

## How to calculate the maximum distance between two switches connected via a multimode cable using Fast Ethernet ports?

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First **the basics** based on standard IEEE 802.3:

Fast Ethernet uses 1300 nm wavelength for transmission.

Fast Ethernet transmits the 100 Mbit/s data stream using a 4B/5B code with 125 Mbit/s effectively.

To calculate the maximum supported distance you have to consider two parameters: attenuation and dispersion (expressed by bandwidth or bandwidth length product).

Now have a look at **the switches**. Hirschmann Fast Ethernet transmitters for multimode fibers usually offer 8 dB attenuation budget with 50  $\mu$  fiber.

For typical **fibers** you can assume an attenuation of < 1.5 dB/km at 1300 nm. Per connection (connector attenuation) you calculate additional .5 dB.

Let's have a look at the attenuation:

8 dB budget offered by switch is reduced by .5 dB per connection.  $7.5 \text{ dB} / 1.5 \text{ dB/km}$  makes 5.0 km. That's maximum distance supported for a direct link between two devices due to the attenuation. Additional patch panels between two devices reduce the distance.

Now we have to consider the bandwidth, or correct: the **Bandwidth Length Product BLP**.

The BLP is used to easily calculate the supported distance limited by the dispersion.

The BLP unit either is Mbit/s\*km or MHz\*km.

You divide the BLP by the bandwidth (speed) used and get the distance.

For example:  $500 \text{ MHz*km} / 125 \text{ MHz} = 4 \text{ km}$  (use 125 MHz or Mbit/s, both fits for our purposes; the theory behind this is a lot more complex).

Hirschmann switches claim to support a distance of up to 5 km with 50  $\mu$  fiber. This is based on the above mentioned attenuation budget and an assumed fiber BLP of more than 750 MHz\*km, a value exceeded by most of today's fibers.

The minimum of both calculations determines the maximum supported distance.

Now a last remark regarding the standard IEEE 802.3:

This standard demands support of at least 2 km by ports.

This means that a distance of 4 km is according to standard.  
It does not mean that the 4 km are beyond the standard.