DATA CENTER GROWTH

DELIVERING leadership compute and graphics DIFFERENTIATION

SUPERCOMPUTING

Leading the Exascale Era

Consistently Winning Top Deployments

CLOUD

Expanding Deployments
with Top 10 Providers

Doubled in 2019

150+ INSTANCES

Expected in 2021*

ENTERPRISE

Large-scale Enterprise Deployments
with Growing Pipeline

Doubled in 2019

150+ PLATFORMS

Expected in 2021*

AMD EPYC™ MOMENTUM EVERYWHERE

Powering the Exascale Era

4.5x-9x faster than today's top supercomputers

High Performance Compute

Design & Simulation

Research & Academia

Machine Learning

Supercomputing

Powering the Cloud

9 of 10 most powerful Cloud Providers in the World

Cloud Service Providers

IaaS/PaaS

Search

Social

SaaS

Powering the Enterprise

Performance and Security Leadership in the workloads that matter
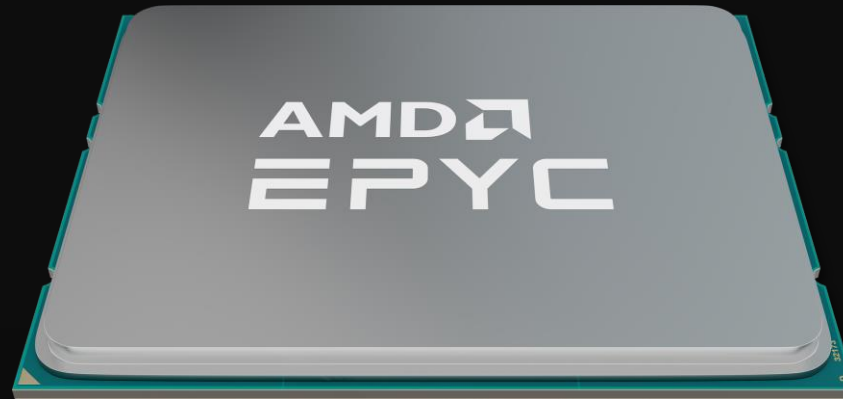
Enterprise IT

Virtualization

SDS/HCI

Hadoop

NoSQL

ADVANCED SECURITY FEATURES WITH INFINITY GUARD™

Source: https://www.top500.org/lists/top500/2020/11/

AMD

3RD GEN AMD EPYC™

THE WORLD'S HIGHEST PERFORMANCE x86 SERVER PROCESSORS, PER-CORE AND THROUGHPUT

Designed to Power the Most Important Cloud Services | Delivering the Best Business Value | Providing the Assurance of Modern Security

WHERE WE ARE TODAY

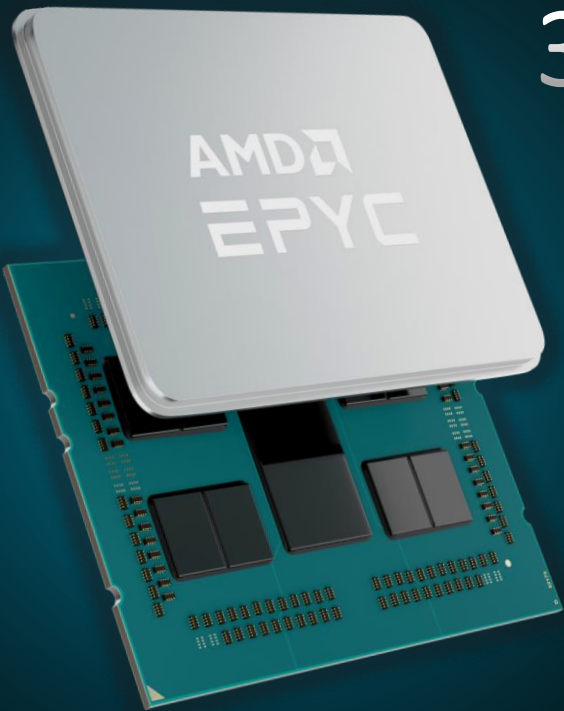✓ Predictable Execution | ✓ Leadership Performance | ✓ Strong Roadmap

AMD

AMD EPYC™ SERVER CPU NDA ROADMAP

Relentless Technology Innovation

14nm

1ST GEN
7001

32C /64T

"Zen" cores
PCIe® Gen3
DDR4 – 2667

7nm

2ND GEN
7002

64C /128T

"Zen2" cores
PCIe® Gen4
DDR4 – 3200

7nm

3RD GEN
"MILAN"

64C /128T

"Zen3" cores
PCIe® Gen4
DDR4 - 3200

5nm

4TH GEN
"GENOA"

"Zen4" cores

Roadmap Subject to Change

AMD

3RD GEN EPYC™ "MILAN" CPU

UNDISPUTED LEADERSHIP PERFORMANCE

Up To

25%[1]

More mid-stack performance
where customers are buying

Up to

15%[1]

Better perf / $ vs.
previous generation

Leading Throughput
Performance[2]

Per Core
Performance[2]

