AI Challenges in Data Center Networking

Side Meeting@IETF 118

17:00 - 19:00 Tuesday, November 7, 2023

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Note Well

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Definitive information is in the documents listed below and other IETF BCPs. For advice, please talk to WG chairs or ADs:

  - BCP 9 (Internet Standards Process)
  - BCP 25 (Working Group processes)
  - BCP 25 (Anti-Harassment Procedures)
  - BCP 54 (Code of Conduct)
  - BCP 78 (Copyright)
  - BCP 79 (Patents, Participation)
 - https://www.ietf.org/privacy-policy/(Privacy Policy)

Agenda

- **Chairs**

- **Networking in AI Clusters**
  Omer Shabtai (Nvidia)

- **Astral-Network: efficient large-scale datacenter network for large language model training**
  Baojia Li (Tencent)

- **Self-Adjusting Networks**
  Stefan Schmid (TU Berlin)

- **CSIG - Simple and Effective In-band Network Signals for Efficient Traffic Management in Datacenter Networks**
  Abhiram Ravi (Google)

- Open Discussions
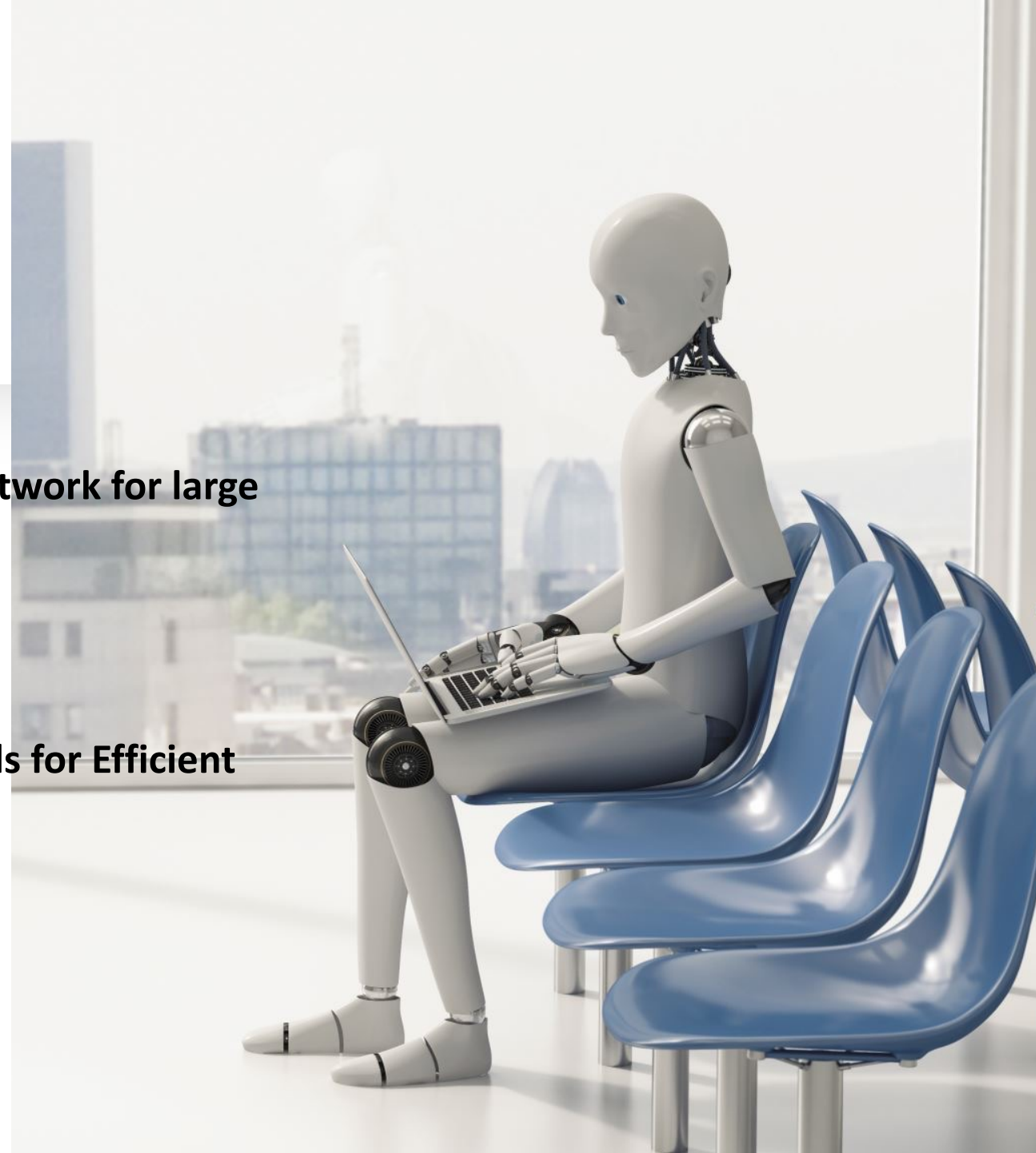
AI networking – what is different?

