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>optical fiber cable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 µm (0.01 mm)</td>
<td>1000 Mbit/s</td>
<td>100 km, without repeater</td>
</tr>
<tr>
<td>copper cable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1 mm</td>
<td>50 Mbit/s</td>
<td>2 km, without repeater</td>
</tr>
</tbody>
</table>

### Cladding dimensions

- Optical fiber cable: 0.6 mm cross section in original size
- Copper cable: 6.9 mm cross section in original size
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</th>
<th>energy consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>in years</td>
<td>100 m cable in kg</td>
<td>in watts per user</td>
</tr>
<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>

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.
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

Lower energy consumption expands shelf life

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

Satellite/Laser link

Height: 700 km

Near-Earth satellite scans parts of the Earth’s surface

Geostationary satellite

Height: 36,000 km

Satellite-laser link

Receiving station on Earth

The laser and optics meet the highest requirements

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.
QR CODES

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