Best TCO Across
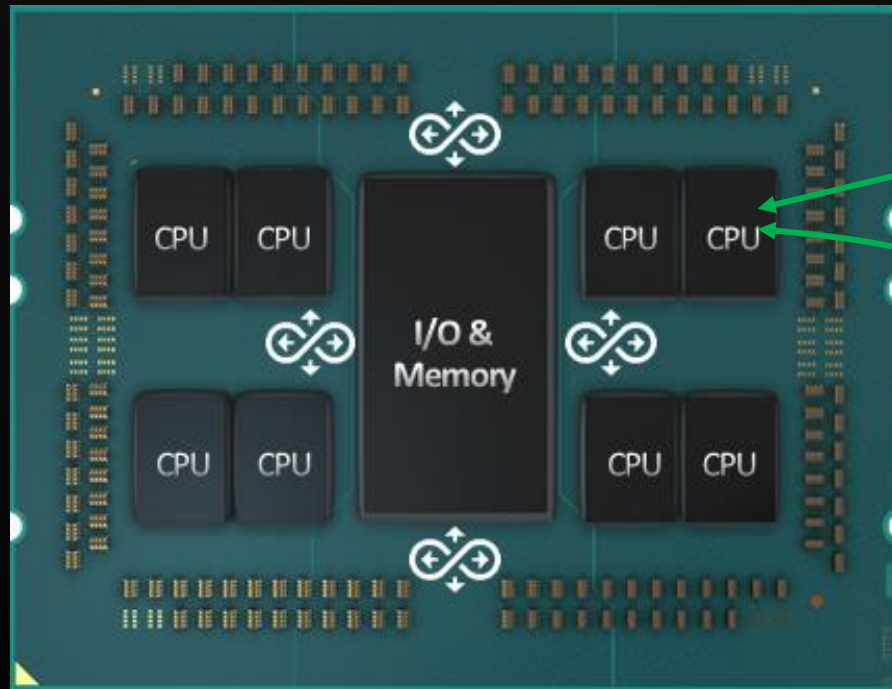Workloads[2]

Leadership Security Features
(SME, SEV-ES, SEV-SNP)

No Compromise
Single Socket

AMD

"MILAN" BUILDS ON INFINITY ARCHITECTURE

7002 ("ROME") & "MILAN" 9 DIE MCM (8 CCD + 1 IO)

"Zen2"/7002 ("Rome")

Z2	L2	16MB L3		L2	Z2
Z2	L2			L2	Z2
Z2	L2	16MB L3		L2	Z2
Z2	L2			L2	Z2

"Zen3"/"Milan"

Z3	L2	**32** MB L3		L2	Z3
Z3	L2			L2	Z3
Z3	L2			L2	Z3
Z3	L2			L2	Z3

AMD

AMD

AMD EPYC™ PROCESSOR NAMING CONVENTION

STARTING with EPYC 7003 Series - "MILAN"

EPYC™ 7553P CPU

PRODUCT FAMILY

NOUN (required for trademark)
- Can also use **Processor** or **SOC**

FEATURE MODIFIER
- "P" = 1P Only

PRODUCT SERIES
- 7xxx – High Performance Server CPU/SOC
- 1st Gen 7001, 2nd Gen 7002, 3rd Gen 7003 "Milan"

GENERATION
- 3 = 3rd Gen 7003

PRODUCT MODEL
Indicates Core Count within the Series

PERFORMANCE
10s digit - Indicator of performance within the Series
- "F" = Hi Performance per Core
- 4, 5 = Performance
- 1 = Value

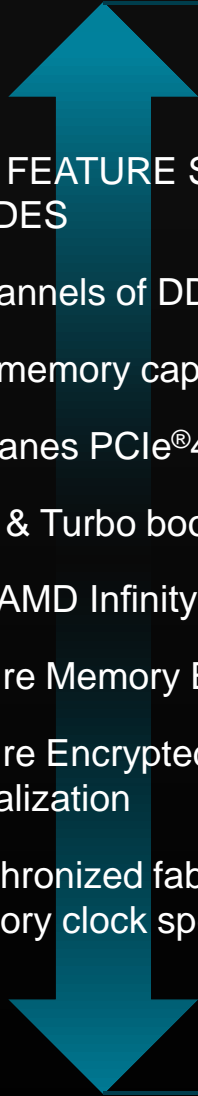| 100s Digit	2	3	4	5	6	7
Cores	8	16	24-28	32	40-56	64

AMD EPYC™ 7003 CPU MODELS

ALL-IN FEATURE SET INCLUDES

- 8 Channels of DDR4-3200

- 4TB memory capacity

- 128 lanes PCIe®4

- SMT & Turbo boost

- 18G AMD Infinity Fabric™

- Secure Memory Encryption

- Secure Encrypted Virtualization

- Synchronized fabric and memory clock speeds

CORES	AMD EPYC
64 CORES	7763
	7713/P
56 CORES	7663
48 CORES	7643
	75F3
	7543/P
32 CORES	7513
28 CORES	7453
	74F3
	7443/P
24 CORES	7413
	73F3
	7343
16 CORES	7313/P
8 CORES	72F3

"F" Performance Per Core Optimized

AMD

AMD EPYC™ 7003 "MILAN"
SOFTWARE AND SOLUTIONS ECOSYSTEM
65+ ISVs / IHVs support at launch

