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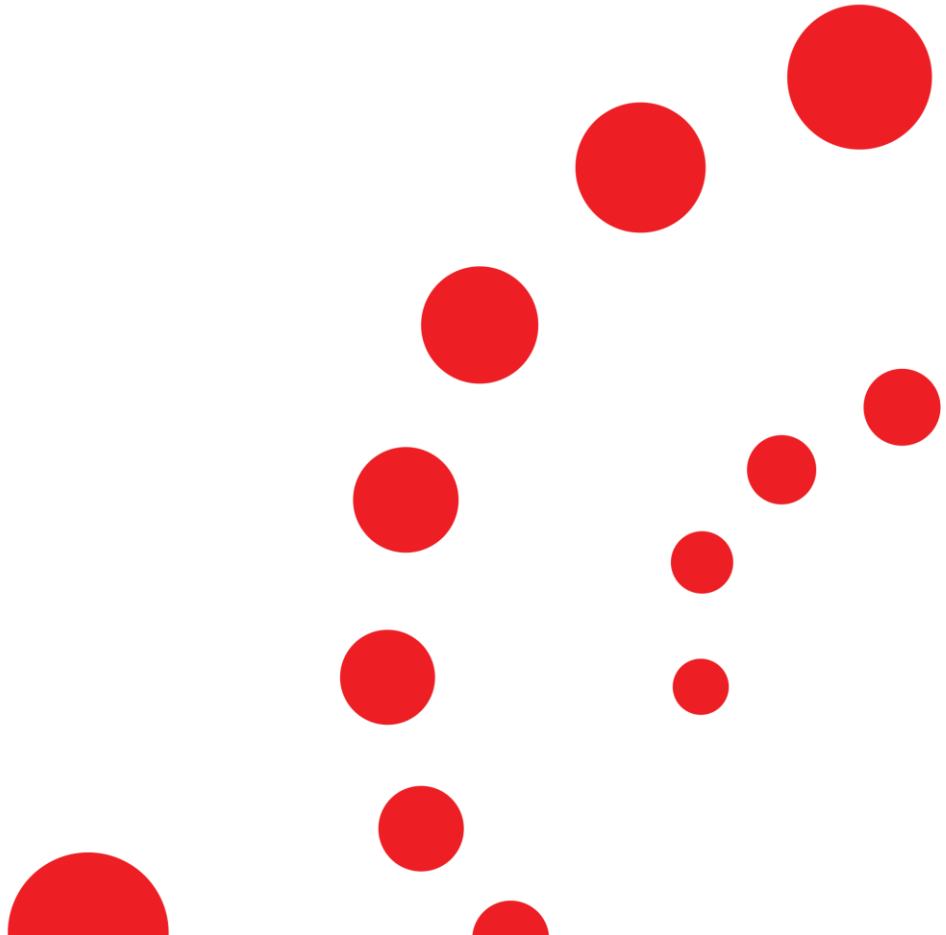
Next Generation HCI

Yong Wang



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Is Investing in HCI R&D Worth It?

- Introduction of HCI
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Introduction of HCI: What Problems Does HCI Try to Solve?

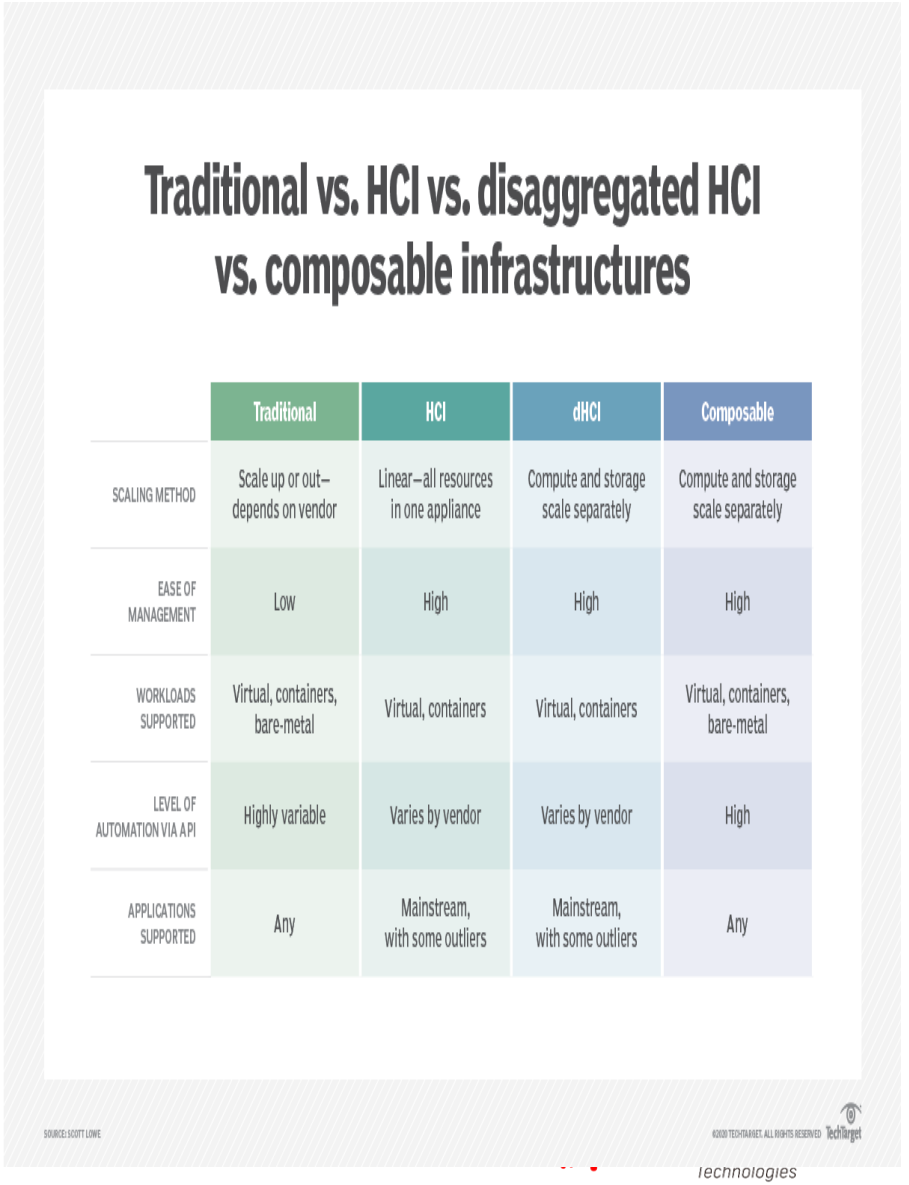
- Data center complexity
  - Traditional three-tier architecture in data centers (servers, storage systems and network fabrics)
  - Need deep planning to build three tier
  - Management complexity
    - HCI provides ease of acquisition, scale-out architecture, ease of management, all to reduce the complexity
    - HCI is more cloud-native, providing application-level integration, for example, it can start with a VM and hide complexity of storage pool and LUNs

