



Enabling SDN & Storage Virtualization in Bare-Metal Clouds

With cloud computing becoming the norm, bare-metal clouds are taking off as customers look for high-performance workloads, direct hardware access and custom environments at scale.

The Promises and Pitfalls of Bare-Metal Clouds

Bare-metal clouds offer key advantages over traditional IaaS and PaaS models, including predictable and consistent performance for big data analytics and AI, direct application access to hardware and simple migration of legacy on-premises apps to the cloud – all of which are driving the increasing demand for bare-metal cloud services.

Despite these advantages, today's bare-metal clouds lack the flexible networking and storage service offering that software-driven IaaS cloud environments provide: Tenant networking, security groups and virtual remote storage are key ingredients of the modern software-defined data-center (SDDC) that are absent in bare-metal clouds. The added complexity of developing and deploying dedicated images onto different bare-metal server environments at scale, as well as maintaining them, is error-prone and adds much overhead to enterprises.

The above also creates vendor lock-in for service providers who are forced to deploy only a handful of compute, storage and network equipment vendors throughout their cloud infrastructures, as any new hardware vendors or models they introduce will likely force end-users to customize their software images.

Introducing BlueField® SmartNIC

Mellanox BlueField SmartNIC is the world's leading, fully-programmable network adapter. Integrating the best-in-class Mellanox ConnectX® network adapter with a set of Arm processors makes BlueField SmartNIC capable of delivering powerful functionality for cloud data-centers, high-performance networking and storage applications. Combining programmable hardware acceleration engines with general-purpose software and advanced network capabilities helps turn BlueField into the ideal platform for bare-metal provisioning, storage virtualization, and more.

BlueField provides built-in functional isolation between the host's CPU and the Arm-based system that protects each individual workload and provides flexible control and visibility at the server level, reducing risk and increasing efficiency. BlueField SmartNICs come in different speeds, CPU core amounts, and PCIe widths—from dual-port 25GbE PCIe Gen4 x8 to dual-port 100Gb/s Ethernet and InfiniBand PCIe Gen4 x16, supporting 4/8/16 Arm cores.



How Mellanox's BlueField SmartNIC Transforms Bare-Metal Clouds

By its unique design, Mellanox BlueField SmartNIC abstracts the network and storage services for bare-metal servers, similar to how host hypervisors provide abstraction for guest virtual machines. The BlueField SmartNIC emulates a VirtIO-compliant network device and an NVMe storage device to the bare-metal host operating-system. Because the BlueField SmartNIC has built-in software acceleration, it also provides superior network and storage I/O performance. The following diagram illustrates how BlueField enables software-defined networking and storage virtualization for bare-metal cloud services:

