CXL Memory, Market Opportunity

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2022 / Memory Global Sales, Marketing & Business Development

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Agenda

- **Preface**

- **Memory Market & Technology**
  - AI/ML Demand by Vertical Industry
  - Memory Market Trend by Application
  - HPC Requirements
  - Pain point – Limitations/Challenges of current architectures
  - CXL Memory Target Market Outlook

- **Conclusion & Proposal**

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Entering the Era of Disaggregation

Arrival of Best for S/W defined architecture w/ vast pools of memory & storage enabled by CXL architecture

xPU-agnostic
- Capacity and Bandwidth are not limited by the xPU

Memory generation-agnostic
- Flexible Supply Operation

Better TCO
- Flexible and Scalable

	'18~	'20~	'22~	'23~	'24~	'25~
Disaggregation ~ by ICs	Storage	Accelerator	Network Automation	Memory	Storage + Memory	CPU + Large Cache
Core Technology	NVMe of Fabric	xPU	5G	CXL	I/O Acceleration	Chiplet
Memory Strategy	LPDDR @Smart NIC	HBMx	HBMx/LPDDR @Network	CXL DRAM	Smart SSD CXL SSD	LLC, Memory Appliances

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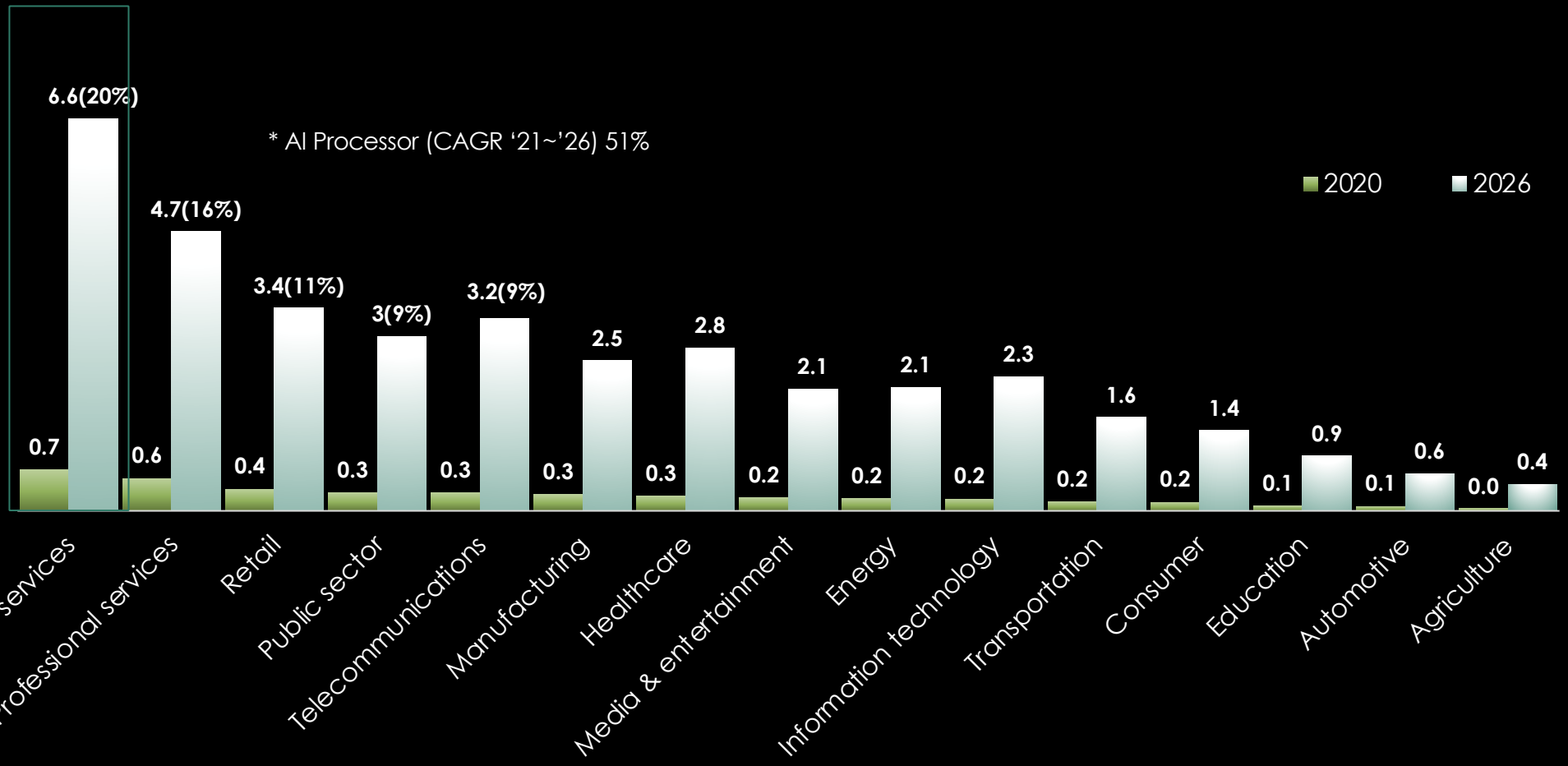
AI Adoption Trend in Vertical Industry