OS
Canonical
Citrix
Microsoft
Oracle
Red Hat
Suse
VMware

IHV (Solution Engagements Only)
Broadcom
Mellanox
Micron
NVIDIA
Samsung

Kioxia*
Marvell*
Microchip*
SK Hynix*
Seagate*
Western Digital*

SDS
RHEL Ceph
Excelro
Pivot 3
Quobyte
Weka.IO

Cloudian*
MapR-XD*
StorMagic*

Big Data Analytics
Apache Hadoop
Cloudera
Couchbase
DataStax
Elastic
Exasol
MongoDB
Splunk
Transwarp

Databricks*
Hortonworks*
MapR*
MarkLogic*
Splunk*
Tableau*
Snowflake*

Databases
MS SQL Server
MySQL
Oracle DB
PostgreSQL
Redislabs
SAP
TigerGraph
Vertica

MemSQL*
Oracle EBS*
SAP HANA*
SAS*

HPC ISVs
Altair
Ansys
Dassault Systems
Emerson
ESI
LSTC
Mentor Graphics
MSC
Shearwater
Siemens PLM
Synopsys

Cadence*
Flow Science*
Haliburton*
Schlumberger*

HPC Open Source
Weather: WRF
Weather: HYCOM
Weather: IFS
NAMD
CP2K
Open Foam
GROMACS
LIGGGHTS
LAMMPS

Telco
Ericcson
Mavenir
Mellanox
NetScout
Nokia
Red Hat
VMware

Keysight (Ixia-BP)*
Palo Alto Networks*

SDI
Microsoft
Red Hat
VMware

Accelerators
Pesando
Xilinx

nCorium*

High Perf.
Formulus Black*
Rescale*
ScaleMP*

Media
Autodesk
BEAMR

ATEME*
Blackmagic*
Chaos Group*
Foundry*
Pixar*

* 30+ additional ISVs supported post launch

CHANGING THE ECONOMICS OF THE

VIRTUALIZED DATACENTER

Vielen Dank!

BACKUP

AMD

AMD EPYC™ CPUS

DELIVERING leadership compute and graphics DIFFERENTIATION

HPC

- CPU optimized for GPU acceleration
- Massive I/O for cluster connectivity
- Memory capacity for large datasets
- Massive I/O bandwidth for NVMe drives

HCI VIRTUALIZATION & VDI

- High core count to enable dense user base
- Large memory capacity enabling more VMs
- Secure Encrypted Virtualization (SEV)
- Massive I/O for scale-out environments
- Single-Socket enabling TCO advantages in socket-based licensed solutions

CLOUD

- High core count to meet SLAs
- Large memory capacity enabling more VMs
- Enabling Confidential Cloud Computing
- Massive I/O for scale-out environments

DATA ANALYTICS - Research & Academia

- High parallelism for complex analysis
- Massive I/O bandwidth for fast data loading
- High integer and floating-point capacity
- Additional security features for business critical data

DATA ANALYTICS - Machine Learning

- Highly parallelized CPU optimized for GPU acceleration
- High parallelism for real time data streams
- High core count for inference
- Massive I/O bandwidth for NVMe™ drives

DATA ANALYTICS – ENTERPRISE IT

- Direct SATA & NVMe Support
- High parallelism for low latency
- More L3 Cache for fast data processing
- Full memory encryption helping improve data security

AMD

AMD EPYC™ 7003 PROCESSORS – "MILAN"

WORLD'S HIGHEST PERFORMANCE

x86 CPU*
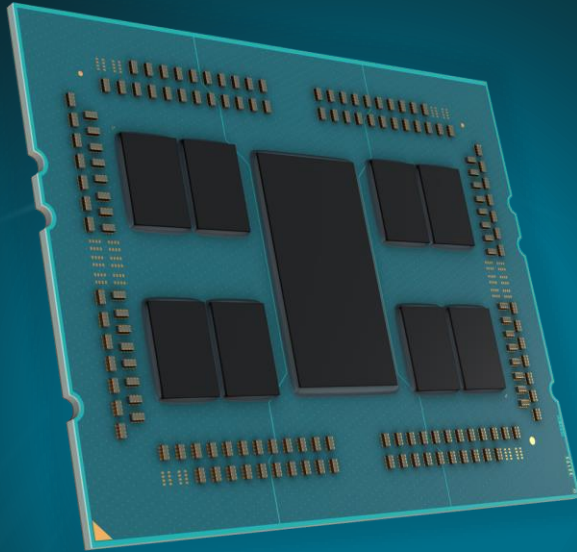
"Zen3" Core Delivering Performance Enhancements

No New Hardware – Drop-in Compatible with Rome Platforms *(BIOS update required)*

Enhanced Security Features

Supports 4, 6 or 8 Memory Channels Configs

Enhanced Memory Performance with:

Infinity Fabric™ and Memory Clock Synchronized

Largest Available x86 L3 Cache – Up to 32MB / core

* Projected performance based on AMD internal testing and subject to change.

See endnotes: MIL-001

AMD

3RD GENERATION AMD EPYC™ LEADERSHIP ARCHITECTURE

AMD Infinity Architecture – The Foundation Of The Modern Data Center

EFFICIENCY ✓

Hybrid Multi-Die SoC Design

Optimized with CPU and Memory Clock Sync

Price / Performance / Watt Industry Leader*

PERFORMANCE ✓

Core Performance Upgrades

Up to 25% increase in mid-core CPUs*

Higher Frequencies for better performance
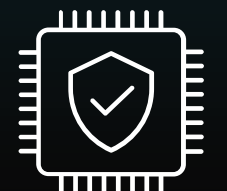
3RD GENERATION   INFINITY FABRIC™

SECURITY ✓

AMD Infinity Guard

Secure Nested Paging (SEV/SNP) added to
EPYC advanced security features

MEMORY ✓

Breakthrough System Features

First x86 CPU with up to 32MB L3 cache / Core

4, 6, and 8 Channel Memory Optimized

* Based on AMD internal projections. Subject to change with actual testing.

