# Satellite connectivity

System engineering

As independent system engineering partner with experience and expertise across all program phases Fraunhofer IIS performs system design, optimization and validation of novel satellite systems. A special focus is put on high-throughput satellite broadband on GEO (geostationary) satellites and multi-satellite constellations in LEO (low earth) or HEO (highly elliptical) orbits. This is complemented by solutions for high throughput satellite (HTS) systems, IoT via satellite, 5G satellite integration and on-board processing.

System engineering services for satellite connectivity – because the system is greater than the sum of its parts

Solutions and intellectual property

- HTS systems
- IoT via satellite
- 5G satellite integration
- On-board processing

- System engineering
- System design
- System optimization
- System validation

- Tool development
- Consulting
- Design review
- Independent assessment
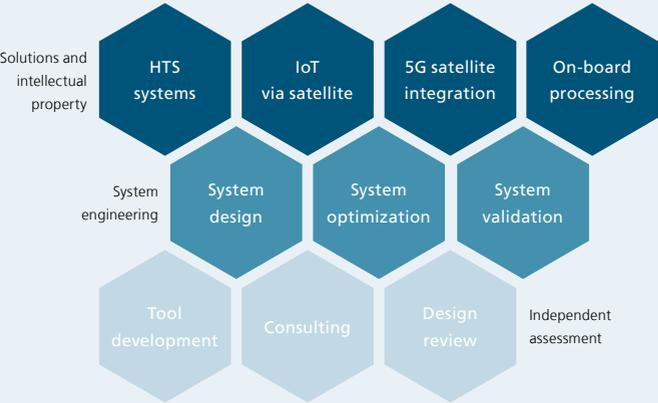
Your satellite connectivity partner

Building on the active involvement in the development, specification and validation of DVB-S2X, Fraunhofer IIS offers IP core solutions and engineering services for integrating the DVB-S2X standard into professional equipment. This offer is complemented by in-depth expertise in the field of satellite communication, focusing on broadband and IoT/M2M connectivity solutions for fixed and mobile applications as well as 5G non-terrestrial networks (NTN).

Fraunhofer IIS's portfolio ranges from development and design of ground antennas, user terminals and waveforms to regenerative payloads and complete satellite communication systems. In addition Fraunhofer IIS operates special measurement facilities and testbeds for component characterization and validating prototypes.

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Satellite connectivity

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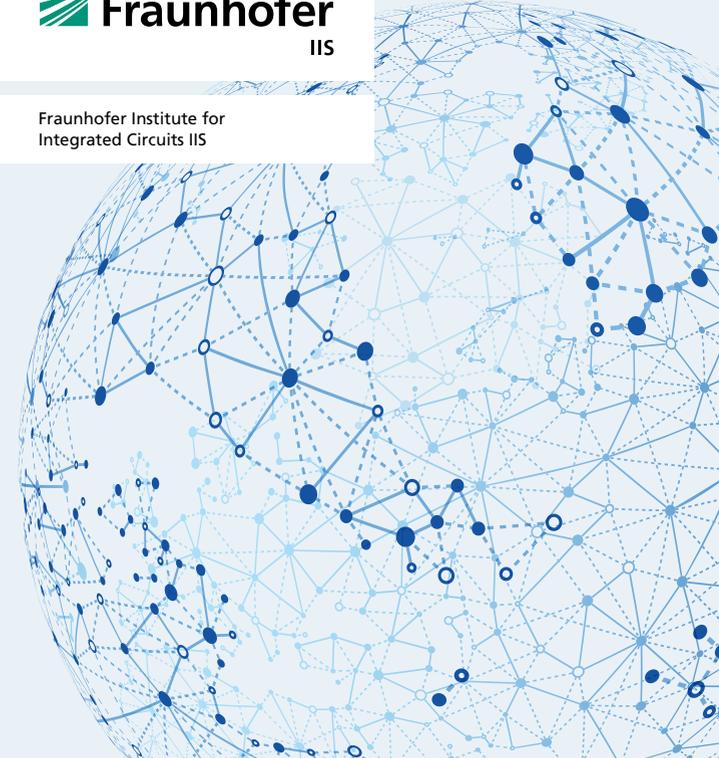
Satellite connectivity

High throughput satellite systems

Professional modulator and demodulator (MODEM) equipment is primarily being used in satellite-based professional applications like in-flight entertainment, remote site connectivity, news gathering and content distribution as well as in the military domain (MILCOM). Satellite connectivity can also be deployed as backup connection or added value in terrestrial or cable MODEMs for higher value markets.

The new satellite communication standard DVB-S2X meets the demanding requirements of professional markets by providing improvements in performance and spectral efficiency for lowering cost per bit.

Fraunhofer IIS offers a readily available and FPGA-based DVB-S2X receiver implementation using Annex E, format 4 and 5 (super-framing) that can be quickly tailored for different products and throughput ranges:

- Fast deployment due to existing and validated solution
- Versatile adaptation to customer platform constraints and the favored feature set
- Hassle-free product design, with integration support being part of the solution package

Internet of Things (IoT) via satellite

IoT applications provide various opportunities for established and newfound satellite operators. Fraunhofer IIS solutions and IP is addressing many of the technical challenges in M2M and IoT communication via satellite:

- Solutions for different orbits and satellite classes
- Direct access and backhauling approaches
- Low-cost and power-optimized IoT devices

Solutions are available at different maturity levels, including prototype and demonstration hardware, software and licensable intellectual property:

- Waveforms optimized for different communication scenarios
- Design of IoT systems and subsystems, e.g., IoT terminals, gateway equipment, multibeam antennas and protocol stacks
- System simulations, e.g., to assess and optimize network availability, throughput, latency or capacity

5G satellite integration

5G is giving the convergence of terrestrial and satellite-based networks a major boost. For the first time, the concept of non-terrestrial networks (NTN) is systematically taking satellite integration into account in the standardization of a new mobile communications standard. The integration of satellites into the 5G network offers great opportunities for reliable and global cellular coverage without any gaps:

- Worldwide connectivity
- Seamless reception for mobile applications
- Efficient broadcasting and mobile data offloading

Hybrid satellite terrestrial 5G concepts will allow for smartphones or vehicles to establish a connection either via a cellular base station or directly via satellite, depending on the reception situation. Network architectures are also possible in which the satellite itself serves as the base station (gNB) component. Fraunhofer IIS' research and development activities for combining terrestrial and satellite-based communication systems include:

- Feasibility studies, performance assessments and system-specific integration concepts
- Link- and system-level simulations for determining the performance of 5G NR via satellite
- Implementation of new features from the ongoing standardization process and live tests

On-board processing

Conventional "bent pipe" payload systems restrict bandwidth efficiency as the performance is dominated by the user links and the gateway link remains underutilized. Regenerative payload processing overcomes these shortcuts as it enables signal regeneration and reencoding to provide optimum utilization of all satellite links.

Regenerative payloads based on on-board processors are capable of the following tasks:

- Multiplexing and modulation
- Demodulation and demultiplexing
- Error detection and correction
- Switching, routing and traffic management
- Phased array antenna control and beam-forming

Leveraging the experience of developing the Fraunhofer On-Board Processor (FOBP) Fraunhofer IIS provides services and IP in the following domains:

- Customized digital payload system design
- Technology trade-off and selection based on user's needs
- Reconfiguration framework for FPGAs
- Radiation mitigation techniques
- In-band telemetry/telecommand (TM/TC) link
- Ground station monitoring and control suite