HMI & Virtualization in Process Automation

Thin clients

TDOCT-B0W6_ENG

Your automation, our passion.

PEPPERL+FUCHS

Virtualization is a technology that stems from the information technology (IT) industry and has become more and more popular in process automation. Virtualization promises to ease software management while reducing costs. This trend also has an impact on the human machine interaction (HMI) in such systems. Especially in combination with thin client technology, virtualization provides an easier and cost-efficient way to control process automation systems even in the harshest industrial environments.

In this technical white paper series, *HMI & VIRTUALIZATION IN PROCESS AUTOMATION*, we give an overview on virtualization in process automation and describe how Pepperl+Fuchs' thin client technology fits into virtualized systems.

In technical white paper No. 1 we give a closer look on virtualization technology. We focus on the back end and show how virtualization works and what benefits virtualization offers in process automation.

This technical white paper No. 2 describes thin clients, how they work, what their general advantages are, and which role they play in a virtualized process automation system.

In technical white paper No. 3, we present the P+F remote monitors which are industrial thin client solutions that help to save time and money during installation and operation and offer broader/more functionalities than other technologies.

Dr. Marc Seißler,
Product Portfolio Manager

What is a thin client?

Over the last decade, thin clients have become more and more popular in process automation systems and industrial applications. Especially with the trend to virtualized, centralized automation systems, thin clients represent a powerful and cost-efficient technology enabling the users to access the applications and information that run on centralized hosts (e.g., host server).

In contrast to conventional, decentralized automation systems, where usually all data and applications run on powerful PC-based workstations, in centralized automation systems, the data and applications reside on the hosts which are usually servers. A thin client only runs the user interface that is required to access the applications on the host. (See Figure 1.)

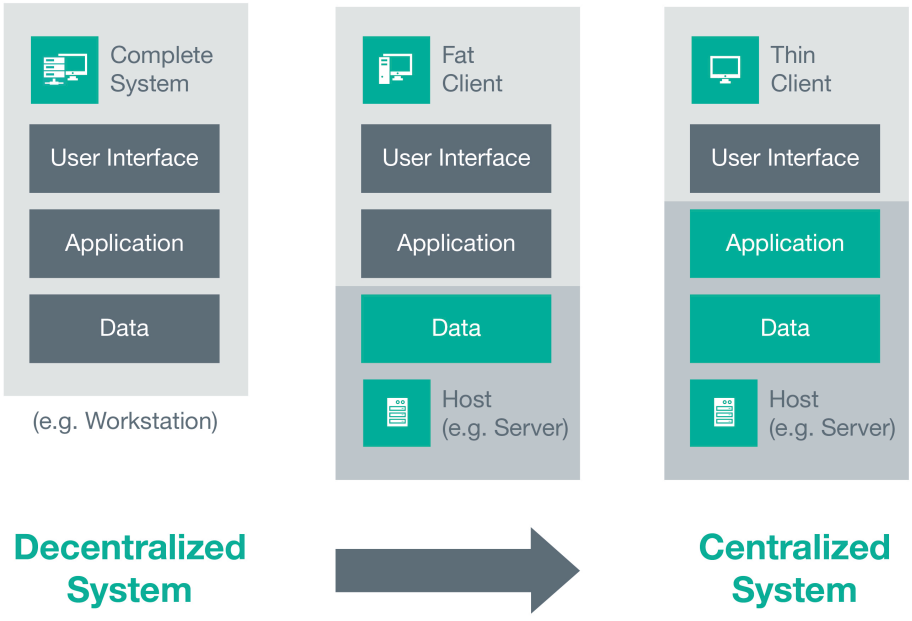

Figure 1: Thin clients are the first choice technology for centralized systems

To do this, a thin client has a minimalistic, usually embedded operating system (OS) and only provides drivers for the input and output devices (e.g., mouse, keyboard, touchscreen, and monitor) that are connected to the thin client.
Additionally, installed communication protocols enable the exchange of the system inputs and outputs between the thin client and host. (See Figure 2.)

