Introduction

There are growing number of choices beyond Intel's Xeon processors for cloud services and choice is good. AMD has re-entered the server market with its EPYC (x86) processor and numerous Arm server vendors are entering or are established in the server market. In addition, Amazon has developed its own Arm-based server chip called Graviton. The advantages of Arm compatible cores are lower power per core, more cores per area, design flexibility to build custom versions, and an established software ecosystem. One leading Arm server company is Ampere Computing. Ampere Computing is led by CEO Renee James, the former President of Intel, and leverages the many years of engineering talent from former AMD, Applied Micro, Cavium, Intel, and Qualcomm engineers. In addition to its deep expertise, Ampere offers some unique advantages in cloud servers.

The Ampere Advantage

While Ampere is a new company (formed in late 2017), its eMAG Arm server processor takes advantage of three generations of processor development from purchased intellectual property (IP) in addition to its own development. While the company is brand new, the processor IP is proven and field tested.

The basic specifications of the eMAG processor are quite impressive. Due to the space efficiency of Ampere's custom 64-bit Arm-compatible CPU cores, eMAG can fit 32 cores on one die along with memory controllers and high-speed I/O. Each of these CPU cores can maintain a very competitive 3.3GHz across workloads. The System-on-Chip (SoC) design of eMAG allows for an integrated DRAM controller, which supports 8 channels of 72-bit DDR4-2667 memory for up to 1TB across 16 DIMMs. The DRAM controller is designed for server applications with full ECC, chipkill, and other enterprise RAS features. The SoC also has plenty of I/O with 42 PCIe 3.0 lanes. The combination of many cores with massive memory support and plentiful I/O bandwidth makes eMAG a natural choice for memory bound and transactional cloud services.

The Ampere Ecosystem Is Booming

The Arm64 instruction set is now a first-class architecture for enterprise Linux distributions, including Canonical Ubuntu, CentOS, Oracle Linux, Red Hat and SUSE. Ampere is at the forefront of the Arm64 ecosystem with deployed silicon that is available in the cloud or on-prem. See Figure 1 to see the extensive ecosystem eMAG has developed, which extends from the operating system, to web services, databases, data analytics, storage, and edge computing. With 32 cores and Docker support, eMAG can run numerous microservices and containers in just one socket. Clearly, eMAG offers an extensive platform for mainstream applications.

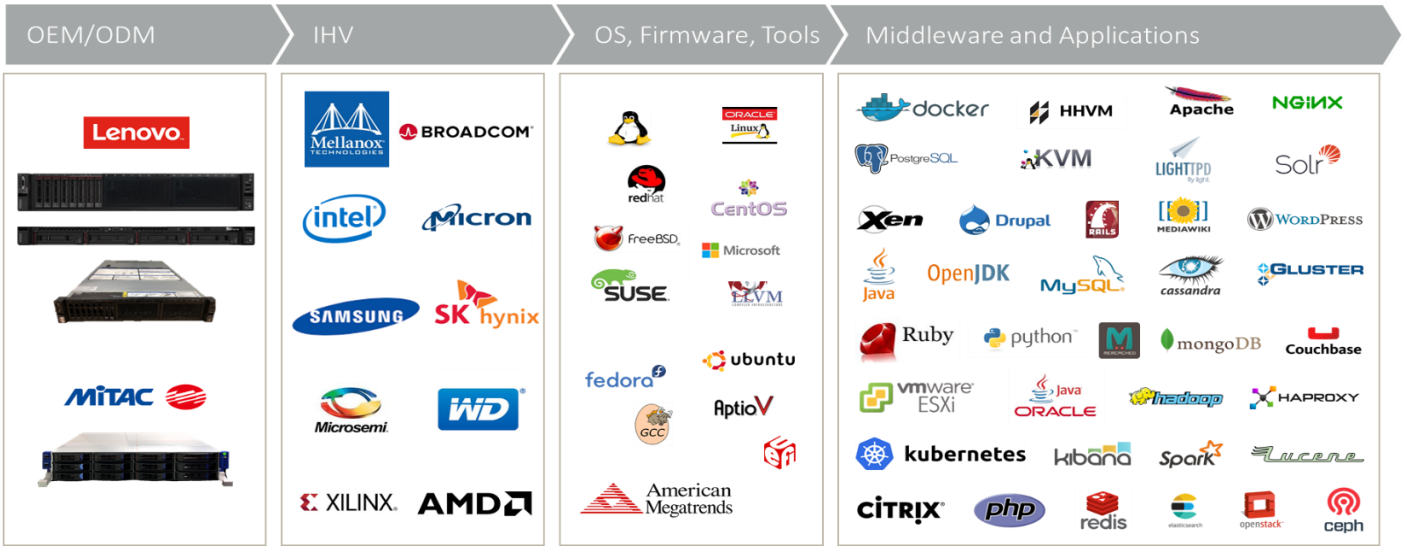


Figure 1. Ampere eMAG Ecosystem Source: Ampere

The eMAG Solution Segments

The Arm64 instruction set used in eMAG has an advantage for specific Android cloud applications. The perfect example is Hatch's Android cloud gaming service. Hatch runs Android applications natively on Packet Cloud Services using eMAG bare metal servers. Because Android applications run almost exclusively on Arm processors, the game software runs with minimal overhead. Ampere servers offer near 100% app compatibility running Android games.

