OPTICAL FIBER NETWORKS

In 1988, the first transatlantic optical fiber cable, the TAT-8, went into operation. Optical fiber quickly replaced copper cables to meet the fast-growing need for greater capacity. Today, submarine cables with capacities of up to several terabytes per second connect the whole Earth.

Optical fibers offer substantially higher transmission rates, while simultaneously providing large ranges. Other advantages are lighter cables, lower space requirements, and fewer repeaters. The operation and maintenance costs are also significantly reduced.

Data cable in city area

<table>
<thead>
<tr>
<th></th>
<th>transfer speed</th>
<th>range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>in Mbit/s</td>
<td>in km, without repeater</td>
</tr>
<tr>
<td>optical fiber cable</td>
<td>1000</td>
<td>100</td>
</tr>
<tr>
<td>cladding</td>
<td>0.6 mm</td>
<td></td>
</tr>
<tr>
<td>copper cable</td>
<td>50</td>
<td>2</td>
</tr>
<tr>
<td>cladding</td>
<td>6.9 mm</td>
<td></td>
</tr>
<tr>
<td>cross section in original size</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Optical fibers offer substantially higher transmission rates, while simultaneously providing large ranges. Other advantages are lighter cables, lower space requirements, and fewer repeaters. The operation and maintenance costs are also significantly reduced.

<table>
<thead>
<tr>
<th>shelf life</th>
<th>weight 100 m cable in kg</th>
<th>energy consumption in watts per user</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>0.6</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>5.8</td>
<td>10</td>
</tr>
</tbody>
</table>
LASER COMMUNICATION IN SPACE

Free space optical communication between near-Earth and geostationary satellites enables the fast transfer of data to a ground station. Vital data during natural catastrophes or in emergencies at sea can be received almost in real time in this way.

### ADVANTAGES OF THE LASER

**LARGE DATA VOLUMES**
1.8 gigabytes per second corresponds to around 500 songs per second

**NO LIMIT**
due to frequency allocations

**LOWER ENERGY CONSUMPTION**
expands shelf life

**LESS MASS**
saves costs

### THE LASER AND OPTICS MEET THE HIGHEST REQUIREMENTS

**SMALLEST TOLERANCE**
for generating a bundled laser beam across largest distances

**stable**
despite great TEMPERATURE DIFFERENCES

**survive**
strong VIBRATIONS and ACCELERATIONS during rocket launches

**over 15 years MAINTENANCE-FREE**

**RESISTANT**
against UV and gamma radiation in space
ADVANTAGES OF THE LASER
EARTH
NO LIMIT due to frequency allocations
LARGE DATA VOLUMES
1.8 gigabytes per second corresponds to around 500 songs per second
LESS MASS saves costs
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SMALLEST TOLERANCE for generating a bundled laser beam across largest distances stable despite great TEMPERATURE DIFFERENCES survives strong VIBRATIONS and ACCELERATIONS during rocket launches over 15 years MAINTENANCE/hyphen.case FREE RESISTANT against UV and gamma radiation in space

NEAR-EARTH SATELLITE scans parts of the Earth’s surface
height: 700 km

GEOSTATIONARY SATELLITE

SATELLITE-LASER LINK

height: 36,000 km

RECEIVING STATION on Earth

DATA TRANSFER 20 LASER COMMUNICATION IN SPACE
Free space optical communication between near-Earth and geostationary satellites enables the fast transfer of data to a ground station. Vital data during natural catastrophes or in emergencies at sea can be received almost in real time in this way.
Cameras and optical sensors often work together with intelligent image or data processing. The QR code (Quick Response) shows this impressively.

USE OF QR CODES

QR codes are two-dimensional bar codes. A camera phone with the appropriate code reader software recognizes this information and decodes it.
QR-CODE STRUCTURE

Apart from the content, QR codes contain additional elements so that the software can recognize the data correctly. This includes:

- positioning
- format information
- timing
- version information
- alignment

Up to 4,000 alphanumerical characters fit on a QR code.

ADVANTAGES OF QR CODES

In comparison to the classic barcode, QR codes can store more information on a smaller area and make fewer requirements of reading devices.

They also function even if they are partly damaged or corrupted:

- graphic/text in code
- distorted
- blurred
- twisted