Rough draft for FAZ special supplement on telecommunication
(Only for approval purposes)

Speeding up the Internet

Today there are around 170 million Internet users world-wide. Over the next two years that number will have more than quadrupled, leading to a rapid increase in the demand for transmission capacity or bandwidth.

Using an optical glass fiber, the successor of the conventional coaxial copper cable, photons can now transfer up to 40 gigabits (billion bits) of data per second. That is the equivalent of more than 2.4 million pages of text or 600,000 simultaneous telephone conversations. The latest glass fiber transmission systems, known as DWDM (Dense Wavelength Division Multiplexing) systems, however, are already achieving 3200 gigabit transmission rates and above in optical networks – and they are doing this without having to install one single extra meter of cable in wide area networks (WAN).

DWDM networks transmit light pulses on the same optical fiber at different wavelengths. To explain: Light moves along a glass fiber by being reflected back and forth from the inner surface of its glass sheath in a forward-moving zigzag fashion. What makes this possible is the difference between the refractive index of the glass sheath and that of the fiber core. With “multiplexing,” laser diodes (e.g. VCSEL) now couple several signal bearing rays of light in the infrared area into the glass fiber. The rays each have a slightly different wavelength spectrum and therefore have no influence on each other. To put this in visual terms, the different colors of the light are like individual lanes on the data highway along which information can flow separately. A large number of channels are set up and the data transfer capacity of a single stretch of glass fiber is multiplied.

The reception of a transfer channel of this type is controlled by an optical filter that only allows a predetermined optical bandwidth to pass through while reflecting others. As a result only certain frequency ranges are switched.

Multiplexing with 120 channels is common at present. With this technology, the capacity of the glass fiber networks could be multiplied a hundred-fold in the next ten years, experts say. The aim is to reduce the size of the channels still further so that there is room in a glass fiber cable for more and more data.

In order to keep data moving in the fast lane over the entire journey from sender to receiver it is not enough to focus only on transnational and metropolitan glass fiber networks. Today, the use of fiber optics for high-speed communications is finding increased use within large and multiple microprocessor systems, or within local area networks (LAN). For instance in large server farms, more and more channels are needed to transmit data through optical cross connects and large scale switches. By adding daughter cards to back planes, the number of channels is increased, however this expansion of channels requires complicated, dense fiber routing and connections. This creates problems for the point to point wiring, which is labor intensive, costly, time consuming and susceptible to connection errors. Fiber management becomes a challenging problem.

Optical shuffles offer an innovative solution to complete complex fiber routings. This fiber management tool from the US start-up Schott Communications Technologies can handle high fiber counts, complex routings and is easily serviced by plugging in mass fiber connectors instead of individual fibers.

This short distance fiber management from between a few centimeters up to several hundred meters is expected to grow in relevance in the next few years, but not only for business applications. As more and more data and multimedia traffic such as TV programming can be downloaded through the internet, demand for glass fiber solutions over short distances is expected to increase rapidly for residential applications too.

Another key aspect to transmitting as much data as possible on a single optical fiber is a fast light emitter, which sends information along the internet in the form of light impulses. Very simplified, the data is first transformed from electrical signals into optical signals and then sent along the internet in the form of light. The light impulses are then transformed back into electrical signals at the receiving end. The faster an emitter can send the impulses, the more efficient the entire system. For that purpose start up semiconductor companies like the German company U.L.M. photonics develop and produce VCSEL-diodes (vertical-cavity-surface-emitting lasers) that allow data transfer from one Gbit/s up to more than ten Gbit/s per optical channel, a level soon to become standard for service providers.

With these and other clever solutions, data transfer via the internet can run literally at the speed of light, whether across the ocean or within a local area network.