Android game software development is also much better and cheaper on native Arm servers. In contrast to running these apps and development environments on an emulation layer on top of expensive x86 server processors, eMAG offers a lower total cost of ownership (TCO). Clearly, this is where Ampere really shines. Ampere eMAG is the perfect choice for application streaming, and application and OS development work. Ampere has a full system solution for cloud gaming that runs on the Ubuntu OS with a custom type 1 hypervisor under the Corellium Hypervisor for Arm (CHARM). This specific configuration runs on Lenovo servers with virtualized graphics support using AMD Radeon graphics card(s) installed. Corellium can support both Android and iOS environments.

In web hosting, eMAG has the advantage of many high-performance cores coupled with outstanding memory and I/O performance. For both on-prem and co-location applications, multiple turnkey ODM and OEM 1U and 2U rack mount configurations are available. As seen in Figure 2, there's an extensive web software ecosystem that runs on eMAG today. Overall, eMAG can offer a performance/Watt and performance/$ advantage over competing solutions in the market today.

The Arm64 virtualization environment is well developed and robust. Memory and I/O translations are handled by the system memory management unit (SMMU) and generic interrupt controller (GIC). Each virtual machine (VM) is assigned a virtual machine identifier (VMID).

The VMID is used to tag translation lookaside buffer (TLB) entries, to identify which VM each entry belongs to.