- Heterogeneous data centers
  - Enterprises want the “best of breed” of each tier
  - Interoperability task is taunting
  - Also want “one vendor” to take the responsibility when something went wrong
  - The more moving pieces you have, the more expensive putting them together will be
    - HCI is a single-vendor platforms that ensure compatibility, interoperability and consistent management

- Fast pace of business change
  - Today, business changes at a much faster pace
  - IT must respond to the demands of business much faster;
  - IT must also eliminate systems management errors and oversights that might leave critical systems vulnerable.
    - HCI resources, the hardware and software, are tightly integrated and pre-optimized
    - HCI can be deployed singularly to start and then quickly and easily scaled out as resource demands increase.

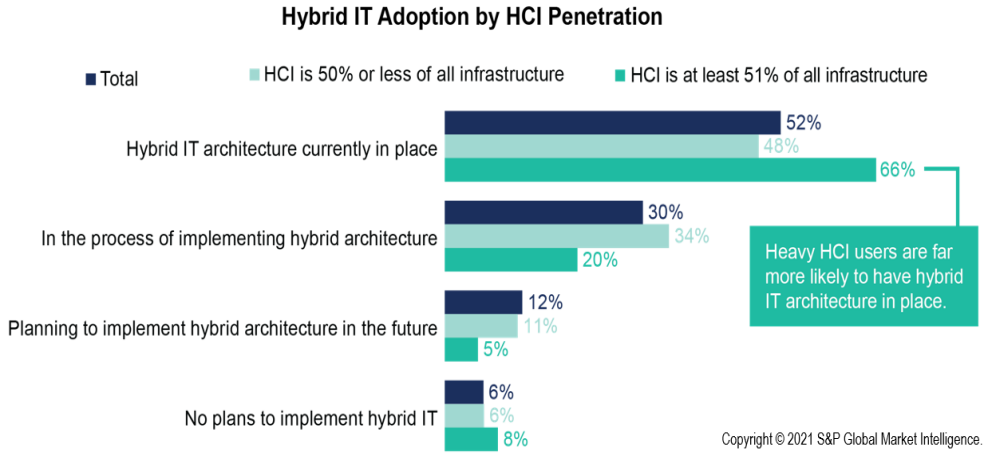
Introduction of HCI: CI, HCI, dHCI and Composable HCI

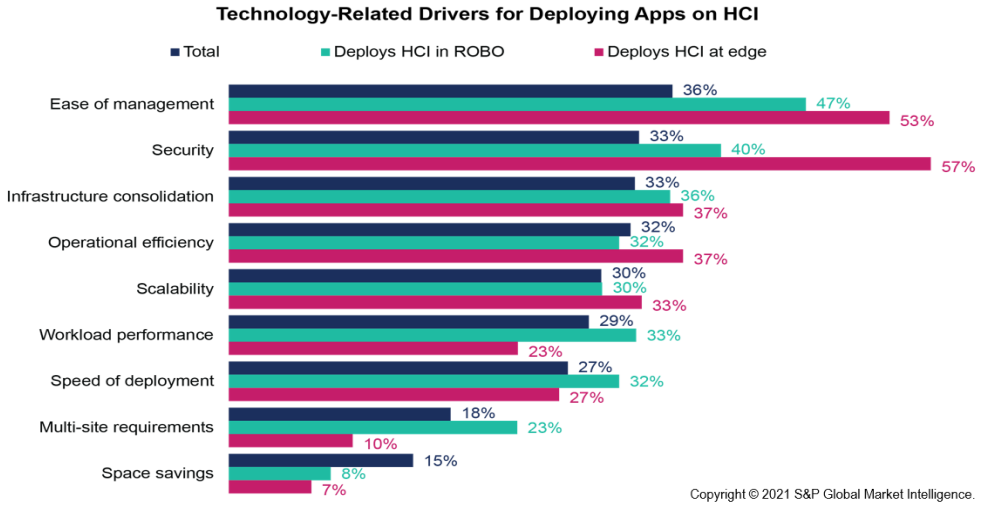
- CI
  - A single vendor would gather the systems and software of different vendors into a single pre-configured and optimized set of equipment and tools that was sold as a package.
- HCI
  - Vendors (started from startups like Nutanix®, SimpliVity® around 2009) took the next step to design and produce their own line of prepackaged and highly integrated compute, storage, and network gear for the data center. It was an evolutionary step. It is software defined and hardware (server+network+storage) hyperconverged
- dHCI or HCI 2.0
  - Address the need for more configurable resource
  - Rather than monolithic all-in-one nodes, dHCI products ship separate compute and storage nodes so you can decide the right mix of each without scaling compute and storage linearly in lockstep.
  - More marketing effort than technology evolution
- Composable HCI
  - Composable Infrastructure, also called Composable Disaggregated Infrastructure (DCI), goes a step beyond hyper-convergence by providing a fluid platform in which all hardware resources are pooled together and tightly managed with software.
  - Composable Infrastructure is getting a lot of hype lately. Several vendor examples are Fungible®, Liqid®, VMWare® Monterey Project, Pensando® ($1.9B acquired by AMD®)
  - Composable have multiple meanings
    - Fully hydrogenous – unclear value and hard to accomplish (see HPE® Synergy)
    - Focus on expensive hardware like GPUs, DPUs/SmartNic, persistent memory etc. – fit customers need to repurpose expensive hardware quickly based on different AI and big data workflows
      - Current market is more on HPC/HPDA
      - DPU/SmartNic is interesting, it accelerates both network (east-west) and data-intensive (north-south). Need research further. Gartner defines as FACs (Functional Accelerator Cards)
      - The technology (composable of DPU/SmartNic) is facing challenges
        - Technology is still young
        - Not all hardware are hot swappable
        - Customers don't trust startup companies on software only solution yet
        - Startups all have hardware and software bundles, like "**Liqid® Composable vSAN HCI Appliance**", "**Fungible® Storage Cluster**"
  - Composable HCI here refers to HCI software and hardware with SmartNic/DPU acceleration technology, See Liqid® HCI and VMWare® Monterey Project (with vSAN)
    - SmartNic covers compute (most are ARM based), network and storage (function), just like HCI
    - East-west (Open vSwitch OVS offload for VM communications) and north-south (data-intensive compute, compression, encryption…) acceleration fit well with HCI



Why is HCI Becoming More and More Important in Future Data Centers?

