



San Francisco, California, USA  
6-11 October 2013

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# Application of Virtualization to CERN Access and Safety Systems

Access and safety systems are by nature heterogeneous: different kinds of hardware and software, commercial and home-grown, are integrated to form a working system. This implies many different application services, for which separate physical servers are allocated to keep the various subsystems isolated. Each such application server requires special expertise to install and manage. Furthermore, physical hardware is relatively expensive and presents a single point of failure to any of the subsystems, unless designed to include often complex redundancy protocols. We present the Virtual Safety System Infrastructure project (VSSI), whose aim is to utilize modern virtualization techniques to abstract application servers from the actual hardware. The virtual servers run on robust and redundant standard hardware, where snapshotting and backing up of virtual machines can be carried out to maximize availability. Uniform maintenance procedures are applicable to all virtual machines on the hypervisor level, which helps to standardize maintenance tasks. This approach has been applied to the servers of CERN PS and LHC access systems as well as to CERN Safety Alarm Monitoring System (CSAM).

## Tool selection

- Main choices: VMware vSphere Infrastructure, Xen, and Microsoft Hyper-V
- Emphasis: management and usability (operability by users of limited experience)
- Want easy no-nonsense data center management and graphical user interface
- Options for assuring redundancy and high availability
- Need virtual machine backup
- Need compatibility with SCADA systems and similar architectures
- Must be able to virtualize systems accessing special hardware: PCI, USB, I/O
- Need compatibility with HP Proliant Servers
- Need off-line patching/upgrade
- Best fit: VMware vSphere Infrastructure