AMD

AMD EPYC ™ 7003 "MILAN" - AT A GLANCE

COMPUTE

AMD "Zen3" x86 cores (up to 64 core / 128 threads)

Up to 32MB L3 cache / core, shared by each chiplet

Flatter NUMA domain, reduced latency w/ smaller system diameter
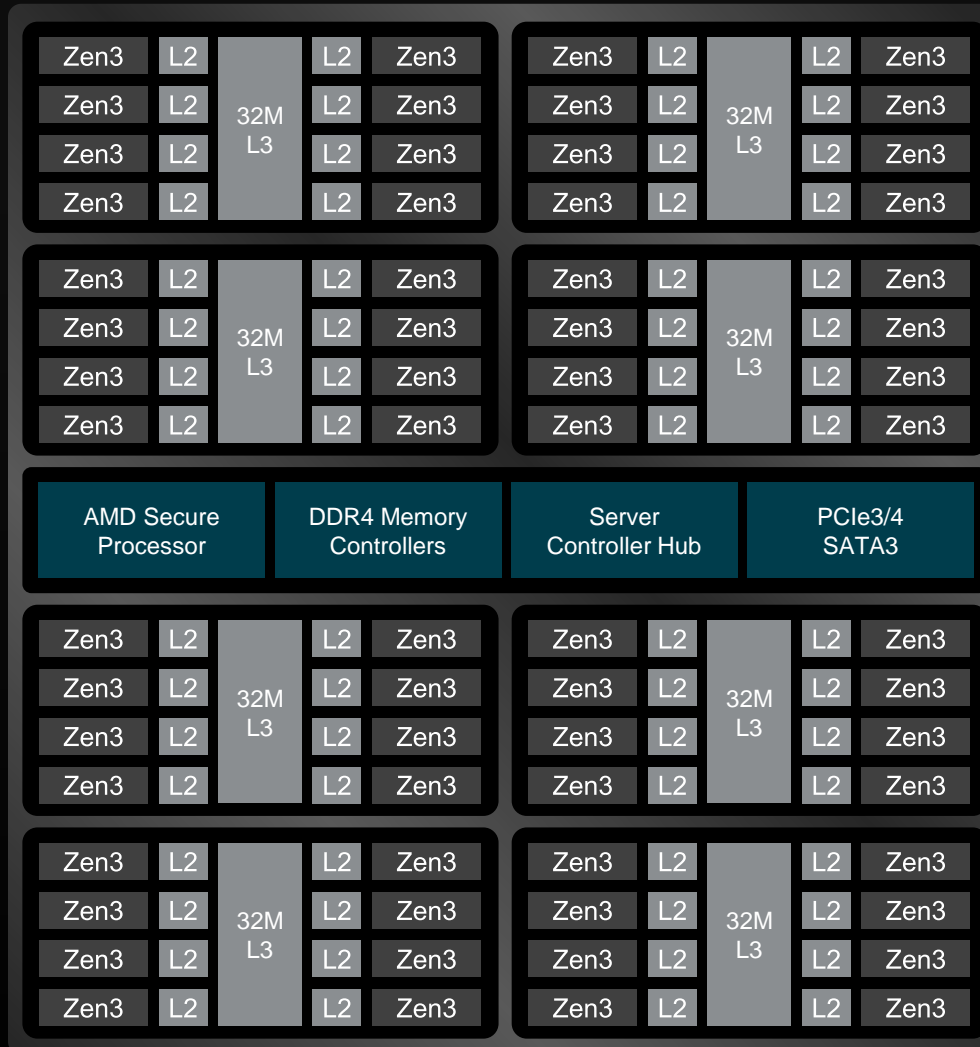
TDP range: 120W-280W

MEMORY

8 channel DDR4 with ECC up to 3200 MHz

Option for 4 or 6 channel Memory Interleaving [1]

RDIMM, LRDIMM, 3DS, NVDIMM-N

2 DIMMs/channel capacity of 4TB/socket (256GB DIMMs)

Zen3	L2	32M L3	L2	Zen3
Zen3	L2		L2	Zen3
Zen3	L2		L2	Zen3
Zen3	L2		L2	Zen3

| AMD Secure Processor | DDR4 Memory Controllers | Server Controller Hub | PCIe3/4 SATA3 |

PERFORMANCE

+Increased Performance/Socket, performance/core, single threaded performance, performance/core/watt [2]

Infinity Fabric™ Gen 2 (xGMI-2)

INTEGRATED I/O – NO CHIPSET

128 lanes PCIe® Gen3/4
- Used for PCIe, SATA, and Coherent Interconnect
- Up to 32 SATA or NVMe™ direct connect devices
- 162 lane option (2P config)

Server Controller Hub
(USB, UART, SPI, LPC, I2C, etc.)

