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VIRTUALIZATION AS A LOGISTICS SUPPORT FOR ENTERPRISE MANAGEMENT

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Abstract:
The aim of logistics is to ensure efficient management of material, information and financial flows so that they are always available in the necessary quantity, time and to the right addressee to meet customer requirements. Customer satisfaction can be measured by the rate of service. But how to achieve the highest level of service to the most efficient and with minimal effort? The solution is to optimize the logistics chain, for all partial activities in the production process or delivery process. Traditional solution in terms of using physical systems (servers and personal computer) has several disadvantages. Use of hardware virtualization, which is a new technology of the 21st century and which we meet every day is a suitable and easy-to-use solution for optimizing the logistics chain.

Key words:
Logistics, flow, virtualization

INTRODUCTION

The basic object of business logistics is to manage the material flor from the purchasing to products selling to the final customer. The material flow is also closely linked to information and financial flow. Even for different levels of enterprise management, it is the information flow from which the resulting decisions depend [1]. Because the logistics use information not only for management but also for planning and evaluation, as it is shown in Figure 1.

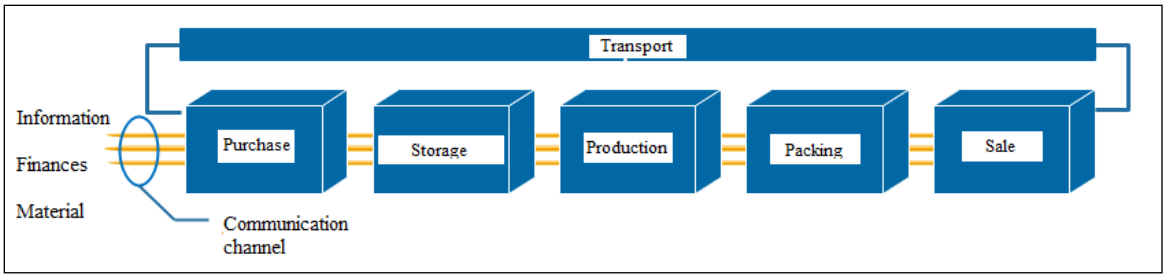

Fig. 1 *Example of material and information flow connection*
Source: [2]

Logistics chain presents a set of logistics elements that create a flow of materials from suppliers to the final customers [3]. Exchange and processing of information are realized due to ICT (Information and Communication Technology) systems and networks, it will have a decisive impact on achieving this goal. Each information system, and this the logistics information system consists of technical equipment, software and service personnel. The architecture of IS (Information System) consists of these subsystems [3,4]:

1. Functional subsystem – this defines the function and purpose of the information system. For example, it may be the processing of input data, information archiving, etc.
2. Technological subsystem – this presents a technical solution for the information system. The selection of the type of hardware, its configuration depending on the required computing power.
3. Data subsystem – used to data storing (information). It can be local disks or network drives depending on the system requirements.
4. Network subsystem – it is created by network components for ensuring data exchange among the elements of information system.
5. Software subsystem – this presents a software of the information system (application).

The information system as a supporting logistics system focuses on customer management, intra-plant processes and distribution to the final customer. It is possible to divide it into three groups [5]:

1st IS for the support of operational (short-term) logistics process – direct management of material, information and financial flows.

2nd IS for the support of medium-term logistics process – material purchase planning, raw material extraction, planning of products production, etc.

3rd IS for the support of long-term processes of the enterprise – creation, planning and optimization of logistics infrastructure of the enterprise, such as the opening of a new branch.

1 VIRTUALIZATION AS A TOOL OF LOGISTICS CHAIN OPTIMIZATION

Virtualization can be used to optimize the logistics chain. There are several types, such as server virtualization, desktop virtualization, network virtualization, virtualization of data storage, applicative virtualization, data virtualization [6]. Hardware virtualization is a technology that allows operation of several virtual systems (VM) on a single physical computer called virtualization host (vHost). vHost has a hypervisor installed instead of an operating system that controls access to hardware components for all VM running on it. VM is a software platform that is independent of virtualization hosts and it is possible to talk about software transportability [7].

Hardware virtualization brings optimization, high availability, scalability, as well as cost saving, it the enterprise can change the traditional implementation of computer techniques. The traditional solution is in terms of physical systems using (servers and personal computers) [8]. The disadvantages of the traditional solution are several:

- A large number of physical systems require a suitable location with sufficient cooling and power.
- Physical systems require high costs for maintenance.
- In the case of power fail, it is difficult to ensure their interchangeability (this solution is quite expensive and moreover, the systems are not properly utilized all the time).
- The use of sources of these systems is very low – around 30%.
- Scalability of such solutions is very demanding with many limitations.

Virtualization is one of the possible solutions to all these problems. Virtualization and its suitable implementation can bring the following benefits:

- Consolidation of systems – reduce the number of installed systems on a smaller area.
- Independence of systems from the used hardware – easier portability or recovery by its failure.
- Lower operating costs – reduce the number of physical systems brings reduced costs for its feeding, cooling and maintenance.
- The effectivity of computer power use will be 80%-
- High availability for critical and less critical applications in the case of failure.

Computer virtualization (also known as hardware virtualization) is a technology that allows multiple virtual systems (VM) to be hosted on one physical computer – called vHost. vHost has a hypervisor installed instead of an OS that controls access to hardware components for all VM. This VM are software platform which is independent of virtual hosts and easily transferable among them [9].