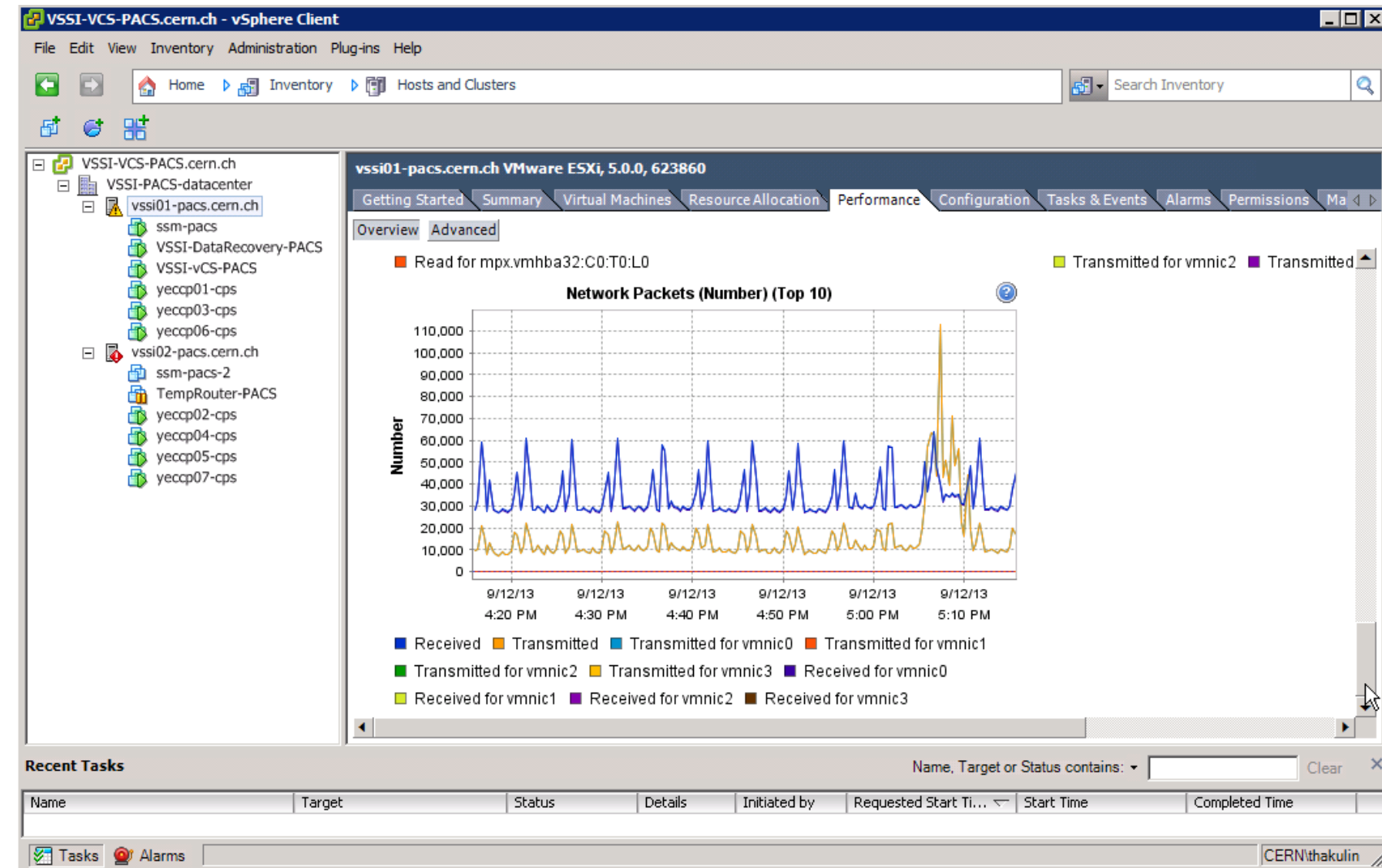
## Access and safety systems by GS/AESE

- LACS** (LHC Access Control System) – who enters LHC and when
- LASS** (LHC Access Safety System) – is it safe for beam or access at LHC
- PACS** (PS Access Control System) – who enters the PS Complex and when
- PASS** (PS Access Safety System) – is it safe for beam or access at PS
- SPS PSS** – integrated personnel safety system for SPS
- SUSI** (Surveillance des Sites) – who enters CERN sites and areas other than the accelerators
- CSAM** (CERN Safety Alarm Monitoring) – alarms for the fire brigade
- Sniffer** – gas detection in CERN tunnels and caverns
- SIP** (Site Information Panels) – display relevant info at access points
- SSA** (Safety System Atlas) – personnel access and safety system for the Atlas detector.