SECURITY FEATURES

Dedicated Security Subsystem

Secure Boot, Hardware Root-of-Trust

SME (Secure Memory Encryption)

SEV-ES (Secure Encrypted Virtualization & Register Encryption)
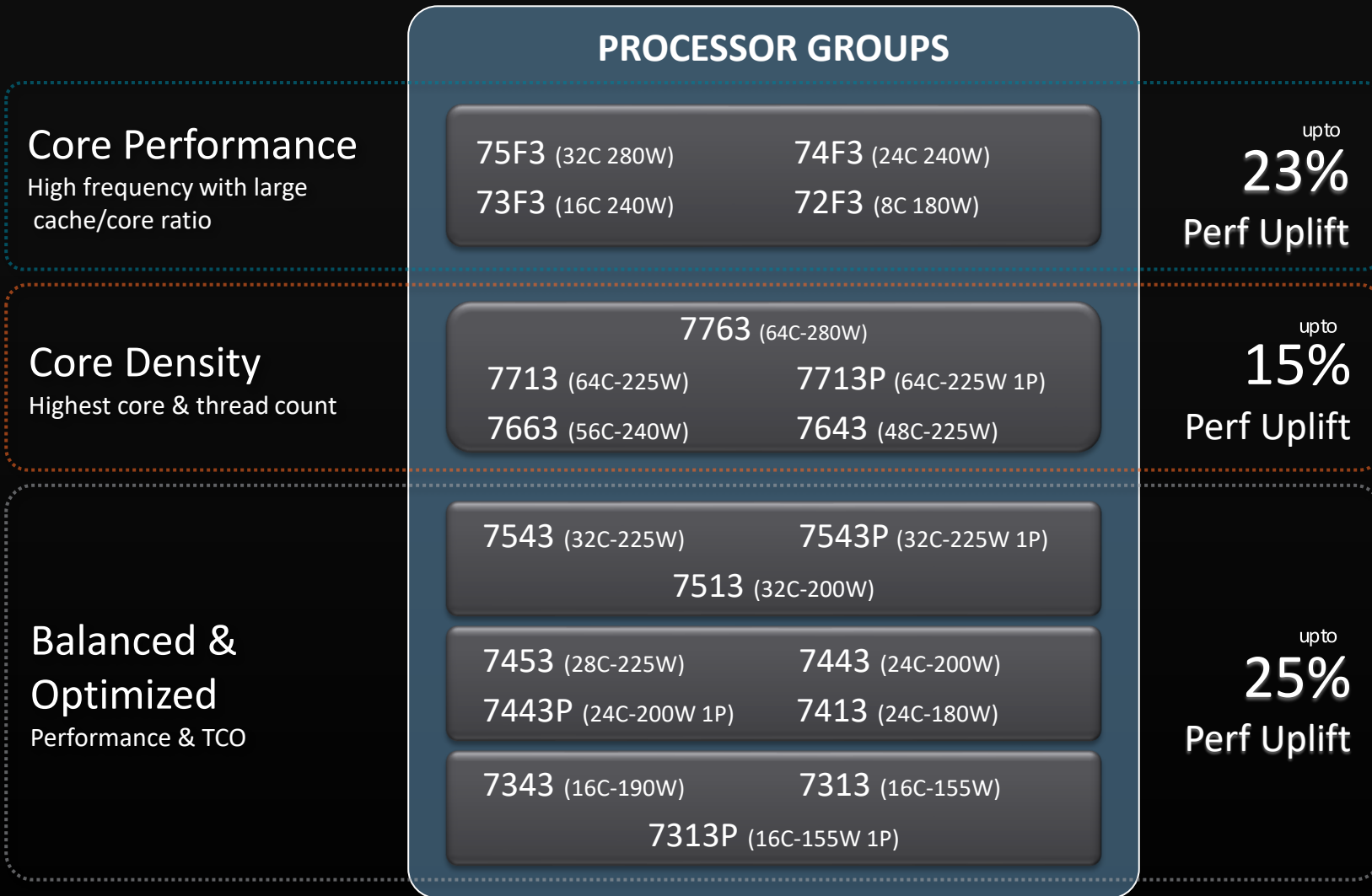
SEV-SNP (Secure Nested Paging)

[1] With certain DIMM population rules.

[2] Increased Performance numbers based on AMD internal estimates. Subject to change based on actual results.

AMD EPYC™ - 7001, 7002, & "MILAN" COMPARISON

Category	7001	7002	MILAN
Socket	SP3		
Core	"Zen"	"Zen2"	"Zen3"
Process	14nm	7nm	7nm
Max Core Count/Threads	Up to 32C (64T)	Up to 64C (128T)	Up to 64C (128T)
Max L3 cache size	64MB	256MB	256MB
Max L3 cache per core	8MB	16MB	32MB
Memory Enhancements	8 ch DDR4-2666	8 ch DDR4-3200, NVDIMM-N	8 ch DDR4-3200, NVDIMM-N with DDR4 coupled DDR3200 and 6 channel memory interleave
PCIe® Enhancements	PCIe Gen3, 128L/Socket	PCIe Gen4, 128L/Socket	PCIe Gen4, 128L/Socket with IOMMU for improved IO performance
Security Enhancements	SME, SEV	SME, SEV-ES	SME, SEV-ES, SEV-SNP
New features	---	RDPRU, QOS enhancements, x2APIC extensions, UMIP	Hotplug surprise remove, Probe filter improvement
Chipset	NA	NA	NA
Power	120W - 180W	120W - 280W	120W - 280W

The information contained herein is subject to change without notice.

