

## **Virtualized Grid on a Virtualized Network---Magrathea, VirtCloud, and SBF**

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While virtualization provides a promising tool to deal with some of the very difficult problems of Grid deployment, a proper Grid virtualization needs direct support in many of its components. In this paper we will present a virtualized Grid environment deployed as the Czech Grid infrastructure that connects virtualized computing resources---nodes running Xen---via a virtualized network---the VirtCloud system---using scheduler extensions---the Magrathea and SBF systems. The Xen-based virtualization of computing nodes allows our users to run individualized software environment (including different operating systems and middleware stacks) on the same physical substrate. The VirtCloud system uses network virtualization to provide compartmentalization at the network level to separate user's machines from unwanted (or even insecure) interaction among themselves or with Internet. The Magrathea system extends the basic Grid schedulers to understand the virtualized hardware platform and to take care of different states virtual machines can take (e.g., the frozen or hibernated state of an image). The SBF adds scheduling capabilities to the network layer, supporting creation of subnets (at the Level-2 of the network, i.e., independently on the IP addressing) that connects virtual nodes into virtual clusters and Grids. The VirtCloud system supports dynamic creation of the subnets without the need of run-time administrative privileges on the backbone core network, without any degradation of performance as otherwise experienced with the use of VPN based solutions. Real experimental results will be shown, experience discussed, as all these components are deployed on the Czech Grid infrastructure and are in a pre-production service.