- Important Trends in Post Pandemic World
  - Cloud adoption and growing hybrid- & multi-cloud
    - On-prem data centers are still critical IT infrastructure: cloud cost, regulation, geopolitics
      - HCI can become the OS of hybrid- & multi-cloud
  - Edging computing
    - Near data processing at edge
      - HCI can become main components in data centers
  - Hybrid (remote) work
      - HCI provides the best VDI solution
  - Skill challenge
      - HCI provides many ease-of's
  - Optimizing cost
      - HCI provide very high ROI: 524% ROI in 5-years, and 60% reduction of 5-year operating costs





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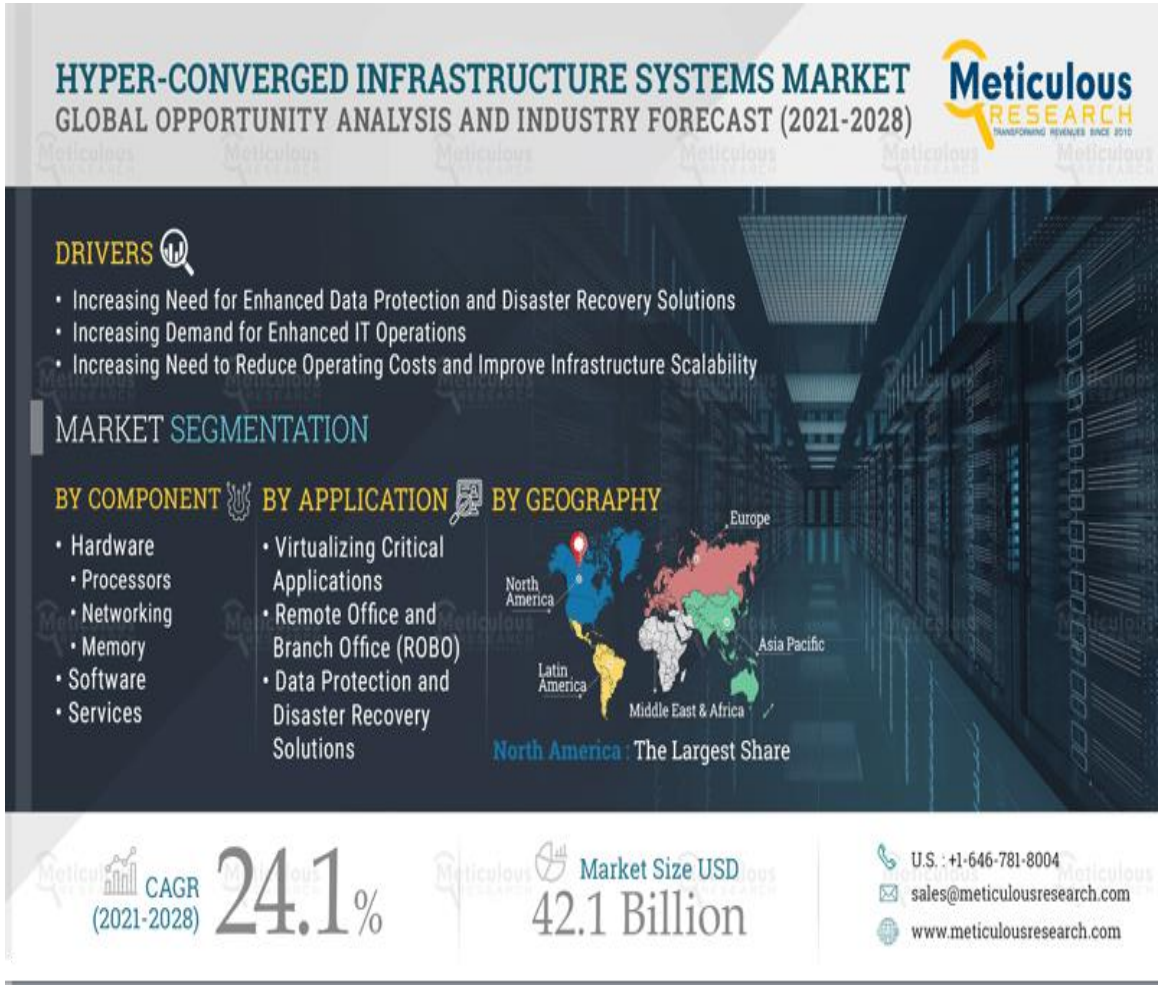
HCI Market Analysis and Forecast

- HCI is by-far the fastest growing storage sector in next several years
  - Twice of the growing speed to the 2nd fastest

- HCI market size (averaged from multiple reports) in 2028
  - $50.97 billion
    - As system to include compute, network, and storage
    - Storage portion alone could be 1/3 to 1/2
  - 27.43% CAGR

- Potential breakthrough of composable HCI to HPDA market
  - According to IDC® report, the market for composable infrastructure solution will grow at a six-year CAGR of 58.2% and reach $4.7 billion in 2023
  - The HPC market is estimated to reach $49.4 billion in 2025 with five-year CAGR at 5.5%
  - High Performance Data Analytics (HPDA) market has even higher value which is estimated $345.9 billion by 2028 with a CAGR of 23.6%



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HCI Market Analysis and Forecast: HCI Vendor Ranking and Analysis