- Performance optimized vs cost optimized (RDMA semantics)
  - cost of bit lost
  - cost of bit delayed
- JCT drives the networking
  - throughput != goodput != JCT
- Under-subscription is not an option – 90%+ utilization is mandatory for network bound jobs
  - every kW spent on networking is not spent on GPUs
- Many different networks
- Platform play -> communication libraries + smartNICs + switches

2012 – AlexNet – 2 GPUs/61M parameters
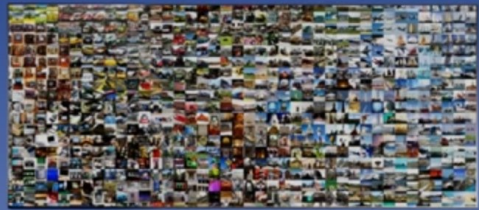
AlexNet
61M Parameters
262 PetaFLOPS

AlexNet was trained on a GTX 580 GPU with only 3 GB of memory which couldn't fit the entire network.

The network was split across 2 GPUs, with half of the neurons(feature maps) on each GPU
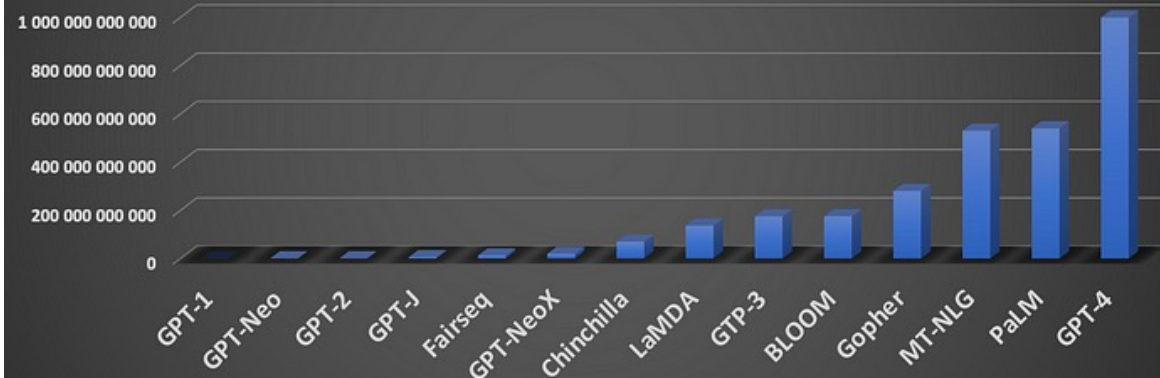
2022 − 512GPUs/175B; 2023 − 6K+ GPUs/100T