AMD

AMD EPYC™ 7003 ROADMAP CPU STACK

AMD EPYC™ 7003 Series Processor Models and Details

Model #	Cores / Threads	Base Freq (GHz)	Max Boost Freq[8] (GHz)	Default TDP (W)	cTDP (W)	L3 Cache (MB)	2P/1P
7763	64 / 128	2.45	3.50	280W	225-280W	256	2P or 1P
7713	64 / 128	2.00	3.675	225W	225-240W	256	2P or 1P
7713P							1P Only
7663	56 / 112	2.00	3.50	240W	225-240W	256	2P or 1P
7643	48 / 96	2.30	3.60	225W	225-240W	256	2P or 1P
75F3	32 / 64	2.95	4.00	280W	225-280W	256	2P or 1P
7543	32 / 64	2.80	3.70	225W	225-240W	256	2P or 1P
7543P							1P Only
7513	32 / 64	2.60	3.65	200W	165-200W	128	2P or 1P
74F3	24 / 48	3.20	4.00	240W	225-240W	256	2P or 1P
7453	28 / 56	2.75	3.45	225W	225-240W	64	2P or 1P
7443	24 / 48	2.85	4.00	200W	165-200W	128	2P or 1P
7443P							1P Only
7413	24 / 48	2.65	3.60	180W	165-200W	128	2P or 1P
73F3	16/ 32	3.50	4.00	240W	225-240W	256	2P or 1P
7343	16 / 32	3.20	3.90	190W	165-200W	128	2P or 1P
7313	16 / 32	3.00	3.70	155W	155-180W	128	2P or 1P
7313P							1P Only
72F3	8 / 16	3.70	4.10	180W	165-200W	256	2P or 1P

AMD

EPYC™ 7003 CPU POSITIONING

PROCESSOR GROUPS

Core Performance
High frequency with large cache/core ratio

75F3 (32C 280W)	74F3 (24C 240W)
73F3 (16C 240W)	72F3 (8C 180W)

up to **23%** Perf Uplift

Core Density
Highest core & thread count

7763 (64C-280W)	
7713 (64C-225W)	7713P (64C-225W 1P)
7663 (56C-240W)	7643 (48C-225W)

up to **15%** Perf Uplift

Balanced & Optimized
Performance & TCO

7543 (32C-225W)	7543P (32C-225W 1P)
7513 (32C-200W)	

7453 (28C-225W)	7443 (24C-200W)
7443P (24C-200W 1P)	7413 (24C-180W)

7343 (16C-190W)	7313 (16C-155W)
7313P (16C-155W 1P)	

up to **25%** Perf Uplift

AMD

AMD EPYC™ SECURITY FEATURES

| Secure Root-of-Trust Technology | Secure Encrypted Virtualization | Secure Memory Encryption (SME) |

Differences between generations

AMD EPYC™ Processors

Feature	Notes	"Zen"	"Zen2"	"Zen3"
SME	Secure memory encryption	✓	✓	✓
SEV	Encrypted memory support with 15 encrypted guests	✓	✓	✓
SEV	Encrypted memory support 8TB/16TB PA space with 509/253 encrypted guests		✓	✓
SEV-ES	Encrypted VMCB state	✓	✓	✓
SEV-SNP	Secure Nested Paging			✓
GMET	Guest mode execute trap. Hypervisor can disallow supervisor execute of guest pages via VMCB		✓	✓
Shadow Stack	Shadow stack for protection against ROP attacks			✓
IBC	Indirect Branch Control	✓	✓	✓
UMIP	User Mode Instruction Prevention		✓	✓

* Select Intel security features for comparison.

AMD⤬

PERFORMANCEPERFORMANCE TUNING GUIDE & ANDER RESSOURCEN

DEVELOPER.AMD.COM/EPYC-TUNING-GUIDES

OS Tuning Guides

- Microsoft Windows® Tuning Guide for AMD EPYC™ 7002 Series Processors
- VMware® vSphere Tuning Guide for AMD EPYC™ 7002 Series Processors
- Optimizing Linux for AMD EPYC™ 7002 Series Processors with SUSE Linux Enterprise 15 SP1

Network Tuning Guides

- Linux® Network Tuning Guide for AMD EPYC™ 7002 Series Processor Based Servers
- Windows® Network Tuning Guide for AMD EPYC™ 7002 Series Processor Based Servers
- VMware® Network Tuning Guide for AMD EPYC™ 7002 Series Processor Based Servers

Workload Tuning Guides

- Workload Tuning Guide for AMD EPYC™ 7002 Series Processor Based Servers
- VMware® vSAN Tuning Guide for AMD EPYC™ 7002 Series Processors
- Database Tuning on Linux® OS: Reference Guide for AMD EPYC™ 7002 Series Processors

AMD Technical Document Library

SW Solution briefs
amd.com/en/processors/server-tech-docs/search

AMD Online Tools

Processor Selector Tool & Virtualized environment TCO calculator
amd.com/en/processors/epyc-tools

AMD Meet The Experts Webinars

amd.com/en/partner/meet-experts-webinars

AMD

AMD VIR PARTNER BENEFITS

AMD Partner Hub

Partner website
Sales & marketing resources
Multiple languages

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MTE Webinars

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Access to AMD experts
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6 CHANNEL MEMORY INTERLEAVING
MEMORY POPULATION RULES

NEW

1 DIMM Per Channel (DPC) Servers

8 DIMM socket / server

Servers with 1 or 2 DIMMS Per Channel

16 DIMM socket / server

DIMM	Empty DIMM slot
DIMM	Populated DIMM slot, 1 DPC
DIMM	2 DPC populated configuration *

Supported by all EPYC™ 7003 CPUs

BENEFITS

➢ Help reduce overall memory cost

➢ Provide efficient memory balance for mid and low core count CPUs

➢ Can improve Perf / TCO due to lower memory costs

➢ Can deliver 3200 MHz memory speeds w/ 3200 MHz DIMMs in 1 DIMM per channel (DPC) configs.