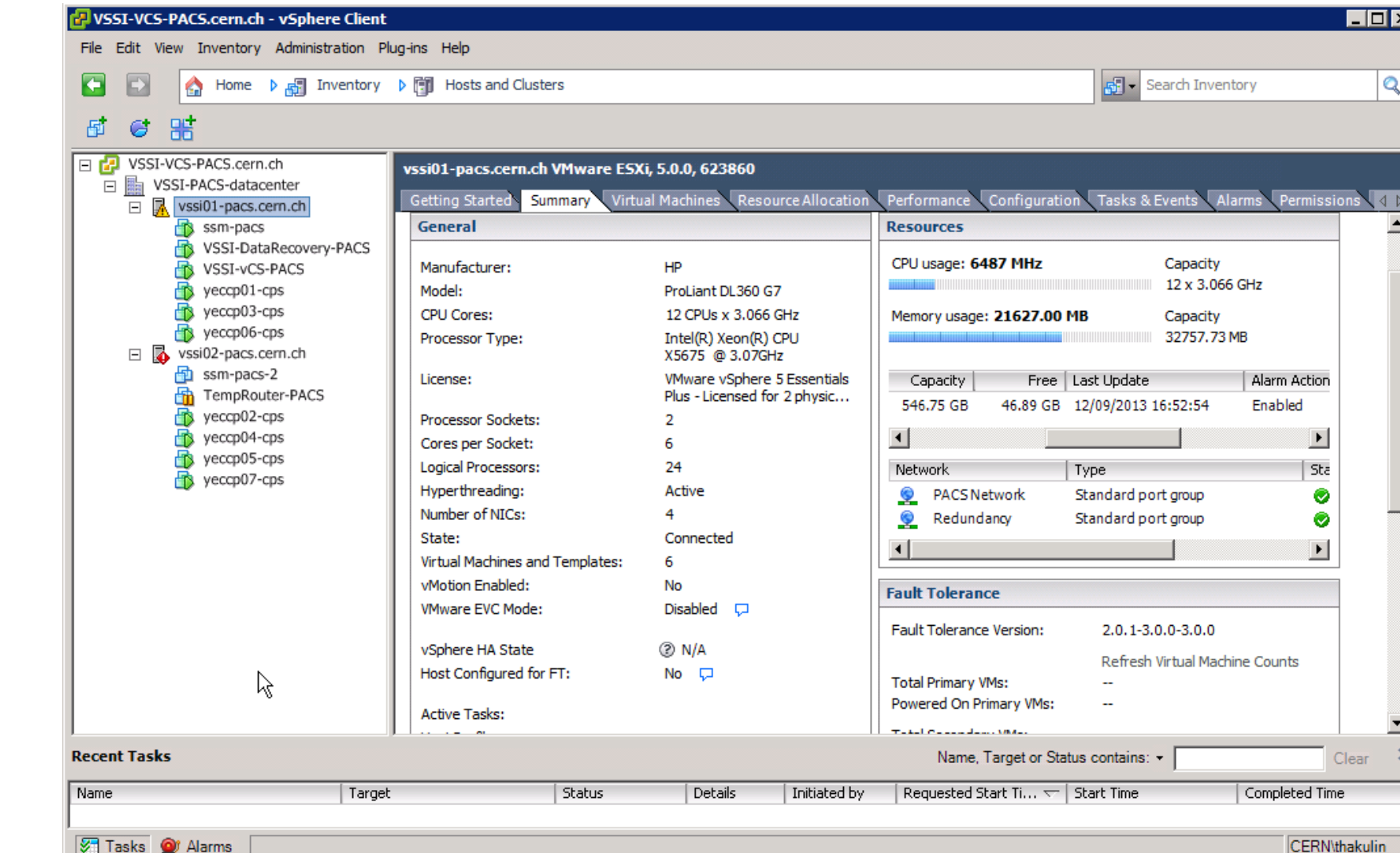
## Use case – why virtualization

- Ease management and increase availability
- Can create, configure and test virtual servers off-line
- Can use a virtual machine template to automate standard installations
- Minimize interruption of service in case of hardware failure: VMs can be restarted in other hosts
- Easy backup of virtual servers
- Safeguard against possible destabilizing effects of system patches using snapshots
- Recovery in case of crash does not necessary require skills in application system

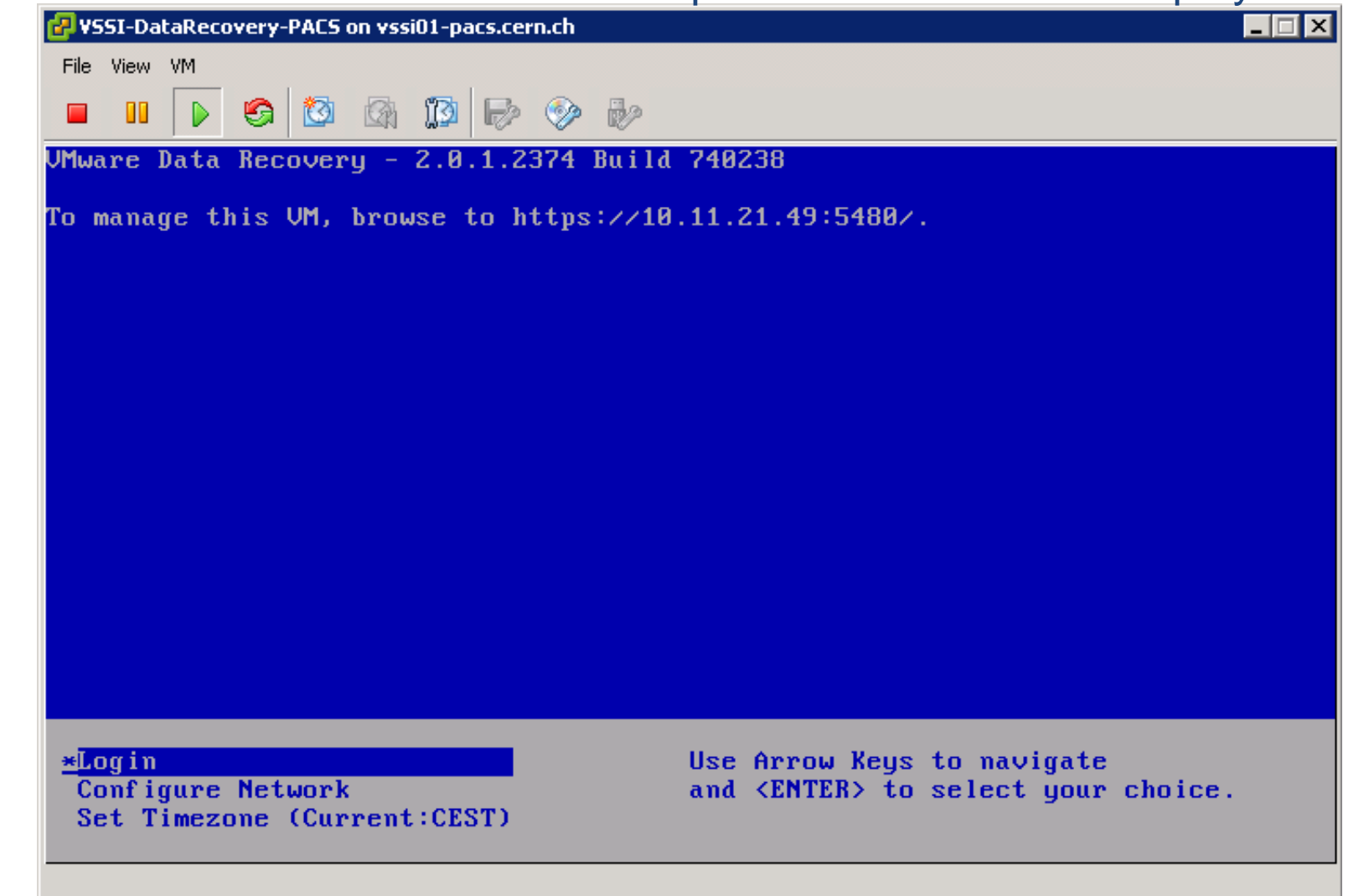
VMware host performance graph showing network packet statistics of all host network interfaces