Top5 AI Adoption Vertical Industry : Financial Services > Professional > Retail > Public Sector > Telecommunications

[By Industry ('20 vs '26 $B)]



(Sources: Omdia '21 AI/ML Adoption Trend)

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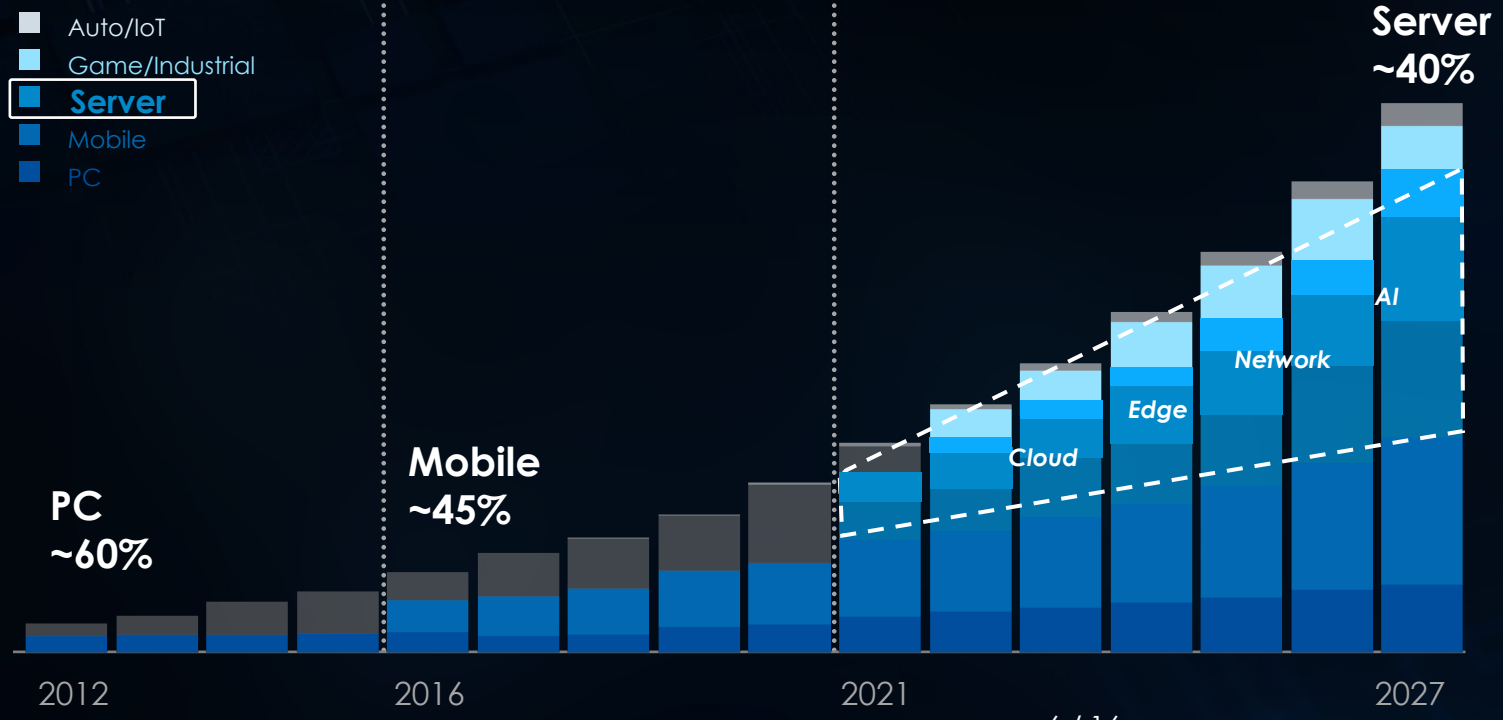
Diversified Applications in Memory Portfolio

PC-centric — Moore's law

Mobile — Wireless connectivity

Data-driven — Data availability & reliability

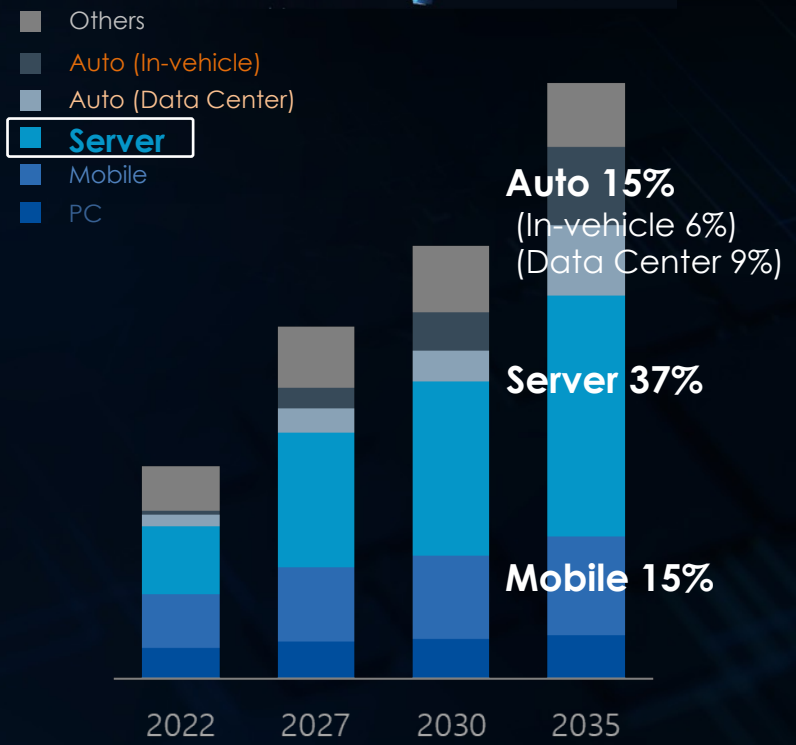
Worldwide DRAM Demand (B Gb)



