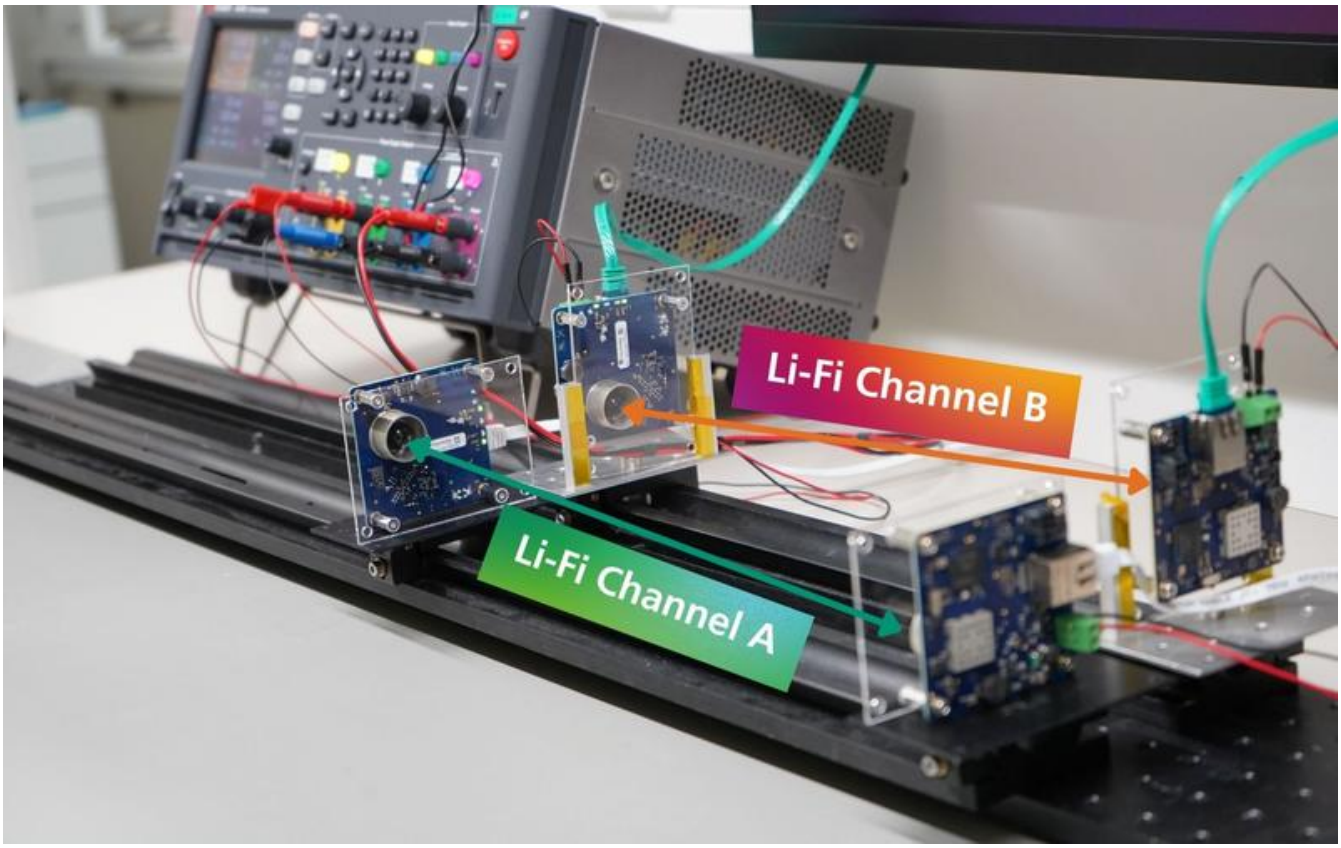
Practical support for industry

The testbed allows companies and developers to evaluate the performance of TSN and Li-Fi for their specific applications and compare it with existing solutions. Key aspects such as real-time capability, energy efficiency, and reliability can be precisely analyzed. In addition, the testbed offers a space to explore entirely new use cases involving TSN and Li-Fi. Fraunhofer IPMS supports this with its extensive expertise in the development, simulation, and validation of TSN and Li-Fi technologies.

What is a testbed?

A testbed is a controlled, real-world testing environment used to evaluate and validate new technologies, systems, or protocols under realistic conditions. It enables straightforward measurement and comparison of parameters such as performance, efficiency, and reliability. Especially for complex communication technologies like Time-Sensitive Networking (TSN), a testbed is essential for gaining practical insights and efficiently transferring innovations into real-world applications.

contact for scientific information:
Dr. René Kirrbach, rene.kirrbach@ipms.fraunhofer.de



Fraunhofer IPMS TSN testbed with two LiFi channels.
Fraunhofer IPMS

Fraunhofer IPMS LiFi GigaSpot 1GHS
Fraunhofer IPMS