All of these remote protocols rely on the same principle:

The host generates the user interface (e.g., GUI and sounds) which is then compressed and sent via the Ethernet-based remote protocol to the thin client. The thin client receives the compressed data e.g., in the form of GUI pictures, decompresses them, and displays them on the screen to the user.

User inputs (e.g., via keyboard, mouse, touchscreen, etc.) are sent in the opposite direction. The thin client captures the physical user inputs and redirects them via the remote protocol to the host. The host decodes the user inputs and delegates them to the hosted operation system and applications. For the applications that run on the host this is transparent, which means that for the applications it looks like the user does his inputs locally on the host. Due to today's high-performance Ethernet infrastructures, the user experiences the interaction with a thin client like sitting directly on the host system.

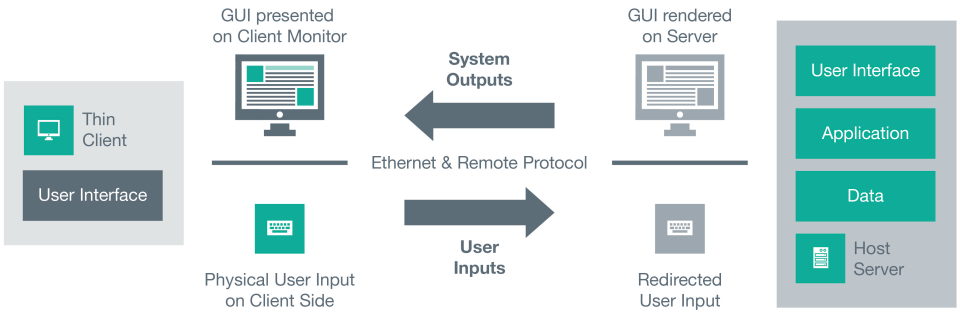

Figure 2: A thin client only provides the user interface to the user

Since thin clients work over Ethernet, they are also the first-choice technology for virtualized automation systems. Conventional technologies like keyboard-video-mouse (KVM) extenders are not suited for virtualized systems. This is because one or many virtual machines (VMs) usually run on host server hardware, which has no dedicated physical interfaces to connect the KVMs to. VMs can be accessed only via Ethernet and the remote protocols.

Today, multiple communication protocols do exist, but there is only a very small set of protocols that are relevant to cover the majority of virtualized – and even conventional, nonvirtualized – applications:

- **Microsoft® Remote Desktop Protocol (RDP)**: RDP is the most popular remote protocol for workstation-based and virtualized automation systems. While today's most recent Microsoft OS can be accessed via an integrated RDP interface (e.g., for remote administration), professional setups with multiple users require a Windows Server OS. The server-based solution for multiuser access is formerly known as Microsoft Terminal Services and was introduced with Windows NT 4.0 Terminal Server Edition many years ago. With Microsoft's strategy to virtualized infrastructures and the launch of Windows Server 2008 R2 in 2009, Terminal Services has been extended and renamed Remote Desktop Services (RDS).
- **Virtual Network Computing (VNC)**: VNC is one of the older remote protocols, which is still quite popular. Especially in smaller, nonvirtualized automation systems this protocol is still used since several open source implementations do exist that allow the setup of cost-efficient solutions.
- **Citrix® Independent Computing Architecture (ICA)**: ICA is a Citrix proprietary, platform-independent remote protocol that is used in large, professional, and virtualized infrastructures with Citrix XenApp and XenDesktop.
- **VMWare PC-over-IP (PCoIP)**: Originally introduced by Terradici®, VMWare integrated this protocol in their virtualized server infrastructure. Besides PCoIP, VMWare also supports access to the hosted VMs via RDP.

Benefits

Using thin clients in a centralized automation system offers a large set of benefits. Many of the features, like centralized management, the need for less local computing resources, and keeping the data on the host server, contribute to a reduced total cost of ownership compared to PC-based, decentralized infrastructures.