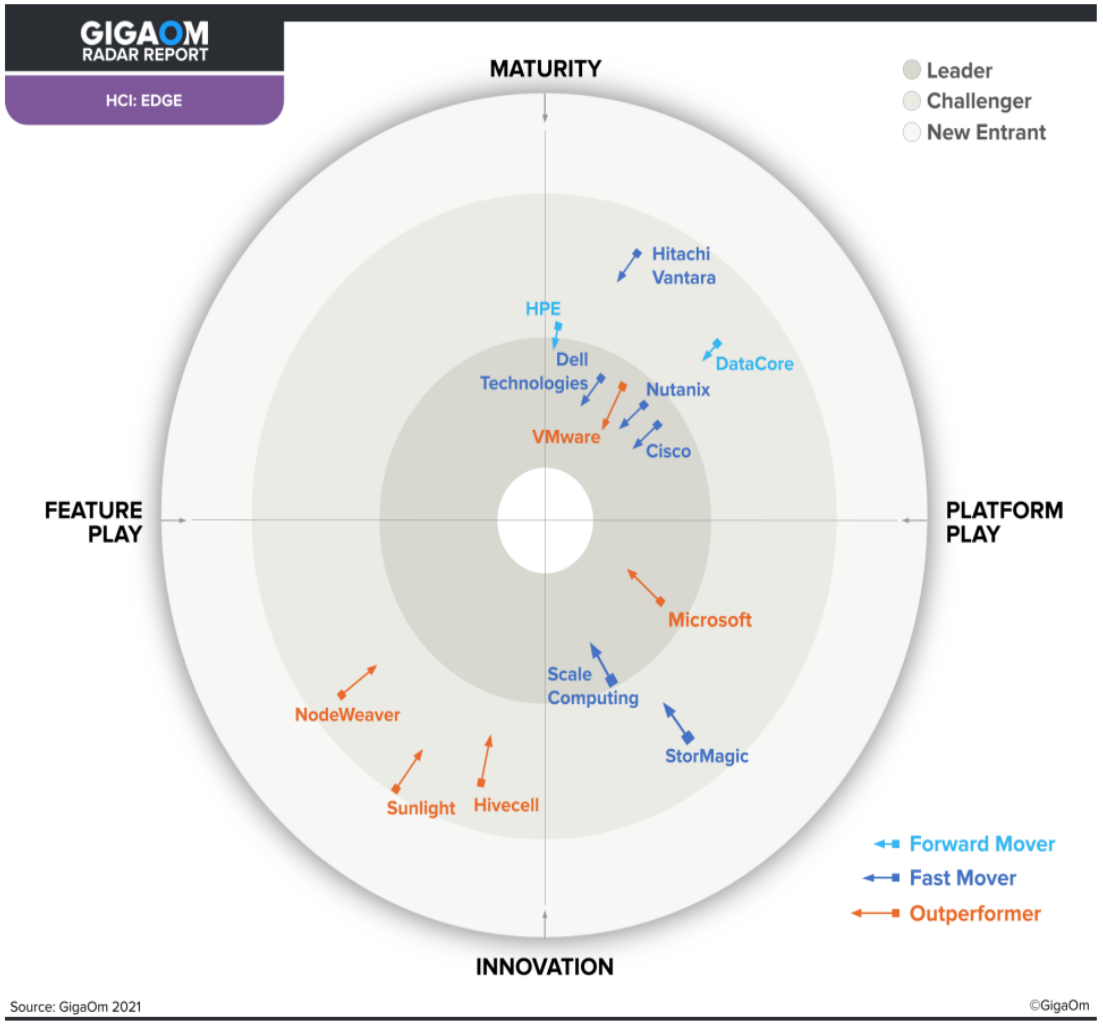

Figure 1. GigaOm Radar for Edge HCI

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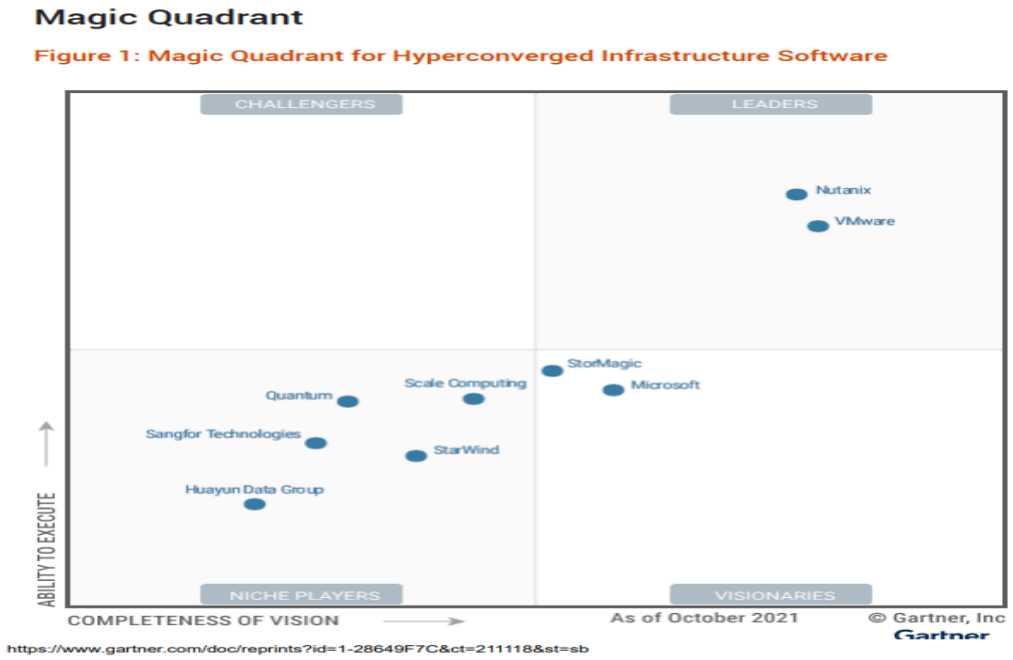
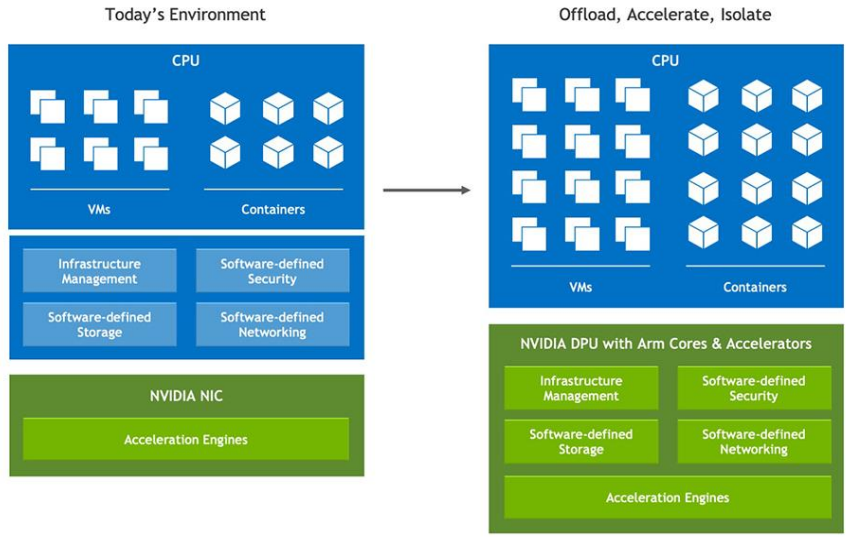
HCI Market Analysis and Forecast: HCI Vendor Ranking and Analysis