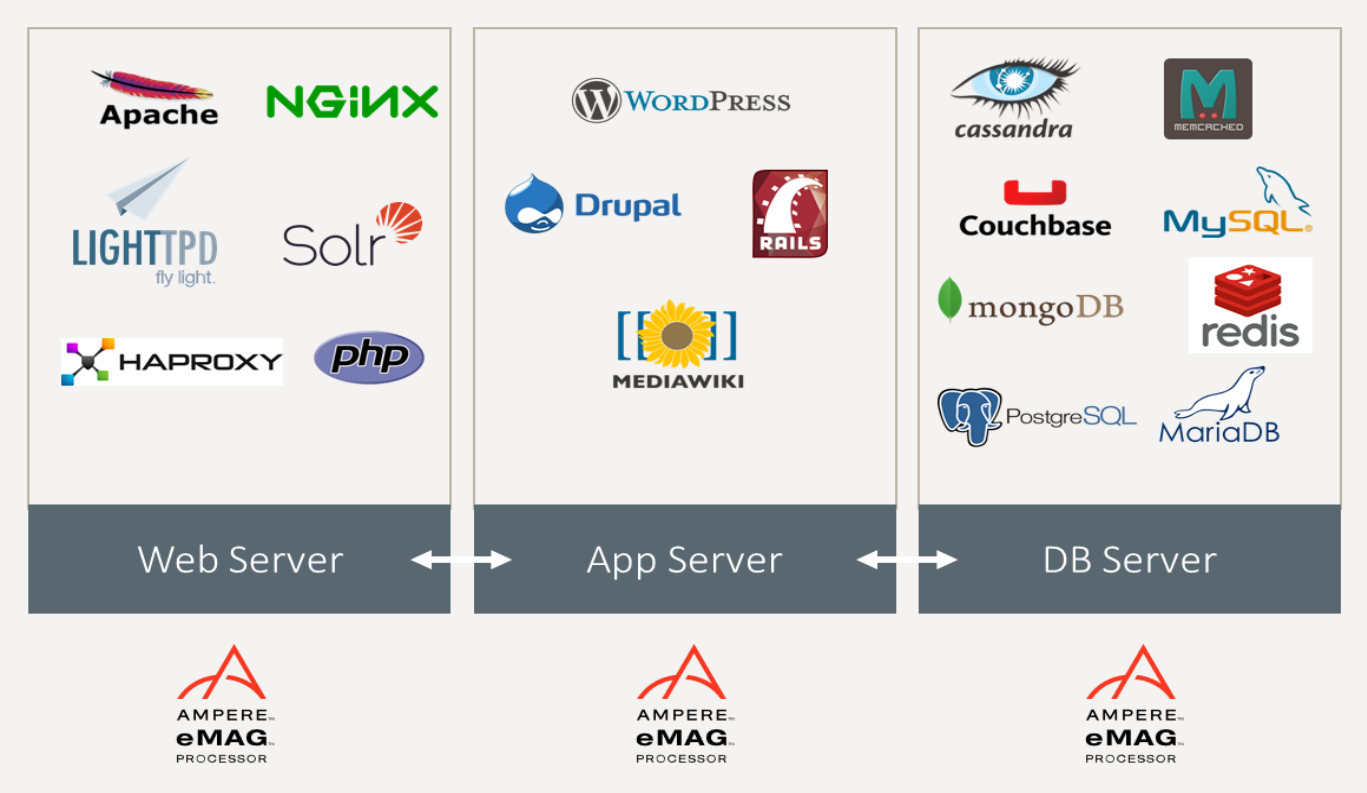


Figure 2: Ampere eMAG Web Hosting Ecosystem Source: Ampere

Another well-suited market for eMAG is telecom and other edge services. There are 16 to 32 core eMAG solutions, offering unique scalability at price points that are a fraction of the price of Intel's Xeon processor. Ampere is actively developing their Hawk board for multiple chassis including Open19, OCP OpenEdge, Nokia Airframe, and Twins formats. The software ecosystem is also evolving fast, as shown in Figure 3.

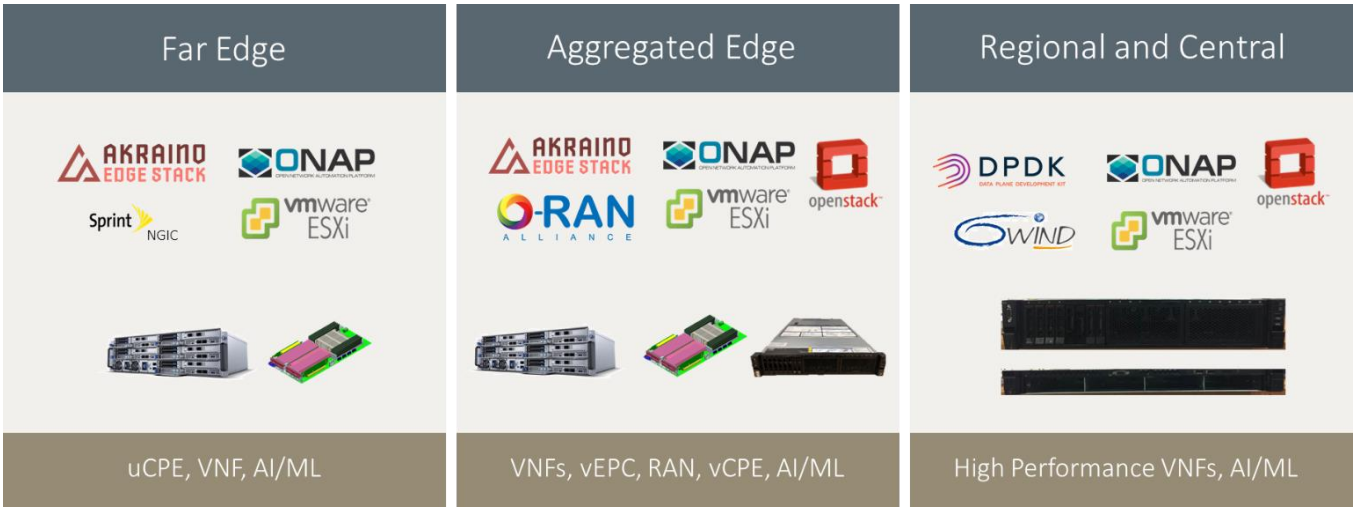
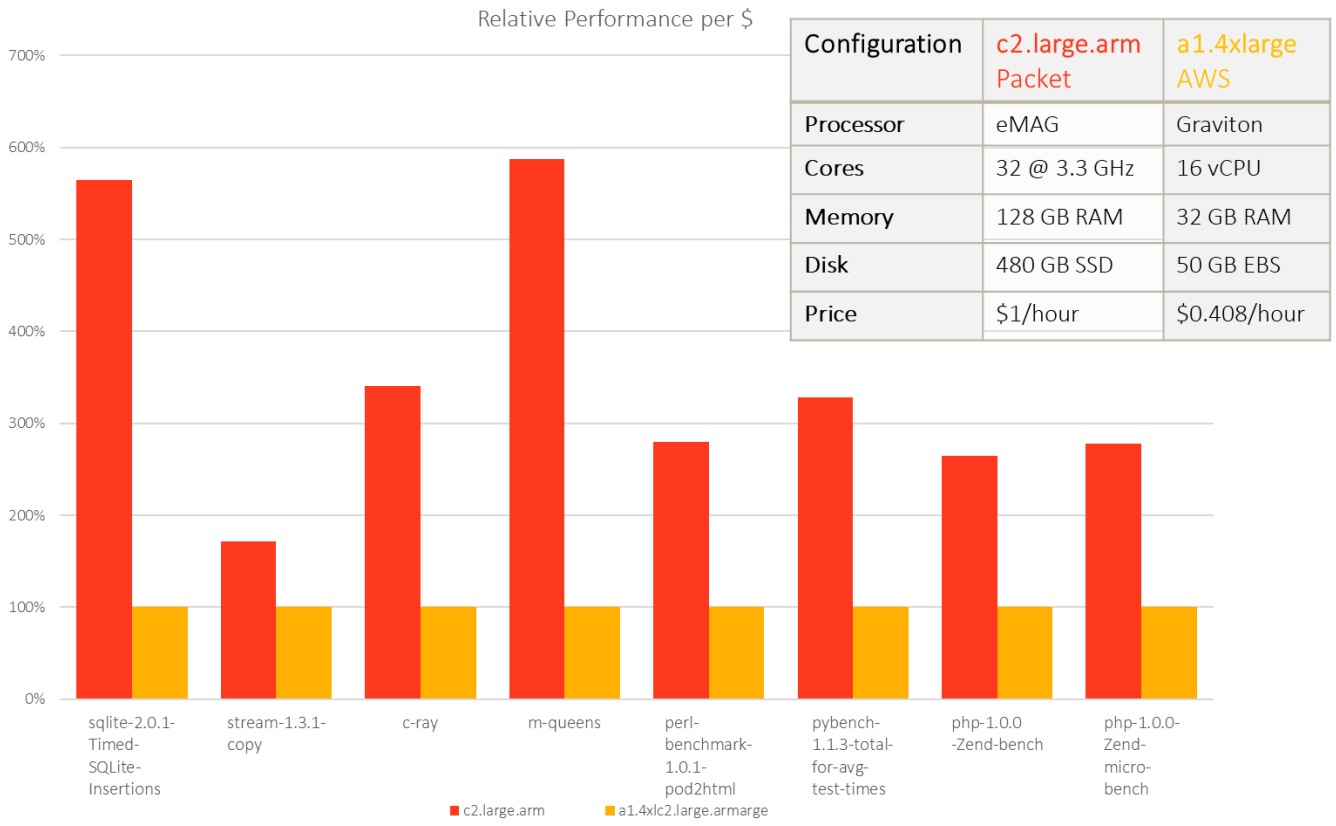


