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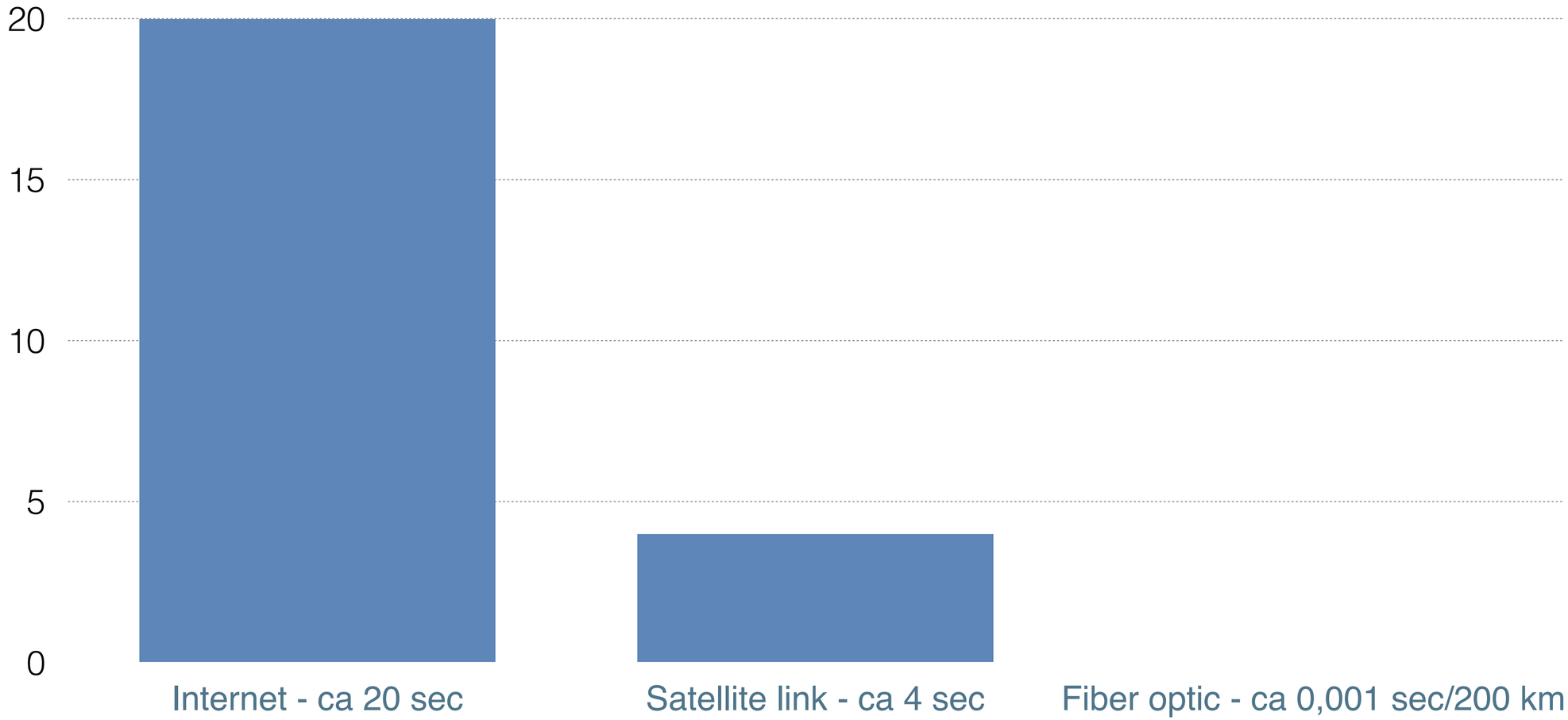
# Fiber for Dummies

TNT/Riksteatern

# Delay


20
15
10
5
0
Internet - ca 20 sec
Satellite link - ca 4 sec
Fiber optic - ca 0,001 sec/200 km

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# Delay

Communication over long distances has been a problem for a long time.
Fiber networks now give the possibility to interact over long distances with minimal delay.

A theatre piece can be performed at several venues simultaneously; a concert can be performed with musicians, soloists, and technicians in different facilities; a musical can be played in front of an audience with the orchestra in another location, and possibilities for rehearsals and learning are created.

Our extensive fiber network allows us to expand the range of culture, stimulate the regional economy, generate new public services, make education and research accessible, and to strengthen international partnership.

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# Sound and Picture

A large amount of audio audio channels can be freely handled and patched between different facilities with microphones and speakers. This enables the participants to talk with each other as if they were in the same room, without any noticeable delay.

It is the lack of delay that creates the feeling of presence. During a concert where the pianist was in Hallunda (Sweden) and the soloist was in Mariehamn (Åland) the delay was measured at 3.5 ms, which is equal to the time it takes for sound to travel 1 meter through air. The geographical distance between the musicians was 200 km but the sound was experienced as if it traveled from the edge of the stage to the first row.

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# Three formats with hardware and network

**1. Communication between two or more people, 25-270 Mbit/s**

For a conversation or meeting, a normal fiber connection is used, which is made via internet. A small delay occurs, but works much better than a video conference over Skype or another mobile solution.