- Strengths and challenges of important HCI vendors
  - Nutanix®
  - Dell/EMC/VMWare®
  - HPE®
  - Cloud vendors
    - Microsoft® Azure Stack
  - Composable vendors
    - Nvidia® BlueField (DPU/SmartNIC) ecosystems
      - VMWare® Monterey Project
    - Self-made DPU vendors
      - Fungible®
    - Software composable vendor
      - Liqid®

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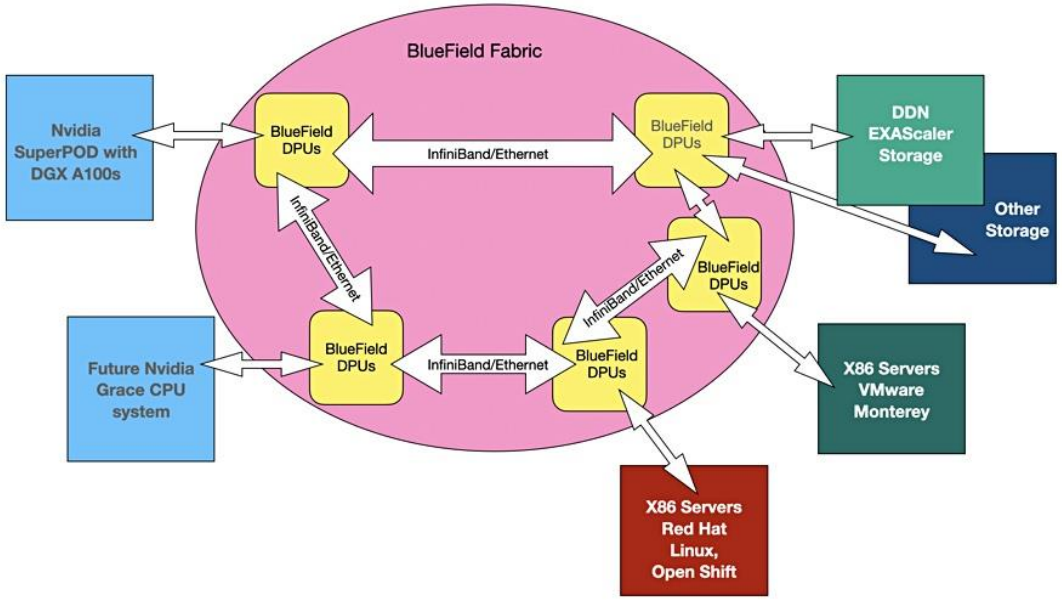
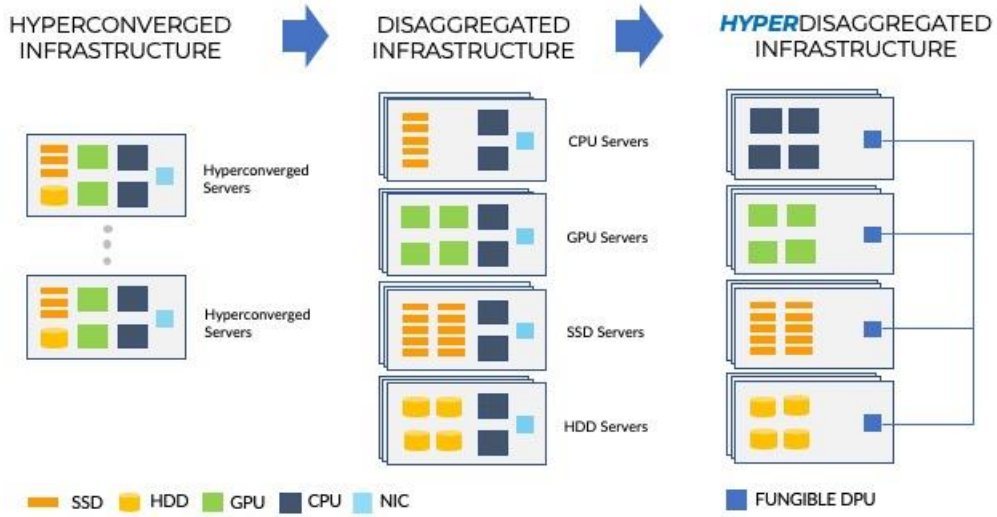
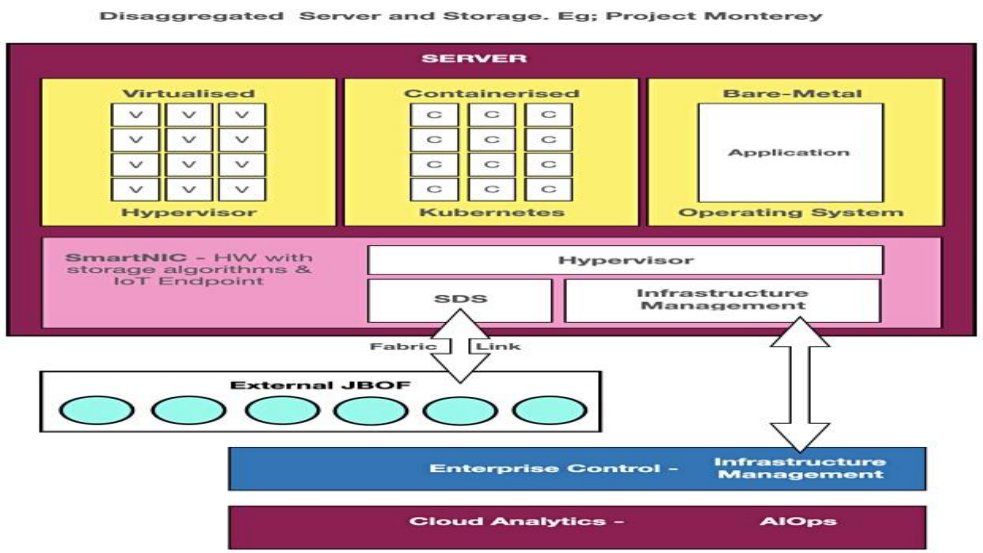
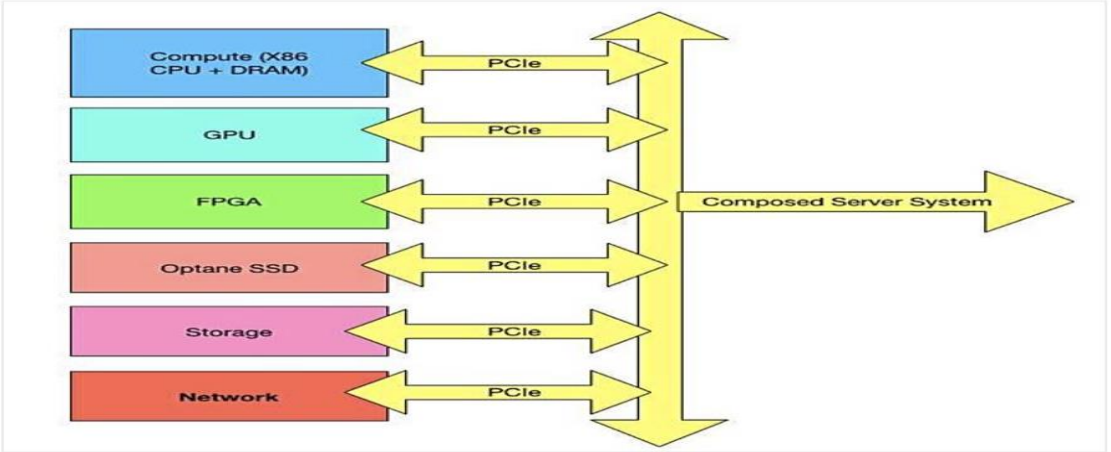
HCI Market Analysis and Forecast: HCI Vendor Ranking and Analysis