(Source : Samsung internal)

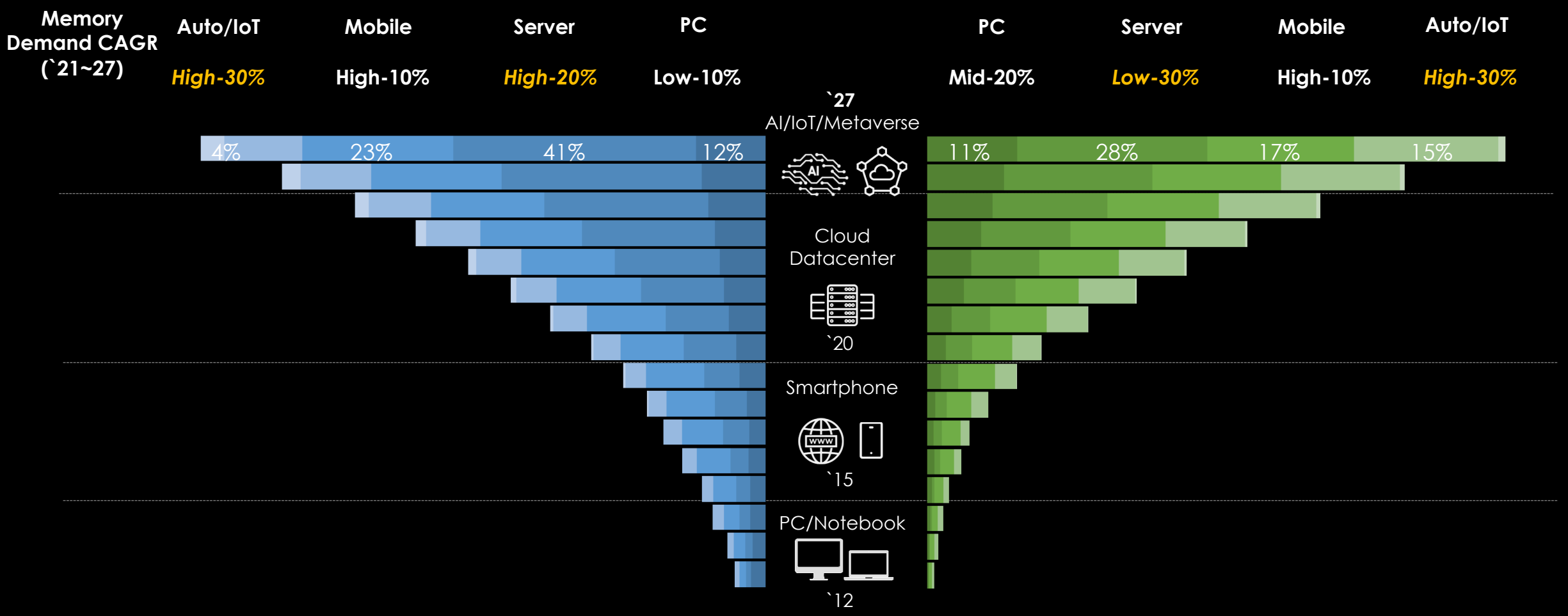
Beyond 2030

Worldwide DRAM Revenue (B $)



(Source : Boston Consulting Group (Aug.22))

