This Whitepaper has the purpose to provide a detailed analysis of KVM technology (Keyboard, Video, Mouse Extenders/Switches) in general, along with an overview of the current global KVM market, markets by type, as well as its users. Further, it explores future developments and demands of the market for this technology.

The KVM technology is currently used in many different important fields and has a vast, continuously increasing amount of possible applications. Those major areas include e.g. AV, Broadcast, Control Rooms, Datacenters, Airports & Air traffic control, Traffic management, Government, Post Production, Healthcare, Maritime, Military, Banking, Event areas and museums, Digital Signage & POS and many more.

Major Key Questions answered in this whitepaper

What is KVM?
What is the History of KVM?
What is the current state of the KVM Market?
What are the requirements for KVM solutions?
How is the KVM market expected to grow economically?
What are the largest KVM Markets in the future?
What are the major challenges, opportunities, and improvements in the future KVM market?
What are the current and future Applications for KVM?

About kvm-tec

kvm-tec is the Austrian Developer and manufacturer of KVM Extender and Matrix Switching Systems. Kvm-tec is serving sales partner and distributors international. All technologies – video compression, line-to-line transmission are in-house developed and the KVM extenders are installed around the world.
KVM Extenders, are devices that enable a user to control several computers from one or more sets of keyboards, video monitors, and mice. Current KVM devices also have the ability to share other peripherals like USB devices and audio, or other additional features.

A KVM Extender has many applications. E.g. in data centers, or control rooms and allows the control of multiple computers from a single keyboard, monitor and mouse (KVM). This Extender then enables data center personnel to connect to any server in the rack. A common example of home use is to enable the use of the full-size keyboard, mouse and monitor of the home PC with a portable device such as a laptop, tablet PC or PDA, or a computer using a different operating system. KVM Extender offer different methods of connecting the computers. Depending on the product, the Extender may present native connectors on the device where standard keyboard, monitor and mouse cables can be attached.

The KVM Extender is typically used to support terminals at both ends of the connection, allowing remote and local access to all computers. A KVM can also be used to regulate numerous groups of servers in a data center.
There are several benefits to a KVM that may include the following

- Silence and heat reducing
  All PCs and additional equipment can be stored in the climatized server room

- Hardware Cost reducing because of innovative Software Features

- Ergonomic features can be developed as Software features for reducing hardware costs.

- Mouse glide & Switch, 4K Multiview commander

- More flexibility and access to virtual machines

- Reliable and convenient technology

- Saving space in the rack

- Almost zero latency

- Perfect developed video compression

- Adaptable USB technology with save features

- Dedicated network for security

- Compatibility with standard network components
Before the mouse became relevant in server switching applications, the term Keyboard Video Switch (KVS) was used to describe keyboard and monitor switching devices. With the increased adoption of Microsoft Windows, the mouse and other I/O ports in peripheral switching became prevalent. Remigius Shatas, the founder of Cybex (a popular peripheral switch manufacturer at that time) expanded the initialism to Keyboard, Video and Mouse (KVM) in 1995. Some years later, Universal Serial Bus (USB) began to become the new industry standard for connecting computer peripherals.

As a result of the growing need to switch peripherals (such as touchscreens) in addition to the keyboard, mouse and monitor, some companies are now selling „KVMP“ switch devices standing for keyboard, video, mouse and peripheral).

With the popularity of USB—USB keyboards, mice and I/O devices are still the most common devices connected to a KVM switch. The classes of KVM switches that are reviewed, are based on different types of core technologies in terms of how the KVM switch handles USB I/O devices—including keyboards, mice, touchscreen displays, etc. (USB-HID = USB Human Interface Device)

KVM switches were originally passive, mechanical devices based on multi-pole switches and some of the cheapest devices on the market still use this technology. Mechanical switches usually have a rotary knob to select between computers.

KVMs typically allow sharing of two or four computers, with a practical limit of about twelve machines imposed by limitations on available switch configurations. Modern hardware designs use active electronics rather than physical switch contacts with the potential to control many computers on a common system backbone.
The KVM systems of the new generation should be flexible and all devices should be compatible with each other. Full HD and 4K should be compatible in a KVM matrix depending on the application.