Composable elements in roll-your-own Liqid's server scheme

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Common Questions Related to HCI Vendor?

- Whether owning hypervisor and ecosystems
  - It is an advantage, but not as important as before
    - Container applications is growing fast
    - Open-sourced hypervisor is growing fast, so the extra cost on vCenter/vSphere etc. might become a burden
    - Vendors started to build container platform, like IBM® Spectrum Fusion HCI
- Whether a server vendor
  - HCI started from commodity servers, so it is an advantage, but not a must-have
  - But HCI vendors better have reliable server partners including OEMs
- Whether a public cloud vendor
  - Cloud vendors do have a good story on hybrid cloud
  - But customers do have concerns on cloud cost, vendor lock-in, multi-cloud support, and lack of optimization/integrations with hardware
- Profitability of HCI software (especially software-only solution)
  - More and more vendors rely on this model, like cloud vendor HCI (Microsoft® Azure Stack HCI) and Nutanix®
  - It still needs time to prove in the market
  - We think
    - Customers still prefer optimized full-stack (software and hardware) HCI, software alone is a difficult proposition
    - Software in HCI is very important, however, especially in hybrid-cloud OS support, to run same software on
    - Continue cloud-native and application driven
    - Adding other advanced features like streaming, high performance, mission critical

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What Could Next Generation HCI Look Like? In One Picture

The Edge Data Centers ⟷ The Enterprise Data Centers ⟷ The Cloud

Edge Data Centers

- Edge DC types
  - ROBO edge DCs
  - IoT edge DCs
  - Cell tower edge DCs
  - Data-center-in-a-box
- HCI position in edge DCs
  - HCI boxes will be major components in Edge DCs
  - Edge HCI must support:
    - Low network bandwidth (data protection)
    - Rugged design
    - Low power/cooling consumption & tight rack space
    - Cloud-native support
      - Serverless
      - Streaming
      - Edge analytics

Enterprise Data Centers

- Future enterprise data centers
  - Traditional 3-tier architecture still exists, but portion is decreasing
  - Hybrid IT (hybrid- & multi-cloud) is a new norm
  - Fast pace, new workflows every day
  - HPC and HPDA will be generalized in enterprise DCs
  - Real time and streaming workflows will increase
  - Customers demand cloud-native (app mobility, app-driven, …)
- HCI position in enterprise DCs
  - Portion of HCI will increase to ~50% of enterprise DC components
  - HCI software can become the OS of the hybrid IT
  - HCI advantages in fast innovation, deployment, multiple purposes
  - HCI will extend more into:
    - Freedom to choose: highly flexible, optimized, integrated
    - Supporting workloads anytime, anywhere and any SLAs
    - Mission critical workloads, big data, remote work etc.
    - Real time and streaming support
    - HPDA/HPC playground:
      - Composable architecture
      - Technologies in offloading data-intensive compute, acceleration..
  - Cloud-native: serverless, app-mobility, ….

Cloud

- Future Cloud
  - Continue enjoying growth
  - Customer concerns on cost, regulation and geopolitics
  - Cloud vendor HCI solutions
- (non-cloud vendor) HCI position in Cloud
  - Same HCI software running on multi-cloud
  - HCI boxes increases in co-lo
  - HCI supports efficient app-mobility and data-mobility
  - HCI embedded data protection
    - Cloud backup
    - Less depend on backup software
  - HCI embedded data acceleration & reduction

Hybrid IT Operating System, HCI software:

Data Services: Protection, Mobility, Acceleration, Reduction, Security
Unified Management: Hybrid- and Multi-cloud Support
Cloud-native: Application-driven, Application Mobility (Orchestration & Serverless), Abstract Away IT Complexity
One-vendor Service Model: Same Software Running Everywhere
Openness: best-of-the-breed, address customer concerns on cloud vendor lock-in, cost etc.

What Could Next Generation HCI Look Like?