Memory Portfolio Change : Client → D/C → AI / IoT



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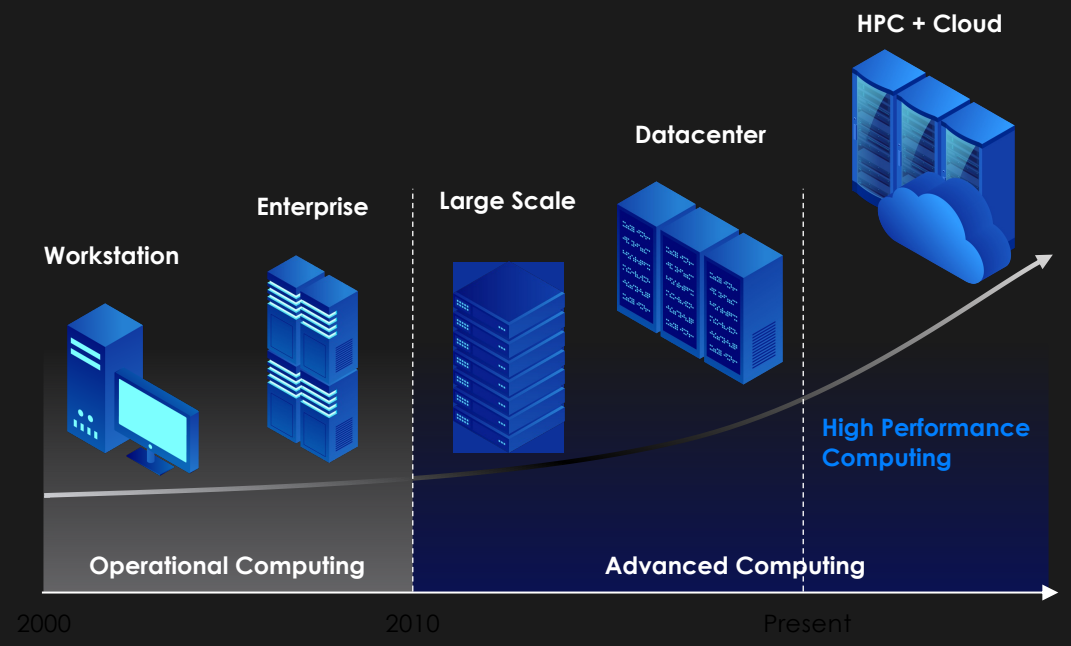
High Performance Computing

HPC for Big Data Analysis & AI/ML

Massive scale-out architecture; Server class CPU + GPU accelerators

General Computing (Server) Trend Since 2000



HPC Applications

Genomics	Advanced Engineering	Materials Science	Finance

	Today	Tomorrow
Nature of data	Generated/ Synthesized	Data is stored (AI/ML Data feed)
Major use case	Checkpointing, Simulation	High speed Data processing
Data access pattern	Predictable, parallelized read/write	Random

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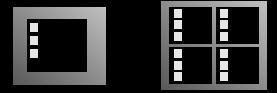
Major Trends in Server System

Higher Bandwidth & Capacity of memory/storage solution to meet these major trends

CPU

Core Count
(2~3X last 5 yrs)

Scaling
+
Multi-chip packaging

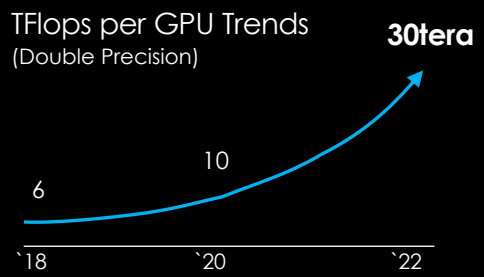


Higher Bandwidth / Density Module

DDR5
>2X (vs. DDR4)

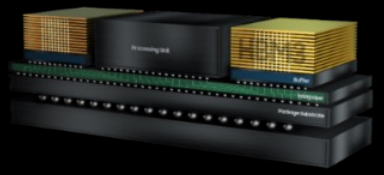
GPU / AI Accel.

Increasing FLOPS
(~5X last 4 yrs)



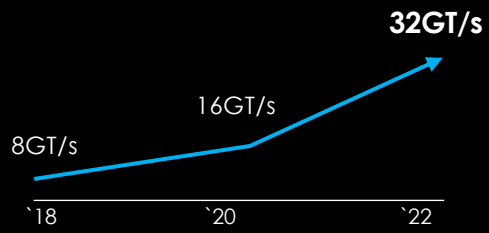
Extreme BW Solution

HBM2E / HBM3
>1.5~2.5X (vs. HBM2)



Storage

Increasing PCIe
(4X in 3 Gen)



