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KVM Extenders

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1. Introduction

In today's IT world, screen-based workstations can be found in many different areas, from the classical workplace in the office as well as on the production floor for machine control. Many more types of screen-based workstations exist, but most of them can be associated with the office sphere (e.g. POS – point of sale counters; workplaces at hospitals, especially in the operating theatre or treatment room).

At many screen-based workstations the PC is located under the desk. In areas that are at the frontline to the client, such as reception desks or bank counters and similar service counters, this may be undesirable as it could ruin the aesthetic impression. In a recording or video cutting studio, the noise created by the fans may prevent productive work entirely. In the widest sense, automatic teller machines can also be seen as screen-based workstations, where the workstations need to be protected against vandalism. These are only some examples for the desire to get the computer "out of harm's way" or to provide a productive and ergonomical work environment.

2. Traditional KVM Extender technologies from yesterday and today

In the early days simple extension cables were used to shift screen-based workstations. Even today, this option fulfills its purpose for short distances. Then there were various solutions using proprietary cables based on coaxial conductors as KVM (keyboard/mouse/monitor) extenders. These have since vanished completely from the market in favour of other technologies.

Today's transmission medium is copper wire (CATx) or fibre. The key selection criteria for KVM extenders are the desired resolution of the video signal and the distance that needs to be covered. It goes without saying that keyboard and mouse signals can be transmitted simultaneously, even though they are not explicitly mentioned here. These peripheral signals require only little bandwidth and are thus quite immune to interference. The video signal is visible, however, and therefore the defining component.

Requirements for KVM extenders have increased significantly. In the early days, mainly analogue video signals with VGA resolution (640x480) were transmitted, while today SXGA (1280x1024) has become the standard at the workstation. Image resolutions are still higher at CAD and graphic workstations (1920x1200 and higher). The increasing use of digital video signals (DVI) instead of conventional analogue transmissions needs to be considered as well.

3. KVM via optical fibre

When transmitting an analog video signal via optical fibre, sophisticated KVM extenders usually digitalise the signal first and then transmit it via two optical fibre strands. With multi- mode optical fibres (50/125) distances of up to 500 metres can be covered, and up to 10 kilometres with single-mode fibres. However, there are certain limitations because of bandwidth requirements due to the digitalisation, such as a restricted maximum resolution or a reduced frame rate (images per second) at high resolutions. The latter in particular may cause juddering images. While this may be fully sufficient and acceptable for applications with static content, such behavior is totally unwanted at workstations where graphics and animated pictures are processed.

4. KVM via CATx cables

Problems increasingly occur in analogue transmissions via CATx cables as well. Instead of the once common CAT5 cables, CAT6a CAT7 or even CAT8 cables with shielded wire pairs are installed today. The higher category cables have been optimised for network transmissions, but not for the transmission of video signals.

Most users equate the use of a CATx cable with a digital signal transmission. This is a popular misconception. The CATx cable is only used a transmission medium. The transmitted signal is still analogue. This means it cannot be transmitted via network switches or sections of optical fibre in the network.

The red analogue signal is transmitted via the first CATx pair, the blue analogue signal via the second pair, and the third pair transmits the green analogue signal together with the synchronising signal (sync). The fourth pair is used for the remaining signals such as keyboard, mouse and others, e.g., serial data, audio or the like.

Signal assignment as well as electrical data of signals transmitted via CATx cables are not standardised. It is thus impossible to mix sender and receiver units of different manufacturers.

4.1. Technical detail: Skew effects introduced by CATx cables

To reduce crosstalk between wire pairs in CATx cables, the individual pairs have different twist ratios. The difference in twist ratios results in different effective copper lengths of the individual wire pairs. This difference in length between the pairs in turn leads to different runtimes of the analogue colour signals. These runtime differences can be found in the data sheet of the cable under the term "Skew" and are specified in nanoseconds. The specified value refers to a cable cut length of 100m network segment length and is 20ns on average.

For short cable lengths and low image resolutions, respectively, the skew value can be neglected. An increase in resolution and/or cable length, however, may cause colour shades on the display. At best, the runtime differences only cause blurs; at worst, colour offset may occur which is clearly apparent at vertical lines. A white line for example might then have an undesirable red shadow.

According to the standard, the permissible runtime differences decrease for shielded wire pair cables. Experience has shown, however, that the additional shielding causes capacitive effects that result in streaking. This can only partly be rectified by the compensation settings of the KVM extenders. The maximum achievable distances are approximately 300 metres. In addition to this, electrical interferences may increasingly occur. Generally speaking, the higher the desired resolution, the shorter the achievable distance.

The highest video quality is achieved if solid U/UTP or S/UTP with a wire cross section of at least AWG24 is used to connect the sender and the receiver of the extender.

In the meantime, analogue extender technology is frequently used in conjunction with KVM switches or is integrated directly into them. By controlling the KVM switch from outside the server room proper, the administrator enjoys a comfortable and ergonomic workplace away from the noise of the servers and the chilliness of the air-conditioned room. It also saves him from bustling between the various servers/server rooms..