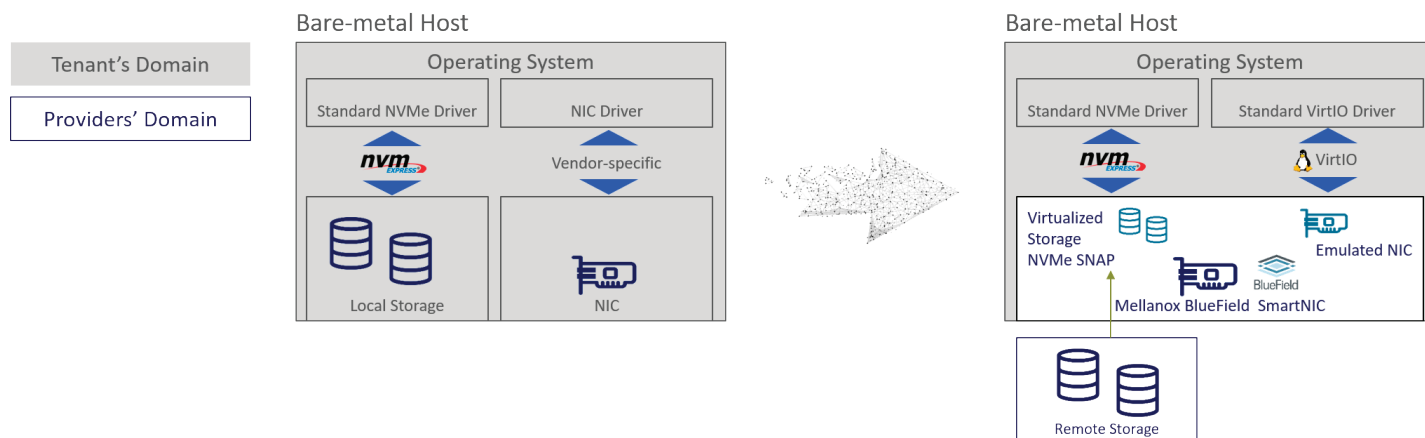


Figure 1: BlueField enables SDN and storage virtualization for bare-metal clouds

Enabling Software-defined Networking (SDN) in Bare-Metal OpenStack Clouds

Mellanox has partnered with the OpenStack community to deliver a bare-metal server provisioning solution, powered by Ironic, Openvswitch (OVS) and BlueField. By deploying the standard Neutron Openvswitch L2 agent on the BlueField SmartNIC, bare-metal servers benefit from accelerated networking connectivity with enhanced services including VXLAN, security groups, DVR, trunk ports and more. As BlueField SmartNIC runs OVS and maintains the existing interfaces on the SDN layer, the solution may be programmed by a full-feature SDN controller, e.g. OpenDayLight, Nuage, OVN, etc., enabling SDN in bare-metal OpenStack cloud environments.

Moreover, as BlueField SmartNIC emulates a standard Virtio-compliant network interface to the bare-metal host, it is unnecessary to install a network driver in guest virtual machines for network connectivity. This is a key benefit for cloud tenants, allowing them to deploy the same software images as they deploy in virtual environments.

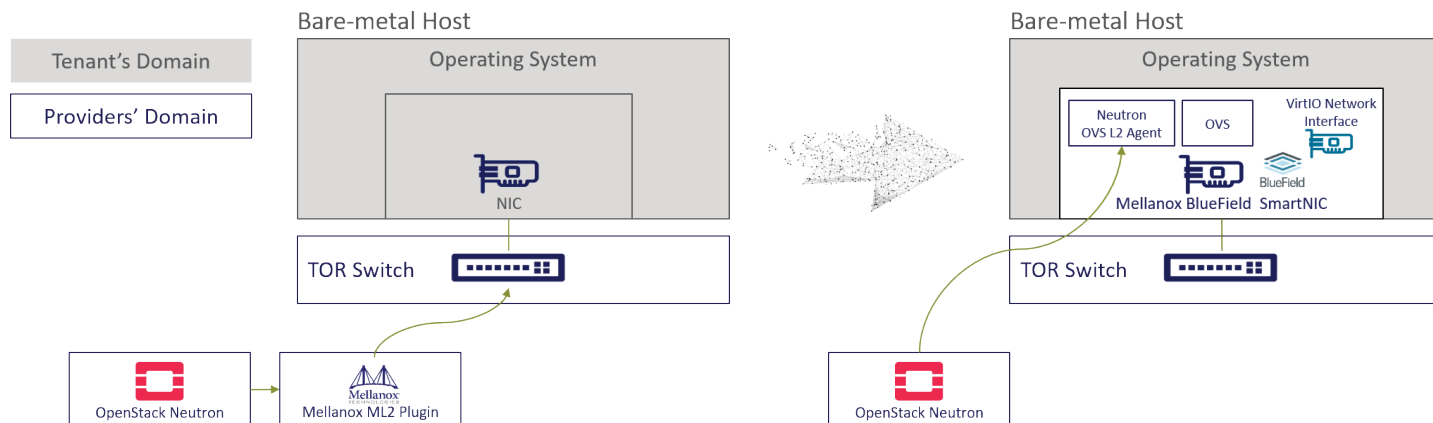


Figure 2: Software-defined networking (SDN) in bar-metal OpenStack clouds

Enabling Storage Virtualization in Bare-Metal Clouds

Bare-metal cloud service providers typically deploy local storage in every server for use by cloud tenants. While local storage offers high-performance access for bare-metal servers, it comes at a price for service providers as it limits their ability to provision remote storage that is easier to maintain and protect.