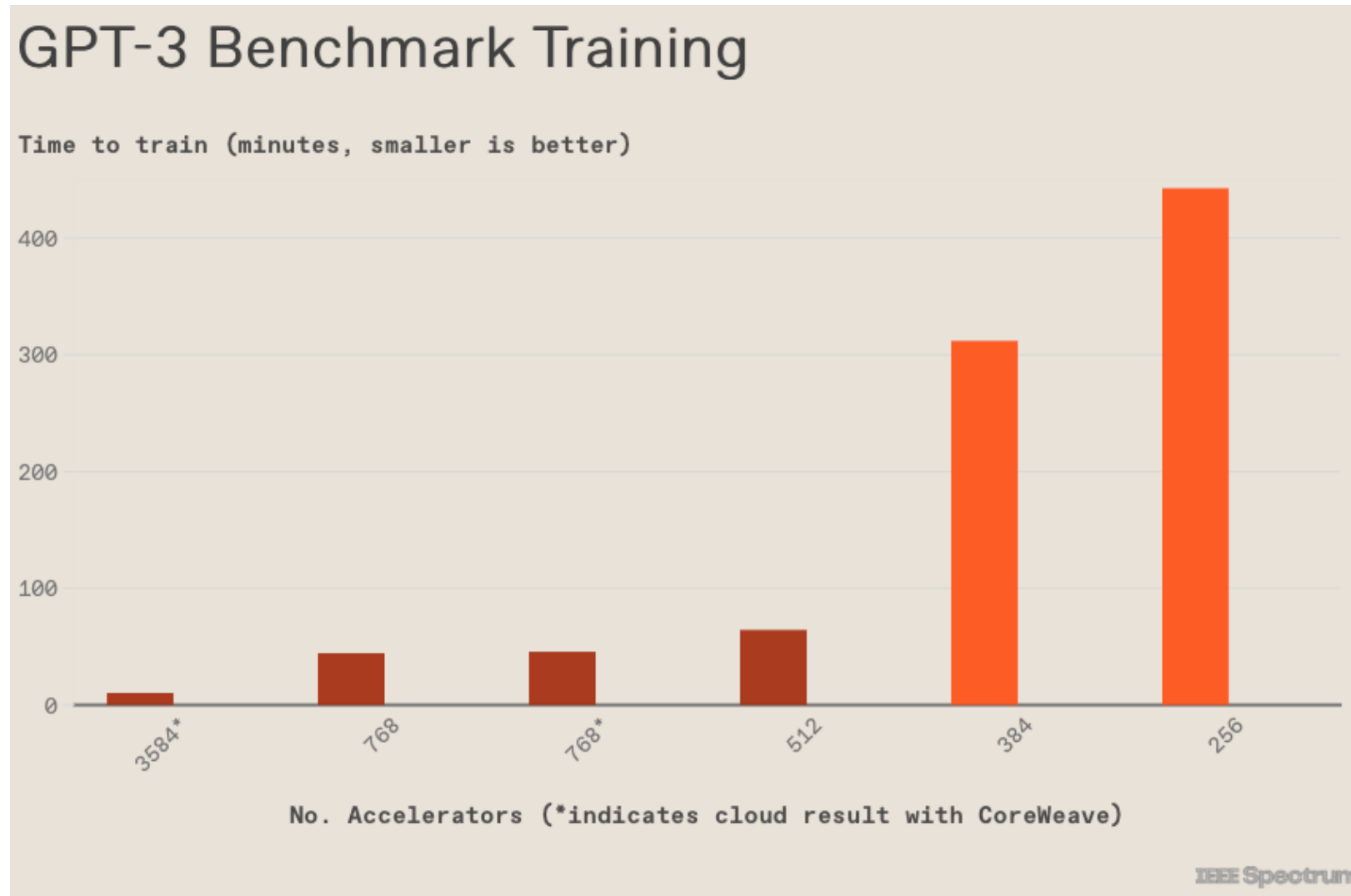# Size does matter! GPU