Extreme BW Solution

PCIe Gen5 NVMe SSD
> 2x vs PCIe Gen4

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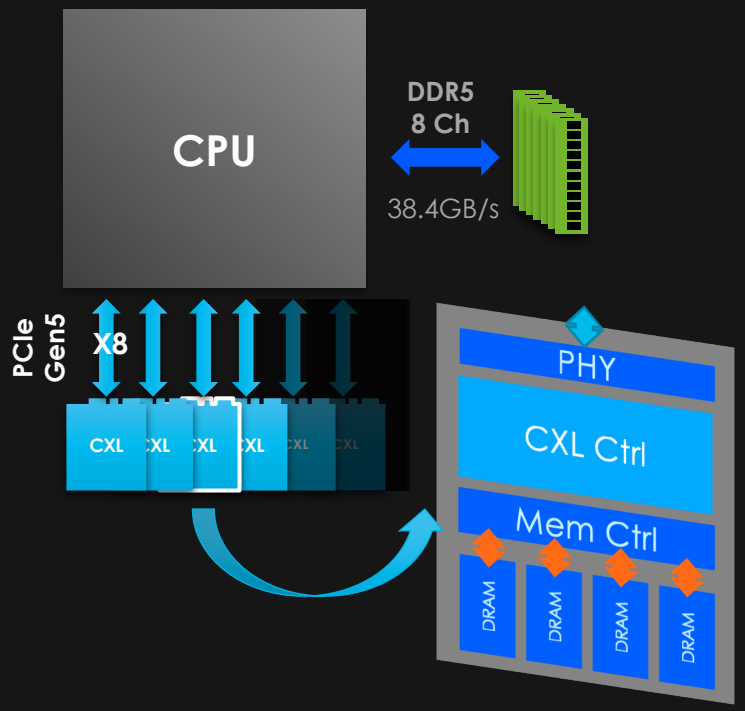
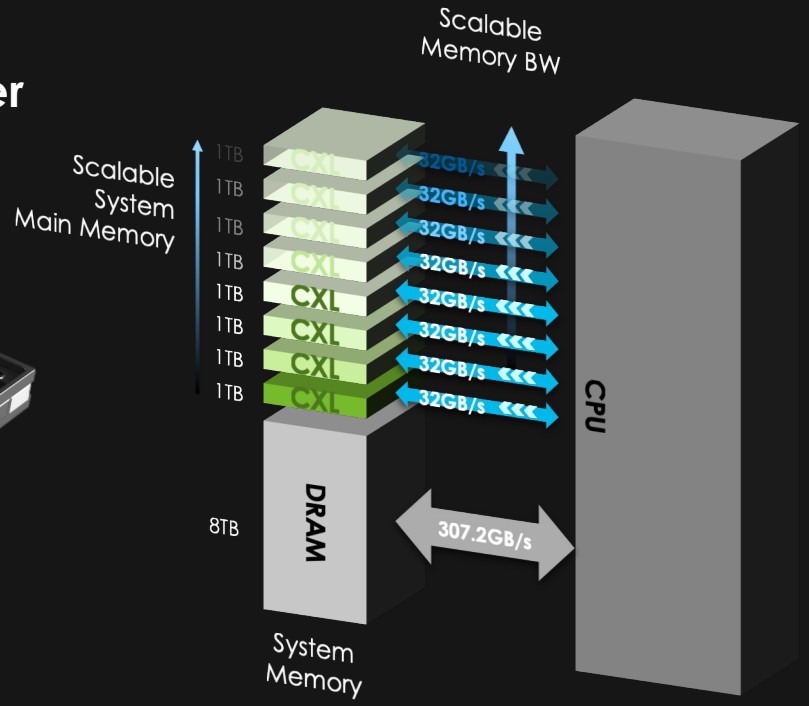
CXL™ Interconnect*: Scalable Memory Capacity & BW

Increase memory bandwidth and capacity per computing system's usage requirements
DDR as memory media, but media-agnostic solution is feasible



World's First
CXL™ Memory Expander



*Compute Express Link™

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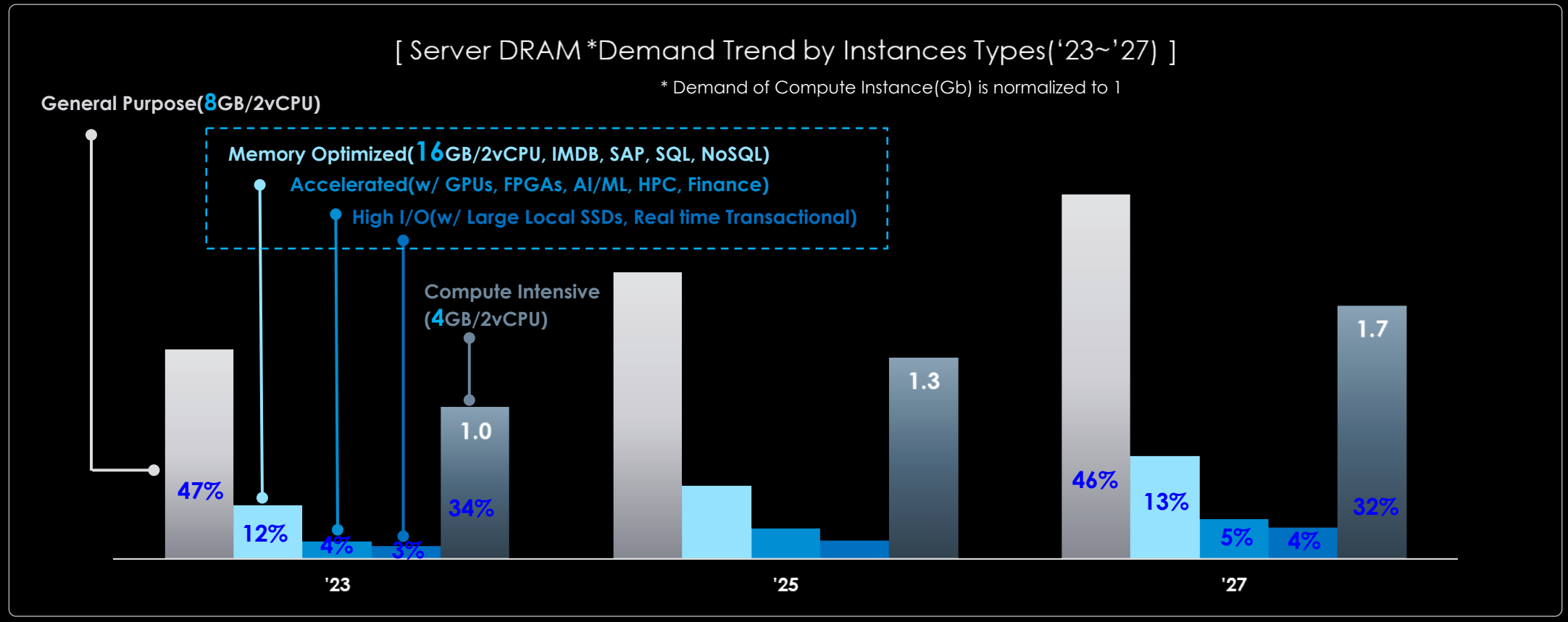
CXL-DRAM, Target Market Outlook