5. KVM Extenders for digital video (DVI)

But not only have the screen resolution requirements changed, the video signal type has changed as well. Working with digital video signals (DVI) is on the increase. The advantages of DVI are obvious: A-D conversion at the monitor and the graphics card is not necessary any more, and there are no visible losses due to the digital signal.

However, a DVI signal requires a considerably higher bandwidth than a corresponding analogue video signal. This leads to entirely different requirements for KVM extenders. Conventional DVI cables can only cover a distance of five metres according to the standard. The data rate of a single-link DVI signal is 3.96Gbit/s, the maximum resolution is 1920x1200.

Both CATx and optical fibre versions of DVI extenders exist. Since the bandwidth of a DVI signal is considerably higher than that of a CATx cable, compression is used. Occasionally, the colour depth is reduced from 24 bits to 21 or 18 bits or the frame rate. Graphic designers notice this difference in colour depth, for standard applications these losses are irrelevant.

Although the transmission via CATx cable is digital, as with analogue KVM extenders, the signal has nothing to do with TCP/IP. The transmission is proprietary. The maximum range via copper is around 140 to 150 metres.

Optical fibre cables provide a higher bandwidth. Transmission over greater distances is thus possible. The video signal is compressed in such a way that the transmission itself is typically at 1 Gbit/s and 1.25 Gbit/s, respectively. Models with a 2.5 Gbit/s link that do not reduce the colour depth are available. The optical fibre variants normally use 2 fibres, as an option, single fibre is also possible.

PS/2 keyboards and mice are increasingly replaced by equivalent USB input devices. Only few USB KVM extenders transmit the USB signal transparently. More frequently emulations are used that only support devices with the USBHID (Human Interface Device) standard (e.g. MS wheel mouse). Multimedia keys on the keyboard or additional mouse keys are either not or only partly supported here.

Newly developed models are available that not only transmit DVI uncompressed over a single optical fibre but also completely transparent USB 2.0.

Most DVI extenders available have one disadvantage: they only transmit the digital DVI-D signal. No analogue signal (e.g. VGA with a plug adapter) can be transmitted.

6. KVM Extenders for analogue and digital video via TCP/IP

There is a flexible extender for DVI and VGA, though, an IP-based KVM extender. This device doesn't use a proprietary protocol or signal for the transmission, it transmits the signal via Gigabit Ethernet instead. The transmission over cheap copper cable can be routed or extended by means of a Gigabit switch at any time. With a simple media converter it is also possible to switch to optical fibre from anywhere in the transmission path, should an increased range or galvanic isolation be required.

Since both inputs and outputs are designed as DVI-I connectors, DVI-D signals as well as VGA signals (with corresponding adapters) can be transmitted. Conversion between digital and analogue input and output signals is also made if necessary.

Naturally, only the popular and cheap Gigabit Ethernet transmission technique is being used.

Because of the high bandwidth required for the transmission it is not recommended to transmit the KVM data stream of bigger applications via the regular in-house network.

7. Conclusion

If a certain image quality or special functions (e.g. transparent USB) are desired, certain costs arise that are often underestimated during planning. Even minor details, such as DDC handling, are important for the KVM extension to function properly.

Before using or buying, it is generally advisable to check and determine one's requirements and then get expert advice. Usually they can offer several KVM extenders suitable for the purpose and together with the user find the solution that offers the best value for money.

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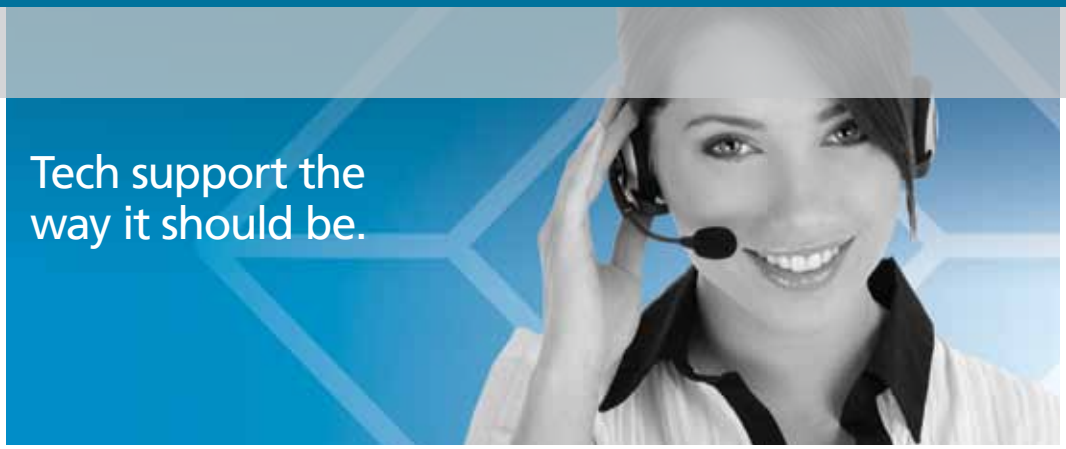

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