hours drive economics
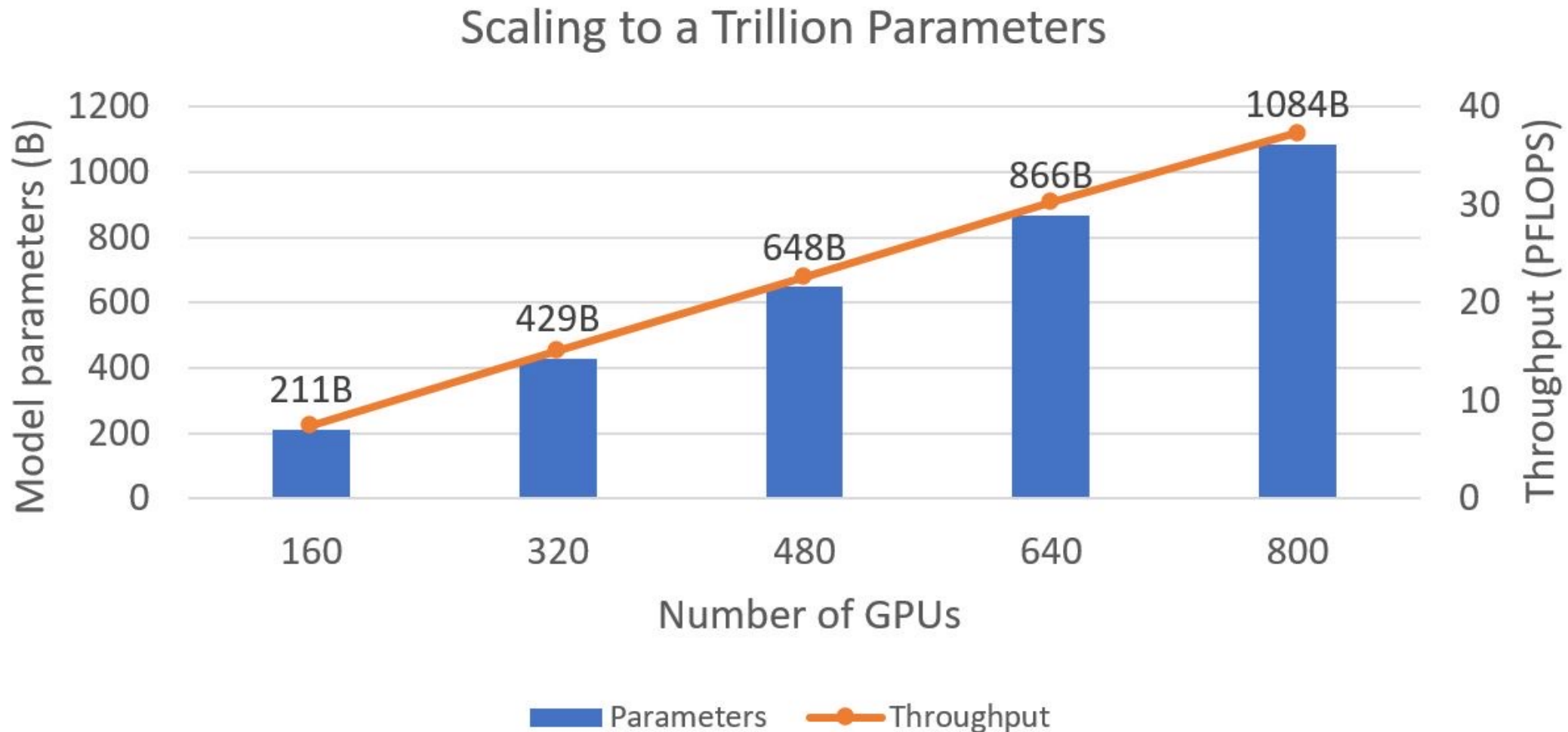