➢ Supports up to 256GB of memory per channel for these configs. This could be 1DPC or 2DPC using these channels.

➢ Optimized to avoid memory hot-spotting when using the indicated channels.
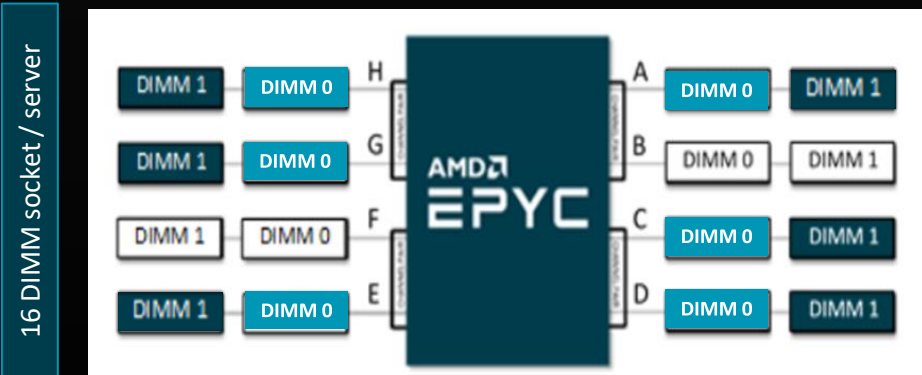
* DIMM type and size rules apply to these population types. Check with OEM for memory population rules.

For optimum performance, the same size and type DIMMs should be used in all populated slots.

AMD

4 CHANNEL MEMORY INTERLEAVING
MEMORY POPULATION RULES - CPUS WITH 128MB OF L3 CACHE OR LESS

1 DIMM Per Channel (DPC) Servers

8 DIMM socket / server

1 DIMM Per Channel (DPC) Servers

16 DIMM socket / server

DIMM — Empty DIMM slot

DIMM — Populated DIMM slot
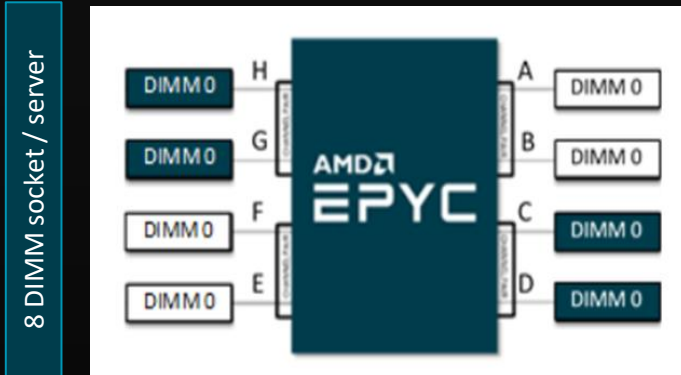
Supported by all EPYC™ 7003 CPUs w/ 128MB L3 cache or less

BENEFITS

- ➢ Help reduce overall memory cost
- ➢ Provide efficient memory balance for low core count CPUs
- ➢ Can improve Perf / TCO with fewer DIMMs
- ➢ Can deliver 3200 MHz memory speeds w/ 3200 MHz DIMMs in 1 DIMM per channel (DPC) configs.
- ➢ Avoids memory channel hot-spotting when using the recommended channels
- ➢ Help optimize low core count CPUs with lower memory costs for many workloads

For optimum performance, the same size and type DIMMs should be used in all populated slots.

AMD
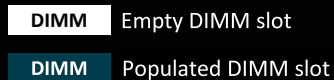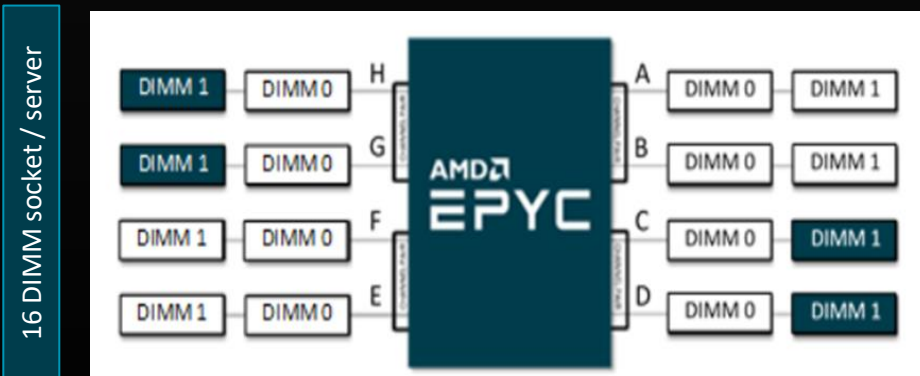
8 CHANNEL MEMORY INTERLEAVING
MEMORY POPULATION RULES