- DRAM Demand for Server, is projected to grow '22~'27 CAGR 18~21%

  Memory Optimized, Accelerated, High I/O Instances – CXL Expander from '23~

  General/Compute Instances – Low Cost Solution w/CXL from '24~



(Source: Samsung Internal Survey '22 Q1)

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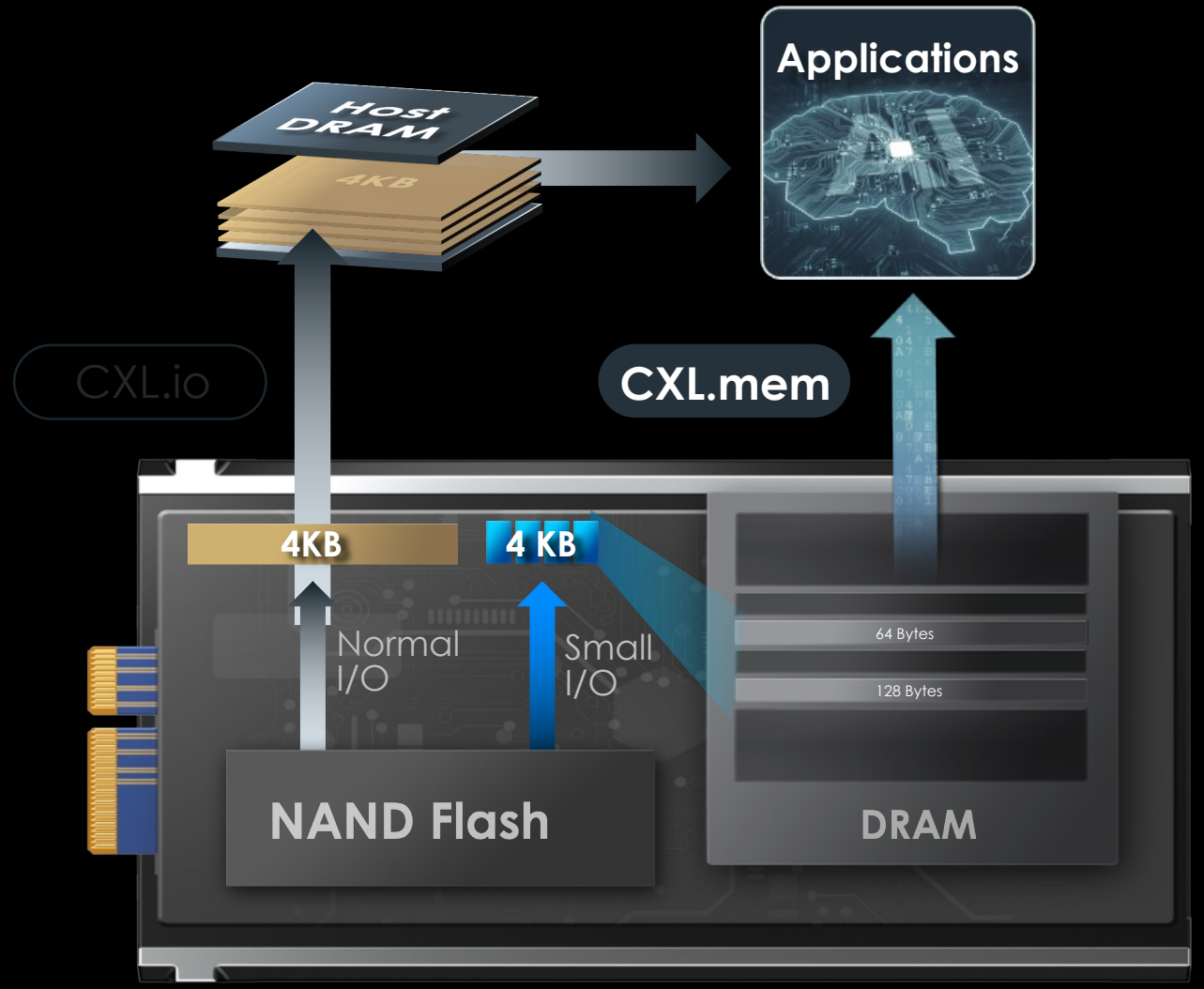
CXL-SSD Concept