Switching systems are compatible with standard network components, enable super-fast switching and should grow with the network. This means for kvm-tec that the number of endpoints can be expanded flexible. Redundancy and uncompressed provide the necessary security in the system. Sustainability is increased by innovative features, which are implemented as software features at kvm-tec without additional hardware. For KVM high performance systems the perfect real time transmission in Full HD and 4K with a latency of <5ms and perfect video compression is important. The in-house development USB 2.0 transparent allows the greatest possible flexibility in the choice of USB devices. The kvm-tec high performance KVM systems are therefore extremely flexible and scalable in size and Gateway and Gateway2go allow access to virtual machines or live images from the switching system.
loss-free transmission of video and USB signals

The transmission of the signals should take place in real time without delay. With conventional transmission, the signals are always transmitted frame by frame or even only after several frames. This results in a delay time of up to 64ms. Therefore a line to line transmission, where each line is transmitted immediately, reduces the latency time to nearly zero.

Compressed versus recompressed video transmission

Video compression is used to reduce the data rate of a digitized video signal to make it easier to store or transmit and is a key point for selecting the Extender. Full HD has a bandwidth of 3.5 Gbit uncompressed. Here it is optimal to compress with a higher factor (factor 4), so that the transmission is visual lossless with low latency. (<5ms)

A delay-free 4K transmission requires a very compact transmission, so that more than 10 Gbit can be transmitted. With a 4K signal, the amplitude becomes weaker and weaker even over a short distance. Therefore, the Extender needs a re-driver to regenerate the 4K signal and bring it to the correct level to enable transmission. 4K Extenders use a 10 Gbit network technology for transmission.

Uncompressed transmission

Some requirements, on the other hand, require uncompressed transmission of the signals, which enables a representation without artefacts. In the medical field, for example, a delay-free transmission of the signals is required, e.g. for endoscopes. For reporting, unmanipulated data is preferred.
USB transmission
Since new USB devices are constantly coming on to the market, the USB transmission should be very flexible and changeable. If a flexible FPGA chip is used for the USB technology, it can be adapted at any time. Optimally, a technology is used in which USB and video are transmitted via a single cable.

USB Emulation Mode and USB Sharing
USB Emulation Mode the PC is a permanent USB connection with an emulated mouse and keyboard and this has the advantage that the data can be switched without delay from one PC to another.

USB Sharing: Multiple users can control one PC and it is possible to take over USB control in sharing mode. There are two possibilities:-

- HID-Mode USB 2.0 For the HID-Mode USB-Sharing activate the function in the Switching Manager software. After activation, all remote units have shared the USB control in HID mode of the shared computer. Keyboards and mice can be shared in HID mode.
Upgrade packages for endpoints

Switching systems are a combination of video router and KVM matrix switching system over IP. Optimal is, if a system can be extended again and again. This means the number of switching endpoints.

Upgradeable

the upgrades can be activated later with a code
Sound, USB memory or VGA

PoE
With PoE all devices can be powered from the network switch that supports PoE.

24V systems
The extenders should also be suitable for 24V operation
Point to point or Matrix Switching Systems

KVM extenders should be able to be installed as point-to-point connections and in a matrix switching system. A very fast switching between the computers is necessary to ensure an ergonomic workflow. Optimal is a technology, where the endpoint is passive during switching, because this allows fast switching and a large number of end points (with kvm-tec up to 2000 endpoints), because the end point gets the information only at the right moment of switching. This leads to less data traffic in large systems.

The management in the switching system should be possible via OSD and for larger systems additionally via a control software.

In the matrix switching system, Full HD and 4K extenders should be combinable with each other. In different solutions, e.g. with a video wall Full HD and 4K are required in one matrix. In control rooms it is always successful to create an almost visual workspace with unlimited pixel space. Several sources are displayed and operated via one monitor wall. Users should be able to switch or share between the video walls at any time.

Decentralized Switching System

With several local and remote units, one switch on the remote side and one switch on the local side can be connected via uplink cable. 10 PCs and 10 monitors can be connected with one single uplink cable.
In the switching system, computers and servers are moved from the workplace to the server room. This enables a high security level. This also reduces ambient heat and noise at the workplace and the user benefits from an ergonomic and low-noise workplace. Standard network switches, are using the highest security standard in professional networks.

The PC technology offers the highest security in the network and therefore the Switching network can benefit from the high security standard of the PC technology.

If KVM Extenders are compatible with standard Network components the user can benefit from this security standards.

Redundancy of the system or individual components is a requirement that must be met in safety-critical applications. Entire systems can be set up redundantly and the extenders immediately switch to the other port if, for example, the switch fails. Depending on the requirements, the extenders can also be managed as redundant lines. A redundant power supply is also possible.
Softwaremanagement & Features

Software for Extender Management in the Switching System

With software that is intuitively controlled, the Local and Remote Units can be connected or disconnected with touch or mouse click. The extenders should be able to be optimally arranged and colored and should be able to save scenarios, have different layouts, multi-groups and static partners, live preview, capturing, search box, extender binding.