1 DIMM Per Channel (DPC) Servers

8 DIMM socket / server

Servers with 1 or 2 DIMMS Per Channel

16 DIMM socket / server

DIMM	Empty DIMM slot
DIMM	Populated DIMM slot, 1 DPC
DIMM	2 DPC populated configuration *
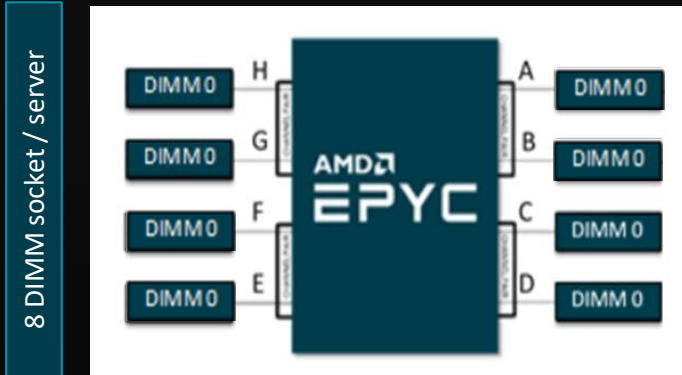
Supported by all EPYC™ 7003 CPUs

<u>BENEFITS</u>

➢ Help achieve a least cost / max memory performance solution

➢ Can deliver 3200 MHz memory speeds w/ 3200 MHz DIMMs in 1 DIMM per channel (DPC) configs.

➢ Enables maximum system memory bandwidth

➢ Help optimize core count with memory capacity and bandwidth for demanding workloads
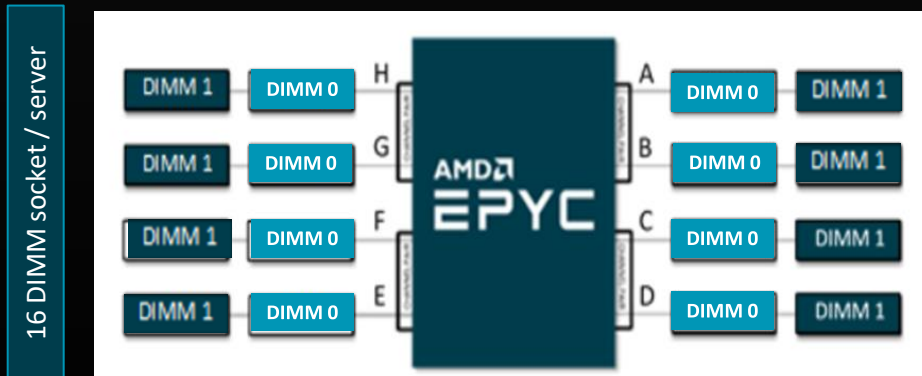
* DIMM type and size rules apply to these population types. Check with OEM for memory population rules.

For optimum performance, the same size and type DIMMs should be used in all populated slots.

SP3 "MILAN" TARGETED OPERATING SYSTEMS & HYPERVISORS

	N - 1	Launch (N)
Microsoft	Server 2016	Server 2019 Azure Stack HCI v1
vmware	vSphere 6.7u3 P03	vSphere 7.0u1
redhat	see notes	RHEL 8.3
SUSE	SLES 12 SP5 Requires maintenance update (Mar 4, 2020 Kernel 4.12.14-122.17)	SLES 15 SP2
CANONICAL	Ubuntu 18.04.5	Ubuntu 20.04
CITRIX		Hypervisor 8.2
CentOS		8.3
ORACLE	UEK 5.5	UEK 6.1

Windows note:
- X2APIC/256T not supported in 2016
- Sept 2019 Media Refresh & beyond provides full 256T/x2APIC support

RedHat notes:
- RHEL 7.x is in maintenance mode – not taking new features, therefore will not support Milan
- Milan users will need to upgrade to RHEL 8.3 (Nov 2020)
- RHEL uses a whitelist to check for known hardware configurations. RHEL versions that work for Rome are expected to boot and run, but the end-user will see the message "Unsupported Hardware Detected".

AMD

ENDNOTES

EPYC-18: Max boost for AMD EPYC processors is the maximum frequency achievable by any single core on the processor under normal operating conditions for server systems. EPYC-18

MIL-001: AMD EPYC™ 7003 Series processors require a BIOS update from your server or motherboard manufacturer if used with a motherboard designed for the AMD EPYC™ 7002 Series processors. A motherboard designed at minimum for EPYC 7002 processors is required for EPYC 7003 Series processors. MIL-001

NOTE 1 - AMD EPYC 3rd Generation ("Milan") processor estimates are based on pre-production silicon on AMD Ethanol X reference platform, Ubuntu 20.04, latest AGESA (92RC2), 4 xGMI @ 10.7GT, with 1 DPC DDR3200 (32GBx16), AOCC3.0 (beta v04) complier, in NPS4 mode, performance determinism, measured at AMD labs in Oct 2020.   The actual numbers measured by our Boston ITs on actual production processors may vary based on platforms, hardware and software configurations and versions. SPEC®, SPECrate® and SPEC CPU® are registered trademarks of the Standard Performance Evaluation Corporation. See www.spec.org for more information.

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AMD