- Dual interface SSD with IO and memory for the same storage space

Dual Mode Support

Small Granularity Access

Better System TCO



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Samsung Memory Semantic SSD

- **Industry 1st CXL-based SSD concept PoC**

Memory Semantic SSD

Form Factor	E3.L 2T
DRAM	16GB DDR4
NAND	2TB
CXL Link	PCIe Gen3 x8
Max Bandwidth	8 GB/s
IOPS	Max. 20M IOPS (@128B)
Latency	< 1us
Version	CXL 2.0
RAS	TBD
Availability	TBD

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CXL-SSD, Target Market Outlook

- NAND Demand for Server, is showing '22~'27 CAGR 31% growth thanks to robust AI/ML adoption

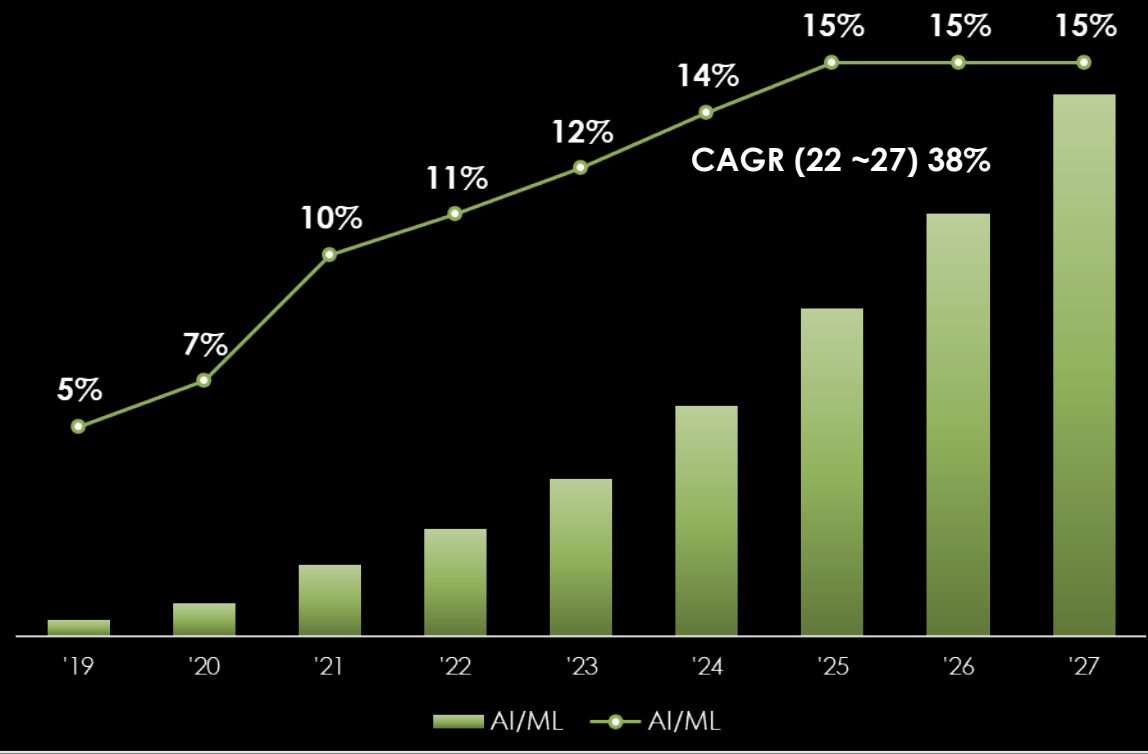
  AI/ML will take 15~18% of Total NAND in 2027 with CAGR 38% growth

  CXL - SSD will be used majorly in AI/ML in 2027

* AI, ML Average GB/sys - DRAM x6, NAND x2~2.5

[NAND Demand Map by Workloads]

[AI/ML Workload SSD Demand Outlook(EB)]



(Source: Samsung Internal Survey '22 Q1)