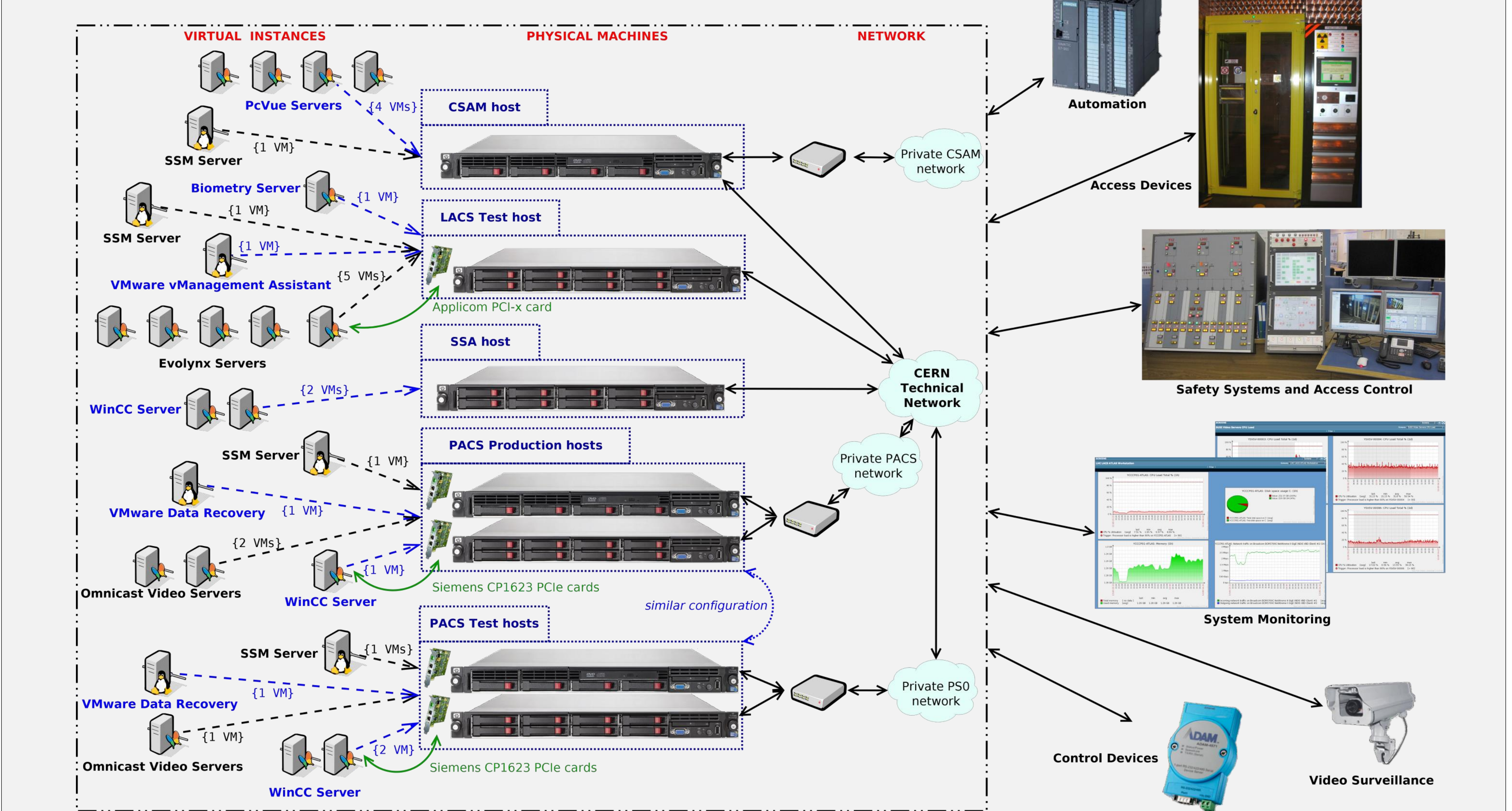
VMware hypervisor management interface showing a list of virtual machines with host status info