Software Features for an optimized workflow

To increase the sustainability of the system, features should be possible without additional hardware.
Mouse glide & switch is a software feature that enables the operation of up to 16 monitors with one mouse and one keyboard.
With the 4K Multiview Commander as a software feature, content from different PCs can be displayed and operated on one 4K monitor.
The KVM market is changing and growing very fast. Technological advancements have provided the KVM business with several new advantages, and new potential markets, resulting in economic growth.

In recent years, high-performance KVM devices have found many new applications. The AV, broadcasting, control room, datacenters, industry, esports, traffic and air-traffic control sectors in Western Europe and North America have been the driving force for this increased adoption.
According to latest market research, the worldwide market for KVM Switches is predicted to grow at a CAGR of approximately 1.9% -2.7% over the next five years, and will then reach ~910 – 1155 million US$ in total in 2024.

There are several factors being identified for the rise of the KVM market, including the increasing demand, due to the before mentioned benefits of KVM Technology. The KVM Technology saves time, space and money, it has a great price performance ratio, and has many other already mentioned benefits.

Certain companies, which have large amounts of data and high susceptibility to cyber-attacks such as power, emergency services, banking, telecom, and IT are storing data need reliable solutions, providing enhanced security features to protect critical data from intruders. KVM devices help to control multiple systems at once and provides secure and easy access.

Also, the rise in awareness regarding the features and utilization of the systems is increasing adoption.
Currently, North America holds the largest share of the KVM market. Following North America, the Asia Pacific region holds the second largest part of the total market in the following years. With the rise in the adoption of advanced KVM technology and increasing demand for the integration of KVM Extenders in many applications and industries, the market is further growing. Europe, Middle East and Africa are predicted to have smaller growth rates during the next years.

The East Asia and South Asia regions are projected to have a CAGR of 5.8%, which is 2.5x more than the total growth of the KVM Switch market by value, due to an expected increase in the demand for KVM Extenders in the emerging countries such as China and India.
The KVM technology has many advantages compared to classic IT architecture and infrastructure. A fact, which is lately being recognized by an increasing number of companies around the world in many different fields.

In addition to the growth of datacenters in general, new developments in gaming, industrial and healthcare applications, are transforming the KVM market into a quickly growing market.

Before, controlling various devices required multiple numbers of remote control devices. This resulted in increased costs, increased power consumption, and increased complexities in handling and managing. A simple device that could control keyboard, video, and mouse has been developed to ease the complexities in managing too many remote control devices.

During the last years, we are seeing an increase in demand for KVM switches all over the world. The rise of the esports industry, particularly in the USA, Asia, and Europe has also been a driving force for KVM demand. Secure KVMs are more important than ever, with governments and military organizations looking for secure ways of communication and IT infrastructure. Furthermore, there are indications of growing use outside of traditional markets like in the healthcare and manufacturing industry.
Another primary growth factor for the keyboard, video and mouse (KVM) switch market has been identified. It is the short lifespan of servers. Servers in data centers have different lifespans depending on the workload. Application updates and patches degrade the performance of the servers in enterprises and data centers. Servers are adopted depending on their durability and capability to provide high-quality performance in a dynamic environment. The need for new servers based on the workloads will ultimately drive the need for KVM switches.

Future KVM Extenders and Switches have high performance, save space and cost, are economical and very convenient to use which makes them perfect to meet the needs of any application. In addition, KVM devices are becoming more versatile, easier to install, configure and operate.

The KVM systems of the new generation should be flexible and all devices should be compatible with each other. Full HD and 4K should be compatible in a KVM matrix depending on the application. Switching systems are compatible with standard network components, enable super-fast switching and should grow with the network. For kvm-tec this means that the number of endpoints can be expanded flexibly. Redundancy and uncompressed provide the necessary security in the system. Sustainability is increased by innovative features, which are implemented as software features at kvm-tec without additional hardware. For KVM high performance systems the perfect real time transmission in Full HD and 4K with a latency of <5ms and perfect video compression is important. The in-house development USB 2.0 transparent allows the greatest possible flexibility in the choice of USB devices. High performance KVM systems are therefore extremely flexible and scalable in size and Gateway and Gateway2go allow access to virtual machines or live images from the switching system.
FUTURE APPLICATIONS

Public security and Emergency centers

Control rooms of utility companies and power plants

Medical technology, nuclear research and hospitals

Traffic management and transport

Airports & Airtraffic control

Process-driven industry

Conference centers and educational institutions

Broadcast, Film television, OB vans, Post production

Event areas and museums

Digital Signage & POS

LVDS Solutions at airports, shops, POS and digital signage

LVDS Solution in the industry or in hazardous areas