- Freedom to Choose
- Supporting Workloads Anytime, Anywhere, Any SLAs
- HCI Software Can Become the OS of the Hybrid IT
- HPDA/HPC Playground
- Enable Advanced and Modern Services

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What Could Be the Differentiating HCI Technologies

1. Technologies to Offloading Data-intensive Computations from Server
   - Data-intensive computations
     - Compression, Deduplication, Encryption, AI training, Analytics
   - Offload target
     - DPU, SmartNic, FPGA, GPU, Persistent memory etc.
   - HPDA/HPC playground
     - Composable architecture
     - Ecosystem

2. HCI software: OS of the Hybrid IT
   - Data Services: Protection, Mobility, Acceleration, Reduction, Security
   - Unified Management: Hybrid- and Multi-cloud Support
   - Cloud-native: Application-driven, Application Mobility (Orchestration & Serverless), Abstract Away IT Complexity
   - One-vendor Service Model: Same Software Running Everywhere
   - Openness: best-of-the-breed, address customer concerns on cloud vendor lock-in, cost etc.

3. Real-time Streaming Support
   - Developing the streaming platform
   - HCI integration

What Could Be the Differentiating HCI Technologies

4. Extend HCI to Mission Critical
   - EMR, CRM, ERP, Databases, SAP HANNA etc.
   - Expand into vertical ecosystems
   - Performance is the key

5. Be the Best of Edge and ROBO HCI vendor
   - Develop edge and ROBO HCI based on different use cases
   - Rugged/compact design, low power/cooling consumption, work well under low network bandwidth
   - Ecosystem integration: IoT, ROBO and cell tower etc. edge data centers

6. Be the Best of Hybrid Work support
   - VDI acceleration via GPU
   - Ecosystem integration

Thank You.

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Backup

VMWare Monterey Project

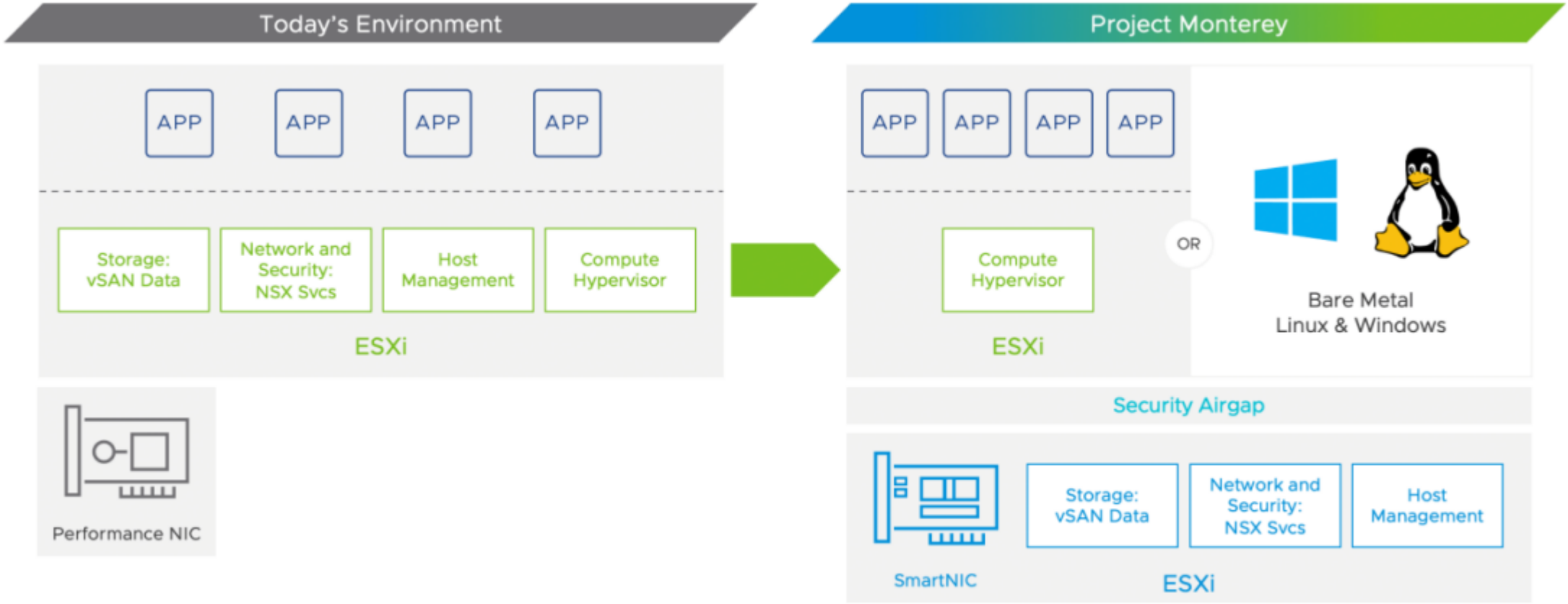

Figure 17: VMware Project Monterey offloads all virtualization tasks to the SmartNIC or DPU [Ref. 46]

AWS Nitro

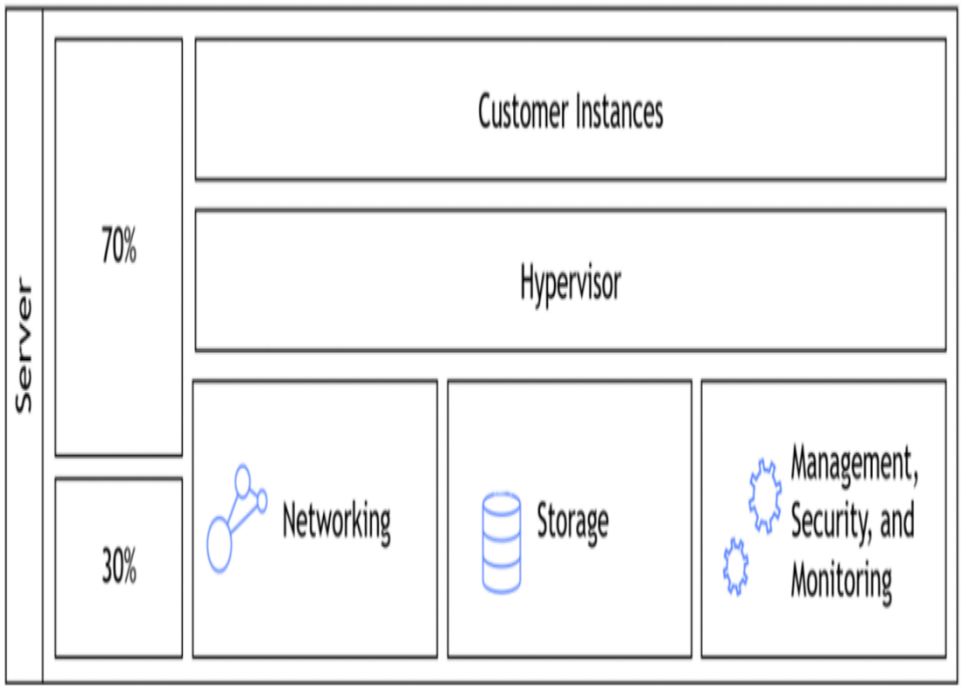

Figure 15: Pre-Nitro AWS EC2 instance host architecture for Xen Hypervisor [Ref. 41]