VMware backup virtual appliance command line console allowing to configure the basic parameters of the backup system



## Current status of the VSSI framework



## Virtual environment

- Host hardware:**
- HP Proliant 360DL G7 with 12 cores, 32GB RAM, 600GB RAID 6 disks
- VMware vSphere Infrastructure:**
- VMware ESXi 5.0 U1 hypervisor
  - VMware vSphere Server 5.0 U1 and clients
  - Tools and virtual appliances: VMware DataRecovery, vSphere Management Assistant
- Virtualized systems:**
- Scientific CERN Linux 5 and 6 servers
  - Microsoft Windows Server 2003 and 2008
- Applications:**
- WinCC – PACS and SSA Safety and Access SCADA system and Human Machine Interface
  - PcVue – CSAM Safety SCADA system
  - SSM server – CERN Safety System Monitoring
  - Omnicast video server – PACS video surveillance and archiving
  - Vox@Net – PACS public address system
  - Biometry Server – LACS and PACS biometric iris authentication
  - AEOS Server – PACS access control and authorization
  - Evolynx Server – LACS and SUSI access control and authorization

## Users and roles

- **Role** – Template with default permissions to be given to a user of the virtual infrastructure.
- **Permission levels and inheritance** – some permissions only make sense on a certain Level of the data center hierarchy. Permissions on a level of the permissions tree are inherited by all the branches below this node.
- **VSSI vCenter Administrator role** – For managing entire vCenter configurations.
- **VSSI Power Operator role** – For configuring application virtual machines: can assign network interfaces, change VM parameters, memory, disk, etc.
- **VSSI Operator role** – For managing application virtual machines: can diagnose problems (view logs, get alarms), start / stop / suspend VMs, restore VM image from backup

## Future

- Migrate current LACS production servers to VSSI
- Refine management of VM back-up and redundancy
- Collect feedback from maintenance and operation teams to improve current management protocols

## References

- [1] <http://www.vmware.com>
- [2] <http://www.linux-kvm.org>
- [3] <http://www.xenproject.org>
- [4] <http://www.microsoft.com/hyper-v-server>
- [5] <http://www8.hp.com/us/en/products/proliant-servers>
- [6] [http://en.wikipedia.org/wiki/HP\\_Integrated\\_Lights-Out](http://en.wikipedia.org/wiki/HP_Integrated_Lights-Out)
- [7] P. Ninin et al., "Refurbishing of the CERN PS Complex Personnel Protection System," MOPPC059, this conference.
- [8] T. Hakulinen et al., "Revisiting CERN Safety System Monitoring (SSM)," MOPPC055, this conference.