Reduced total cost of ownership

Since the applications reside on the host systems, thin clients have less hardware demands compared to workstation PCs. Low-power processors are sufficient to run the different remote protocols and to encode/decode the compressed data exchanged between the thin client and the host. This has an impact on the overall hardware costs, since the thin client components are significantly cheaper than high-performance components of workstation PCs. To have the same performance in a thin client infrastructure, this for sure demands more powerful host servers. Since centralized infrastructures allow a more efficient use of the hardware resources (e.g., due to load management), the total hardware costs sink, especially in mid-size to large applications. (You'll find more about that in the technical white paper no. 1, *Virtualization*.)

Hardware & software longevity

Another benefit of thin clients is that they can have a longer life time than PCs. There are two reasons:

First, application software updates do not affect thin clients, since they only communicate with the host via a remote protocol. This allows thin clients to be used, even if the OS or applications on the host are updated.

The second reason is that the embedded OS that runs on thin clients are supported much longer than desktop operating systems (like Windows XP Professional or Windows 7 Professional) which usually run on PCs.

Reduced configuration effort

Thin clients are much simpler to configure. Instead of installing applications on several workstation PCs, thin clients only need to be configured. This is mostly limited to two steps: Assign the thin client an IP address and specify the host server or VM name the thin client should connect to.

In large installations where multiple thin clients need to be configured, tools for centralized configuration and management help to maintain whole groups of thin clients with one mouse click.

Due to the limited amount of settings that need to be made, this can be done even by personal with limited IT knowledge.

Increased system availability

Especially in industrial environments, systems must run reliably not only for cost reasons, but to protect process equipment and personnel. With thin clients, the process reliability can be increased due to several reasons:

As pointed out before, thin clients have no locally stored data or applications and can be exchanged in a few minutes in case of a hardware defect. This does not affect the applications since they are running on the host.

Since thin clients only need very limited computing power, industrial-grade components can be used for a lower price than a powerful workstation would cost. This has a positive effect on the robustness of the thin client and allows its use in harsh, industrial environments where hardware has to withstand heat, shock and vibration, dust, washdowns, and explosive atmospheres etc.

In case of a host failure, backup hosts can be used. Modern thin clients like Pepperl+Fuchs' remote monitors also allow preconfigured connections to backup hosts to which the thin client can connect automatically as soon as a host failure is detected. With this feature, highly reliable process automation systems can be set up.

Increased flexibility

Thin clients use Ethernet technology to connect to their host systems. Therefore, thin clients can connect to any host system which is located in the LAN, WAN, or even Internet.

This allows the implementation of sophisticated application scenarios, like connecting to backup hosts in case of a failure, to connect to and to supervise different machines in a plant or to access information from different system types like a decentralized control system (DCS) and a manufacturing execution system (MES) which might run on two different hosts and networks.

Higher security

Centralized IT infrastructures also offer a higher security since data and applications reside on the hosts in the data center with centralized backups, redundant servers, etc.

Thin clients in particular are further protected against manipulation e.g., with tools like enhanced write filters and USB lockdowns that prevent users from installing software locally. This significantly reduces the threat of installing viruses.

Conclusion

Thin clients are a high-performance and low-cost solution for accessing applications and information in process automation applications. Pepperl+Fuchs' remote monitors are especially tailored thin clients to withstand the harshest conditions in process automation applications. (See technical white paper No. 3 *P+F Remote Monitors*.)

One of the key benefits of thin clients is that no data and applications are installed locally and need to be maintained. Thin clients use the industry-standard Ethernet and remote protocols to access applications and data that are located on a host system, which can be a VM in a virtualized automation system or a conventional workstation-based setup. This allows minimizing the performance of the computing hardware on the thin client side and eases the system configuration.

Due to the use of standard technologies like Ethernet, end users can take advantage of readily available expertise to implement their automation systems. Software tools for centralized management of thin clients further help to ease the integration of thin clients, even for automation engineers without deeper IT background knowledge.

With the trend towards virtualized process automation systems, thin clients are the first-choice technology for accessing VMs. While virtualization has only a very limited effect on the thin client side, it changes different aspects on the host side.

In the technical white paper No. 1 of our series *HMI & VIRTUALIZATION IN PROCESS AUTOMATION,* we explain what virtualization is and which benefits it promises for process automation systems.