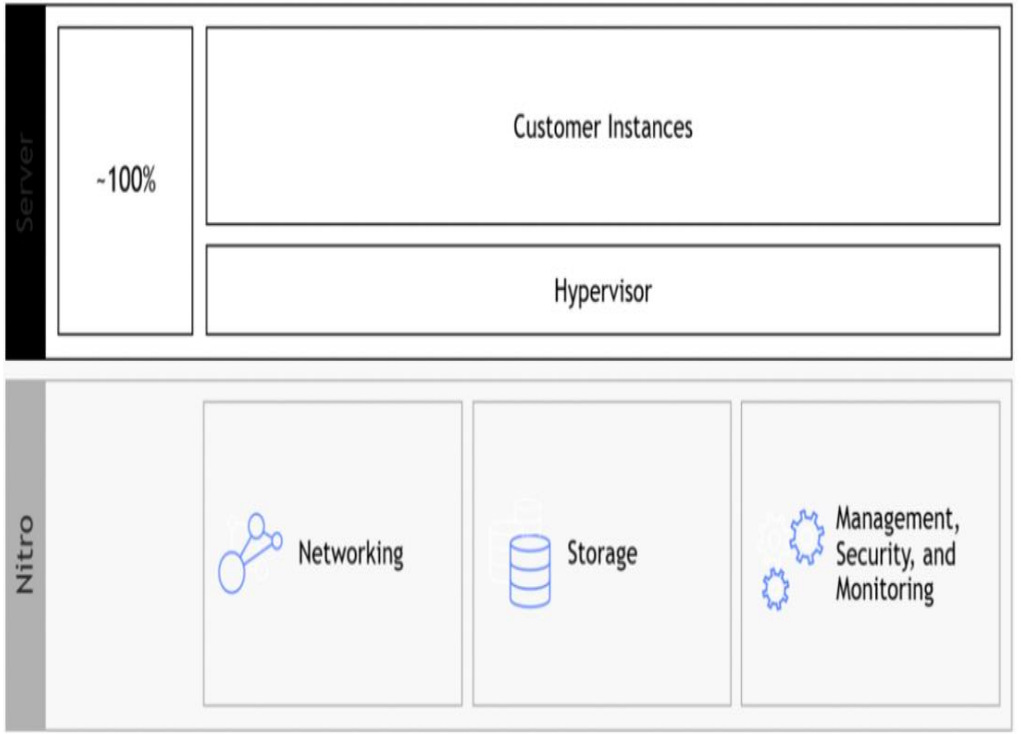

Figure 16: 2017 AWS Nitro System architecture [Ref. 41]

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AWS Nitro

Nitro Cards are a family of cards that offload and accelerate I/O for functions, such as Virtual Private Cloud (VPC), Elastic Block Store (EBS), and Instance Storage, which increases the performance of the overall system. These are the DPUs in the AWS architecture, and the template which other vendors have been using when developing their own DPU offerings.

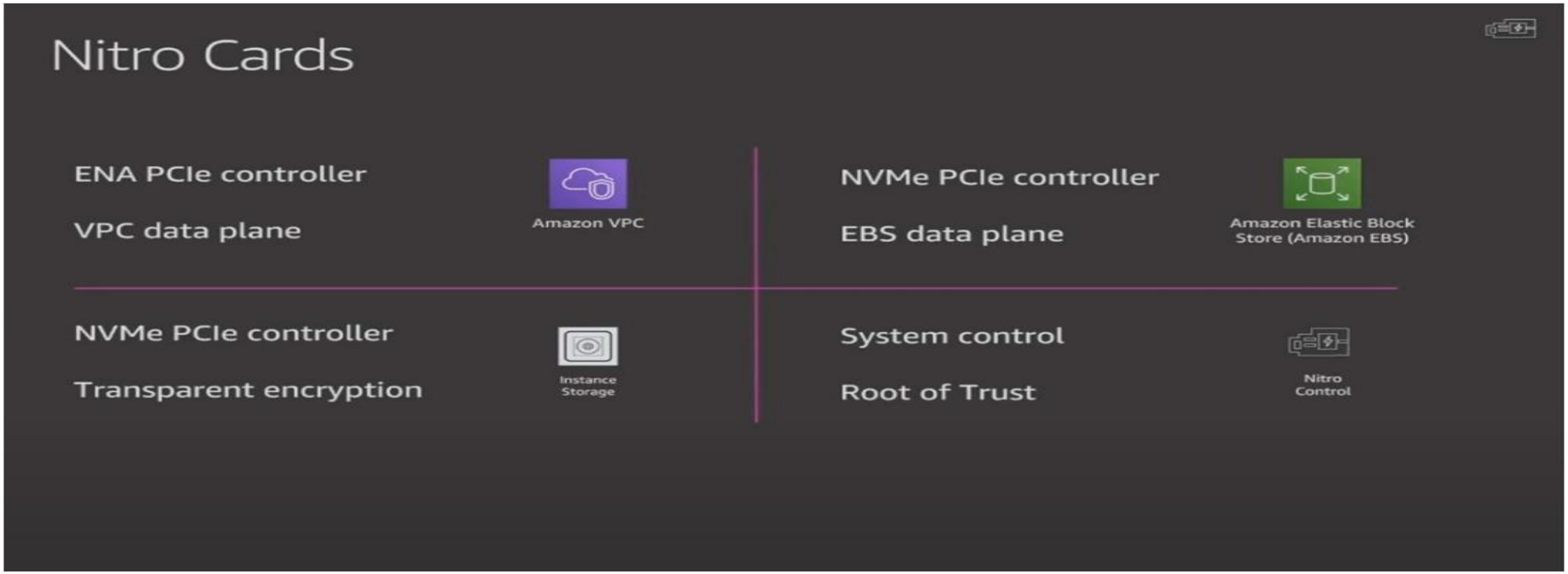

Figure 14: AWS Nitro family of cards [Ref. 42]