Mellanox's BlueField SmartNIC offers NVMe SNAP™ (Software-Defined Network Accelerated Processing), which enables hardware-accelerated virtualization of NVMe storage. NVMe SNAP emulates a local NVMe storage device to the bare-metal host, while the storage media is served on remote NVMe JBOF array. BlueField's NVMe storage emulation does not require any change in the cloud tenant's software images as the storage emulation uses their standard operating-system's NVMe PCIe driver.

Storage virtualization enables bare-metal cloud service providers to disaggregate storage from the compute elements in the data-center with great efficiency and flexibility, including thin-provisioning, data migration and data protection, and cost reduction on CAPEX and OPEX. Because BlueField features built-in NVMe target storage acceleration, it suffers little to no performance degradation.

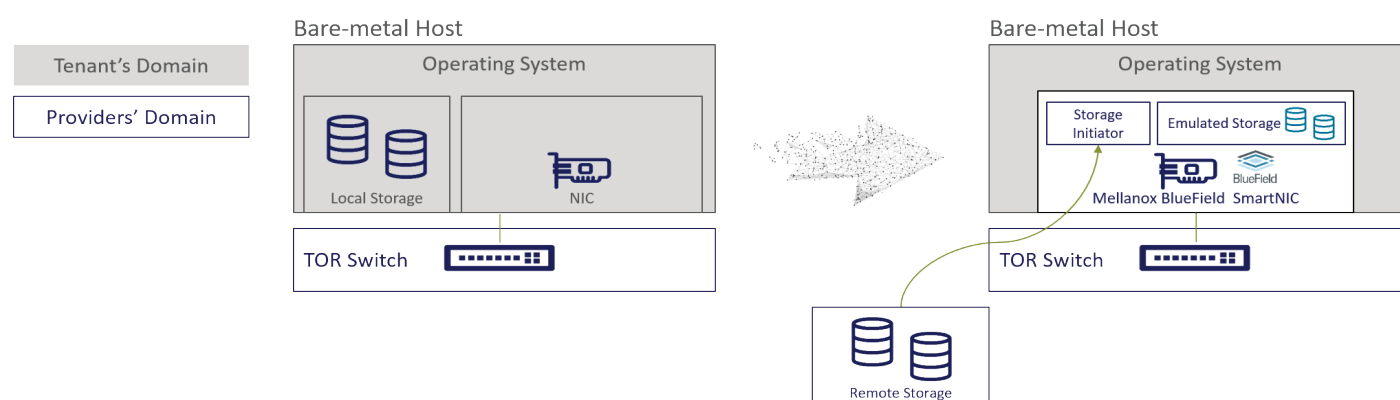


Figure 3: Storage disaggregation from compute elements in the data center

Better Control. Increased Agility. Enhanced Security.

Traditionally, bare-metal cloud providers have been forced to compromise on how they provision, manage and secure their infrastructures. To deliver the promises of bare-metal clouds, service providers remain without access to the server infrastructures they own and service; the only interface they have is in the top-of-rack (TOR) switch, for hosts connecting to the network. The resultant lack of visibility to the host systems has pushed industry network vendors and the ecosystem to devise TOR-based solutions with limited cloud management and security functionality capabilities. Mellanox BlueField SmartNIC provides a complete solution to best serve the challenges faced by bare-metal cloud service providers.

Enabling SDN for bare-metal services, cloud providers can now deploy BlueField in their compute and storage infrastructures, which they can re-purpose as bare-metal or virtualized environments more rapidly, based on customer demand. BlueField eliminates the need to apply special configurations on the TOR switch to achieve SDN-like services, so that a computing cluster can simply transform from a bare-metal into a hypervisor-based cloud environment simply by deploying new images on the compute nodes. The same is true vice-versa, i.e. transforming a hypervisor-based environment into bare-metal cloud-as-a-service, increasing ROI and reducing TCO, while delivering great operational agility and flexibility.