**2. Lesson/rehearsals over long distances, 100 Mbit/s-1.4 Gbit**

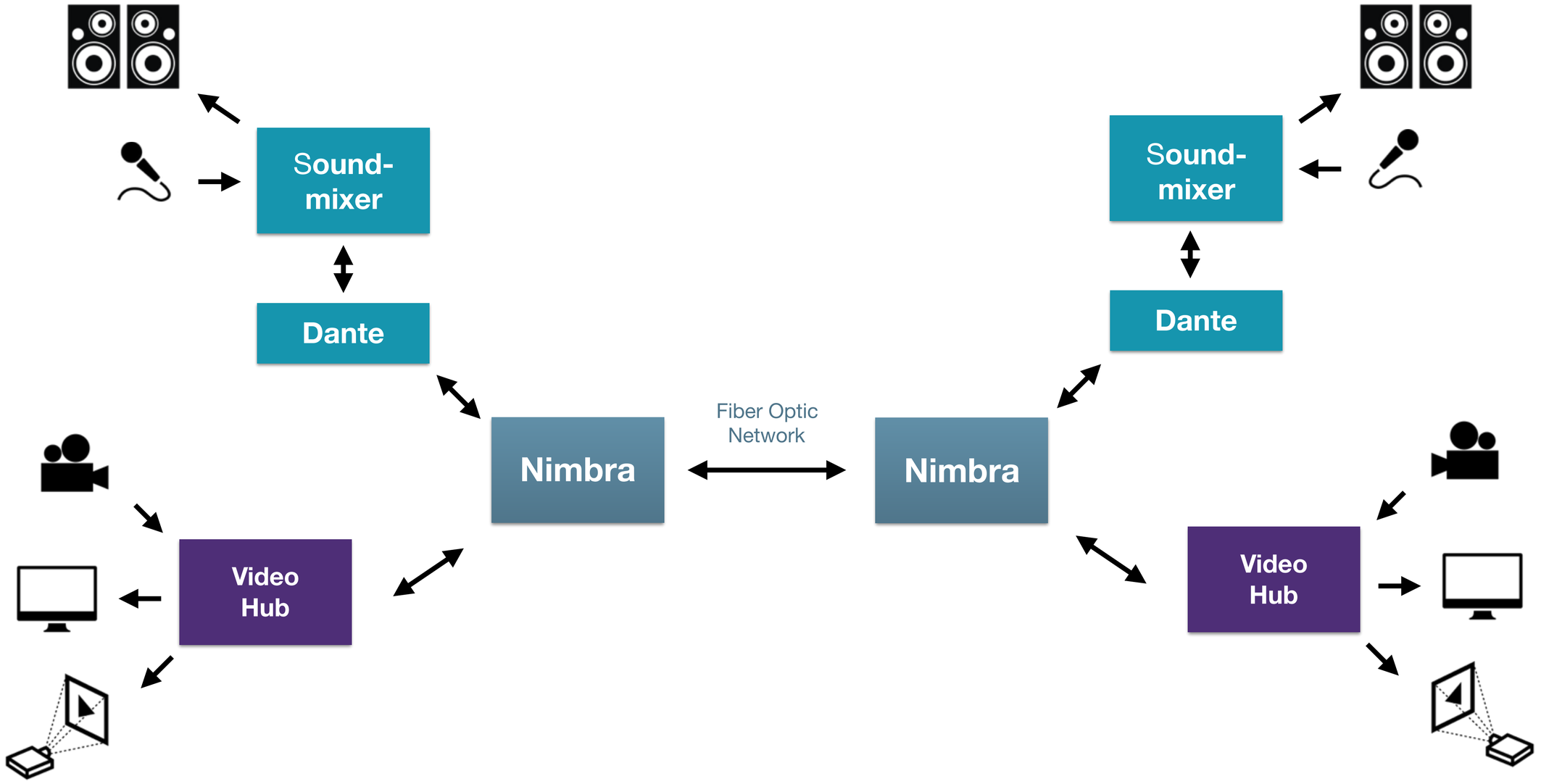
This format can, for example, allow a jazzband rehearse and music lessons to take place over long distances. 2-4 participants can work together from different locations where several cameras can be used. The picture is compressed with a very fast technique that can handle both HD and 4K resolution (used in movie theaters).

**3. Connecting scenes and the audience, 1.5-12 Gbit/s**

In large formats, orchestras and ensembles can carry out a performance from different places. Even sound and light can be controlled from a distance while the performance is simultaneously streamed to other theaters. In this format we avoid compressing the picture and use fiber cables free from other traffic to minimize delay. For up to 80 km distance, this is a solution for sending audio and video at a very low cost.

Using the fiber network at longer distances and over national borders requires a more powerful transmission capacity and several technical components for audio and video. One provider is the Swedish company Net Insight with its Nimbra system.

# Schematic chart



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# Terminology

**Dark fiber/unlit fiber**
Available fiber optic cable. The operator who owns the dark fiber provides the cable, where the user decides themselves what type of equipment will be used when leasing the fiber.  The one who connects is thus not dependent on a particular technology and can choose the technology that best suits the purpose.
Often it is an intermediary in the form of an operator which sells unused fiber.

**Nimbra**
A technical device that converts picture and sound to the correct format. Also works as switch.

**Dante**
Network protocol for audio with built-in remote control.

**SDI**
Serial Digital Interface, a standard for digital transmission of video. The standard does not include compression, which minimizes delay.

**Latency, or delay**
Delay of sound or picture

**Milliseconds**
A thousandth of a second

**Gigabit**
Size of the dataset that is used or needs to be used.

**Video Hub**
Works as a video mixer developed by Blackmagic Design.

**720p, 1080i, 1080p**
The resolution that is used when sending video
I= interlaced, P=progressive, i.e. how the video is drawn up on the display.

**Native format**
The original format which, for example, the camera creates pictures in.  To minimize delay we will avoid conversions of the video format by the camera or projector. It is important to work within the camera's original format.

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# What is fiber?

**Example of a guitar lesson**
https://www.youtube.com/watch?v=ZkdFRa2Djjw

**Technical explanation**
https://www.youtube.com/watch?v=0MwMkBET_5I