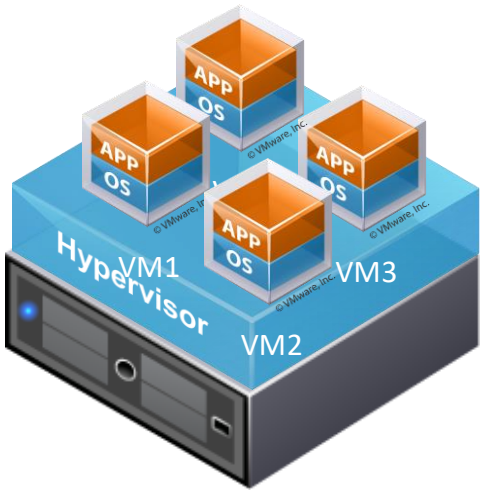

Fig. 2 *Type1 virtualization (bare metal)*
Source: [10]

For the above benefits, virtualization is a sought-after solution for a large enterprise providing ICT services and a cloud of providers, such as Amazon, Google, Microsoft, Vmware or T-Systems. With the number of systems, about 1000 and the mentioned benefits, this system allows them to provide services such as IaaS (Infrastructure as a Service), Saas (Software as a

Service) or PaaS (Platform as a Service). Without hardware virtualization, this would not be possible because the traditional solution is not able to compete with this technology in any aspect. The traditional solutions in comparison with this, are more complicated, inflexible, demanding, ineffective and outdated [10].

Publication describes the design of virtualization solution for ICT enterprises are several [11,12]:

- VMware vsphere design 2nd edition from Forbes Guthrie, Scott Lowe and Kendrick Coleman
- VMware vSphere 6.x Datacenter Design Cookbook from Hersey Cartwright
- Designing Hyper-V Solutions from Saurabh Grover
- Microsoft Hyper-V Cluster Design from Eric Siron
- Architecting the Cloud: Design Decisions for Cloud Computing Service Models (by M.J.Kavis)
- Cloud Computing: Concepts, Technology & Architecture (by Thomas Erl)
- Cloud Computing Design Patterns (by Thomas Erl and Robert Cope)
- Cloud Computing: From Beginning to End (Ray Fafaels)

A suitable implementation of hardware virtualization allows presenting the described advantages also in the field of industrial logistics, for small, medium-sized and other mining or production enterprise. It does not need to be only ICT providers and multinational corporations. There are not many (if any) publications dedicated to the deployment of virtualization within information systems in industry in the market. At the same time, each mining and production enterprise has some information system (or several) through which it plans, processes and manages information, material, financial flows by the production of its final products. These information systems also consist of information technologies that can be very suitable candidates for virtualization. A suitable implementation of virtualization tools within the systems of informational logistics can develop a powerful, stable and customizable information system. This system instead of a traditional server and computer solution can be created by redundant virtualization hosts. These would provide the necessary performance for processing and transmission of information among components in the information systems, not only for the need for logistics. At the same time, they could serve as a platform for creating other information systems, such as ERP, MIS, SCM, CRM and all integrated into one shared enterprise information system for the need of effective processing and control of information flows [13].

2 RESULTS

There are several suppliers on the market, and the most commonly used solutions are Vmware ESXi, Microsoft Hyper-V, Linux KVM, Xen server. They differ in the hypervisor architecture, configuration maxima, guest OS support, licensing method and price. All offer all key functional, such as:

- Migration of VM among vHosts without application failure,
- Adding and removing of some virtual components by open VM,
- Allocate more resources for VM than the capacity of virtualization hosts,
- Creation of HA configuration,
- Scaling and expansibility.

The comparison is presented in Table 1.

Tab.1 Hypervisor Comparison 2019: KVM vs Hyper-V vs XenServer vs vSphere [14]

Feature	**Windows Hyper-V2019**	**vSphere 6.7**	**XenServe R 7.6**	**KVM**
RAM/Host	24TB	12 TB	5TB	12TB
LPs/Host	512	768	288	10/CPU
RAM/VM	12 TB (gen2)	6 TB	1.5TB	6 TB
CPUs/VM	240 (gen2)	128	32	240
VM Disk	64 TB (gen2)	62TB	2TB	10TB
VM Live Migration	Yes	Yes	Yes	Yes
VM Replication supports	Yes	Yes	Yes	Yes
Overcommit resources	No	No	No	Yes
Disk I/O Throttling	Yes	Yes	Yes	Yes
Hot plug of VM vComponents	Yes	Yes	Yes	Yes

Source: [14]

3 CONCLUSIONS

In order to achieve better results with the least possible effort, the enterprise should deal with a suitable implementation of information and communication technologies in the defined quality. These technologies belong to the fastest technologies and they have a significant impact on any human activity. The right proposal, which is preceded by the definition of goals and analysis, is a very important and extensive activity in the establishment of the enterprise, designing of production of a new product, but also in the case of a finding of bottlenecks in the process that we want to remove. It is important to realize that any proposal, whatever it is good at the beginning, is later exposed to changing internal and external factors. Therefore, the proposed solution must fulfil not only the conditions and requirements defined in its creation but also in the future – it should be modular to some extent without the need for a complete rebuilding.

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