Figure 3. Solutions for Telco and Edge applications Source: Ampere

Comparing eMAG Against Amazon Graviton

The eMAG Arm server offers a cost-effective Arm64 choice, but not all Arm server processors are created equal. One recent entry was when Amazon Web Services (AWS) introduced their own server processor, called Graviton. This is the first server processor from AWS so it is a conservative design and much lower performing than other Arm server processors, including eMAG. Even though AWS offers Graviton EC2 Instances (A1) at a lower cost per hour than its Xeon instances, the discounted rate doesn't sufficiently compensate for the lower clock speeds and performance as compared with eMAG. For example, eMAG significantly outperforms Graviton on Perl, Python, PHP, Stream, and SQL lite workloads (see Figure 4), which are representative of the type of applications well suited for Arm servers.

AWS Graviton processors are up to 45% less expensive than other AWS instance types with the same number of vCPUs and DRAM and is 41% the price of Packet eMAG. Despite the lower costs, it's still not competitive with the eMAG service running on Packet networks when performance is considered. The Packet eMAG instance has more memory and the eMAG processor has more cores per socket. The result is that the eMAG instance performance is 72-487% higher (based on Ampere testing), leading to better performance per dollar. While Graviton is beneficial for competition and choice, and it's good that AWS offers a wide variety of instances, including Arm-native, the Packet eMAG instance is a clear winner on performance per dollar.



Configuration	c2.large.arm Packet	a1.4xlarge AWS
Processor	eMAG	Graviton
Cores	32 @ 3.3 GHz	16 vCPU
Memory	128 GB RAM	32 GB RAM
Disk	480 GB SSD	50 GB EBS
Price	$1/hour	$0.408/hour

Figure 4. Comparison of Ampere eMAG vs. Amazon Graviton Source: Ampere

Conclusion

Ampere eMAG running Packet bare metal instance offers a unique value proposition for many cloud workloads, such as web servers, PHP, video, mobile gaming, NGNIX, and WordPress. In some cases, eMAG also eliminates the need for a virtualization layer, like for virtual Android app hosting, allowing for lower latency and better performance.

With an experienced team backing it, eMAG is going to be a compelling alternative in the cloud computing market.