GPT-3 Benchmark Training

Time to train (minutes, smaller is better)

No. Accelerators (*indicates cloud result with CoreWeave)

What drives the network size? Model/data size
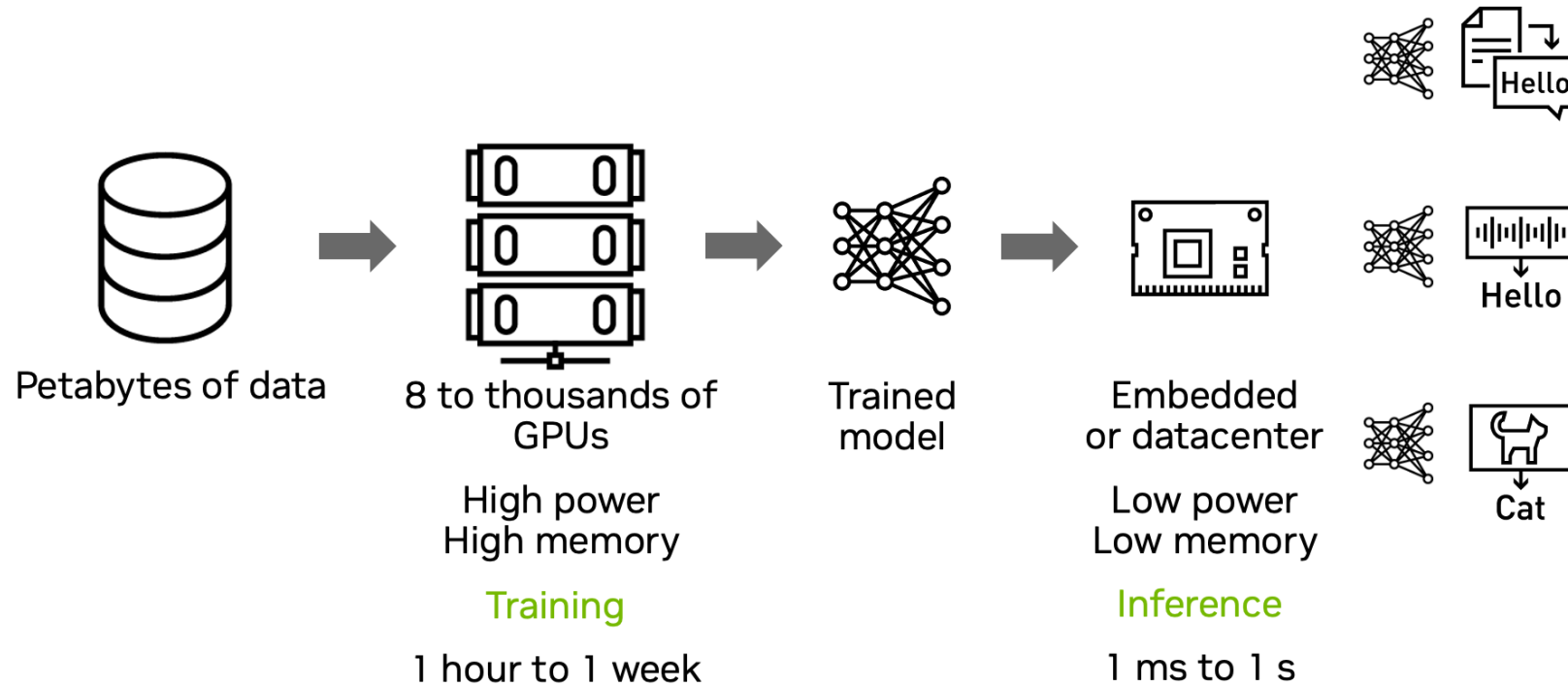

Scaling to a Trillion Parameters

What drives the network size? Model/data size META recent models(networking @scale 2023)

MODEL NAME	RELEASE DATE	MODEL SIZE	DATASET SIZE	TRAINING ZETA (1E21) FLOPS	TRAINING HW (COMPUTE)	TRAINING HW (NETWORK)	GPU HOURS (# GPUS X HOURS)
OPT	May 2022	175 B	300 B	430	1K A100	IB 200Gbps per GPU 25.6 TB/s bisection BW	800K
LLaMA	Feb 2023	65 B	1.4 T	600	2K A100	IB 200Gbps per GPU 51.2 TB/s bisection BW	1M
LLaMA2	July 2023	34 B	2 T	400	2K A100	RoCE 200Gbps per GPU 51.2 TB/s bisection BW	1M
LLaMA2	July 2023	70 B	2 T	800	2K A100	IB 200Gbps per GPU 51.2 TB/s bisection BW	1.7M

AI training/inference workflow

Petabytes of data → 8 to thousands of GPUs / High power High memory / **Training** / 1 hour to 1 week → Trained model → Embedded or datacenter / Low power Low memory / **Inference** / 1 ms to 1 s

AI – how do we scale?

- To scale the model size -> parallelization is mandatory
  - Data
  - Model
  - Tensor
- Details in the next presentation ->

Meeting Materials

[AIDC-IETF118: Meeting materials (github.com)](github.com)