Additionally, as BlueField SmartNIC is, by itself, a computer with a fully-functioning operating-system and applications, it acts as a “computer-in-front-of-a-computer,” enabling applications to run on its CPU, fully isolated from the host’s CPU and operating-system. This isolation enables software agents to run on the SmartNIC when they cannot run on the host system, in turn enabling cloud service providers to deploy software agents that enforce security policies on BlueField instead of the host itself. Enforcing policies on the BlueField SmartNIC is ideal for bare-metal cloud environments due to the following:

- No need to install agents on servers that are in the cloud tenant’s domain
- No impact on server performance, unleashing the full potential of bare-metal clouds
- Eliminating the need for applying security controls in the TOR switch
- Enabling diverse cyber security solutions, enhancing data-center security
- Complete isolation of the security control enforcement from the tenant’s workload

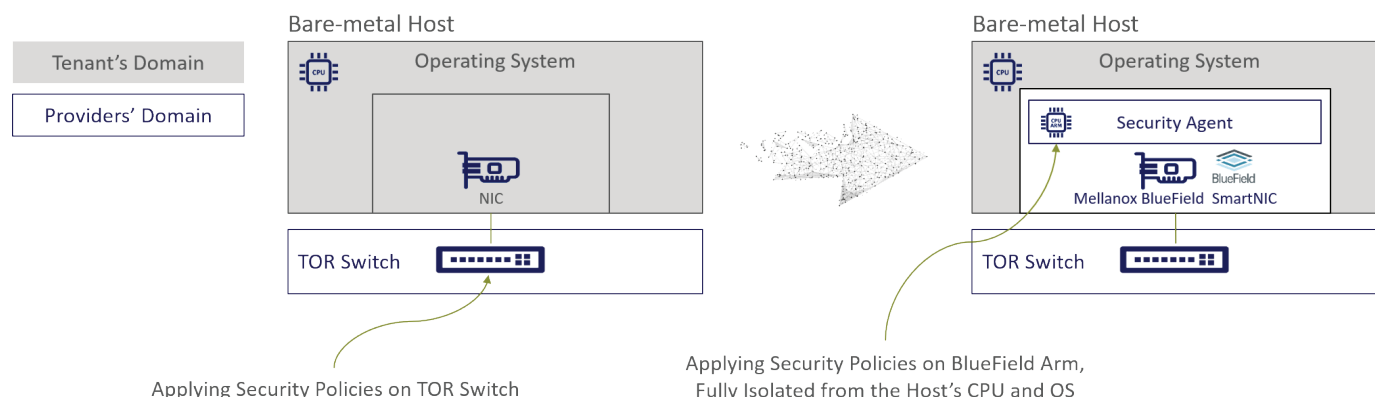


Figure 4: How BlueField empowers data-center security in bare-metal Cloud

By taking a closer look at BlueField’s isolation capability, we can see this isolation is key in making BlueField work best for data-center security solutions in bare-metal environments, as it delivers the needed separation of the security controls from the host, while delivering unmatched performance. In the event a host has been compromised, the separation between the security controls and the compromised host helps stop the attack from spreading further throughout the data-center.

Conclusion

According to a [recent study](#), the global bare-metal cloud market is expected to grow to USD +7 billion by 2023, at a compound annual growth rate of 30% during the forecast period (2019-2023). This exponential growth will require bare-metal cloud providers to scale their infrastructures globally, and rapidly, while increasing operational agility and efficiency. Mellanox’s BlueField SmartNIC is perfectly positioned to transform bare-metal clouds with software-defined networking and composable storage technologies that will redefine bare-metal cloud services of the future, today.

About Mellanox Technologies

Mellanox Technologies (NASDAQ: MLNX) is a leading supplier of end-to-end Ethernet and InfiniBand smart interconnect solutions and services for servers and storage. Mellanox interconnect solutions increase data center efficiency by providing the highest throughput and lowest latency, delivering data faster to applications, unlocking system performance and improving data security. Mellanox offers a choice of fast interconnect products: adapters, switches, software and silicon that accelerate application performance and maximize business results for a wide range of markets including cloud and hyperscale, high performance computing, artificial intelligence, enterprise data centers, cyber security, storage, financial services and more. More information is available at: www.mellanox.com.