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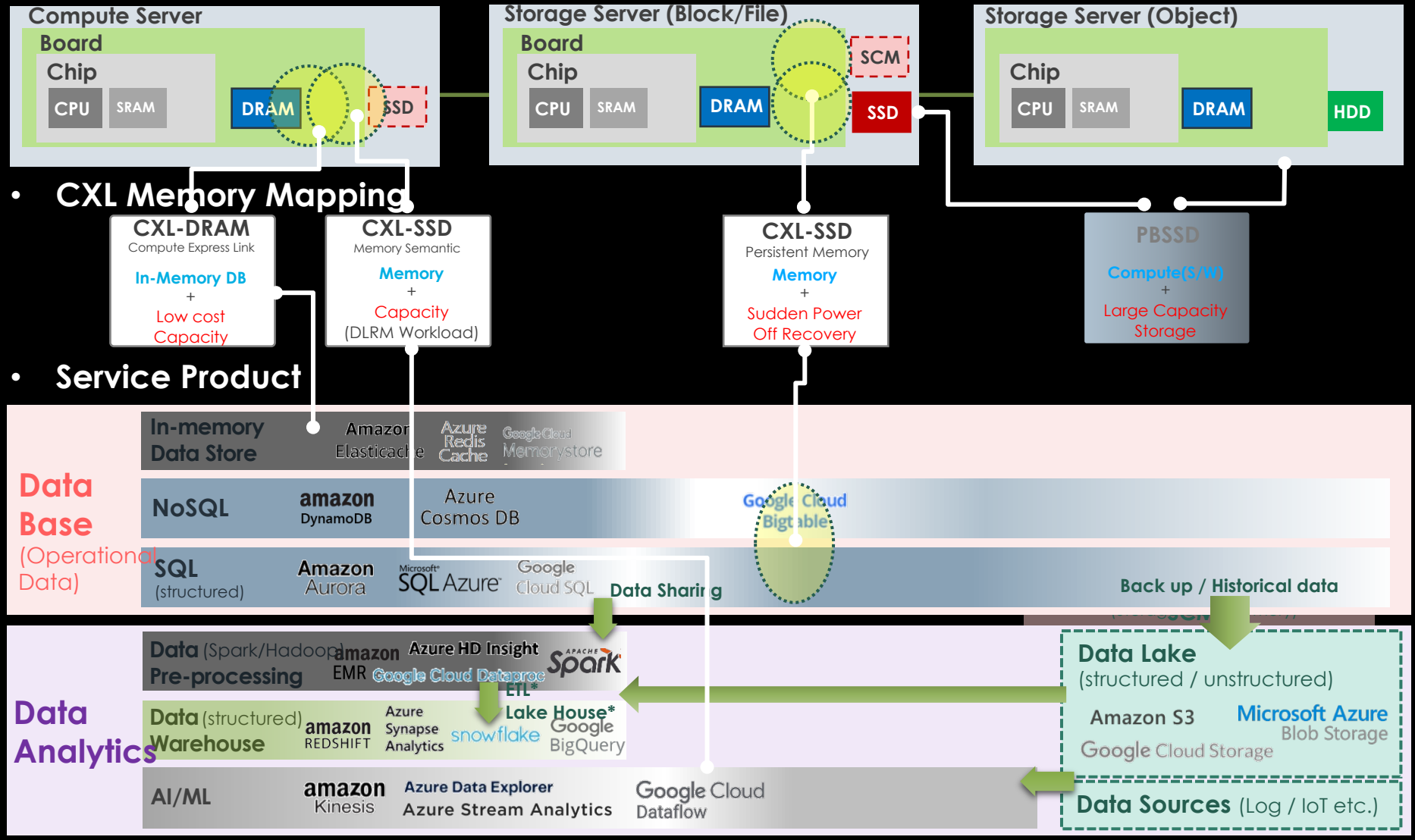
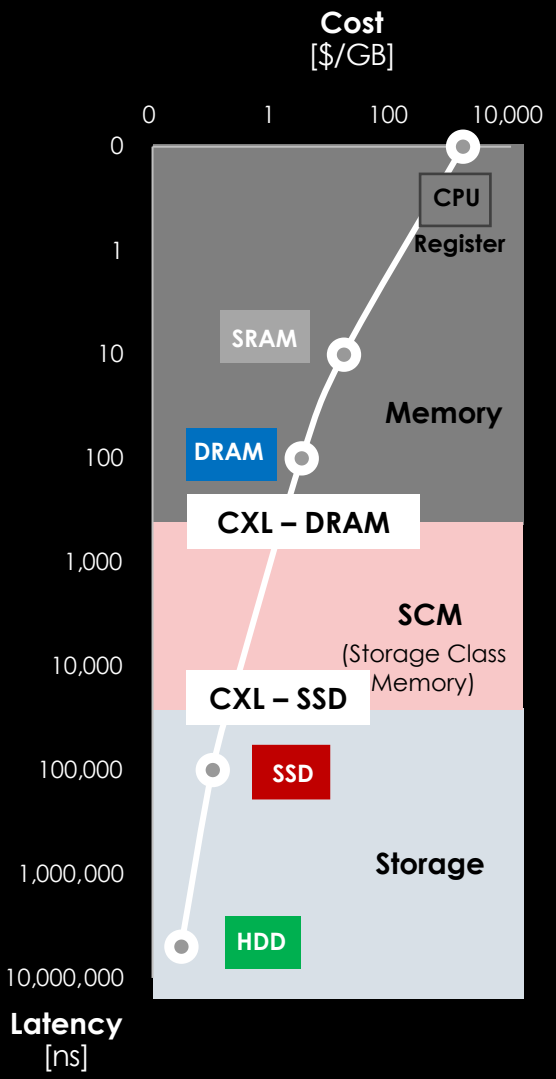
Datacenter Memory Infrastructure Mapping

- Current Server Infra
- CXL Memory Mapping
- Service Product





(*ETL = Extract, Transform, Load *Lake House = Data Lake processing + Data Warehouse)

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Collaboration Proposal

1. **With Eco-Partners**
   1) Deeper Collaboration with MemVerge SW Solution in CXL Tiering and Pooling
   2) Elastic Cloud - CXL Switch

2. **With Server OEMs**
   1) Develop collaborative demo with Samsung CXL-DRAM + SMDK
   2) Identify events / promotions of mutual interest and conduct joint marketing activities

3. **With End Customers - Finance Sector Customers**
   1) Learn More about Samsung CXL Memory Value Proposition
   2) Explore Use Cases
   3) Performance Benchmark Testing

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