Fault-Tolerant Distributed Training of Language Models via Avian Message Passing
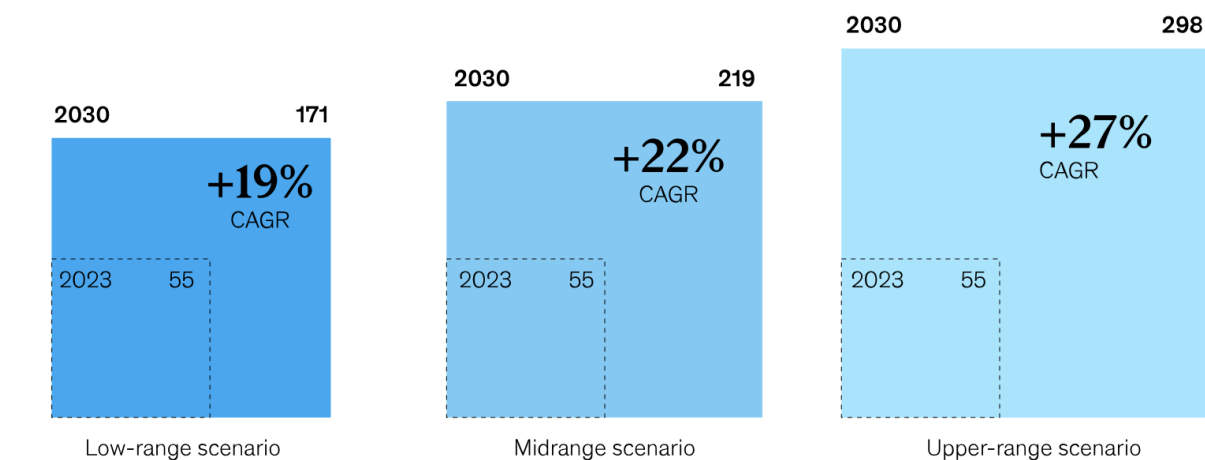
Jared Fernandez, Amanda Bertsch

Redhawk

Data Center Energy Use is Growing ☹

Global demand for data center capacity could more than triple by 2030.

Demand for data center capacity,[1] gigawatts

	Low-range scenario	**Midrange scenario**	**Upper-range scenario**
2030	171	219	298
CAGR	+19%	+22%	+27%
2023	55	55	55

[1]Three scenarios showing the upper-, low-, and midrange estimates of demand, based on analysis of AI adoption trends; growth in shipments of different types of chips (application-specific integrated circuits, graphics processing units, etc) and associated power consumption; and the typical compute, storage, and network needs of AI workloads. Demand is measured by power consumption to reflect the number of servers a facility can house.
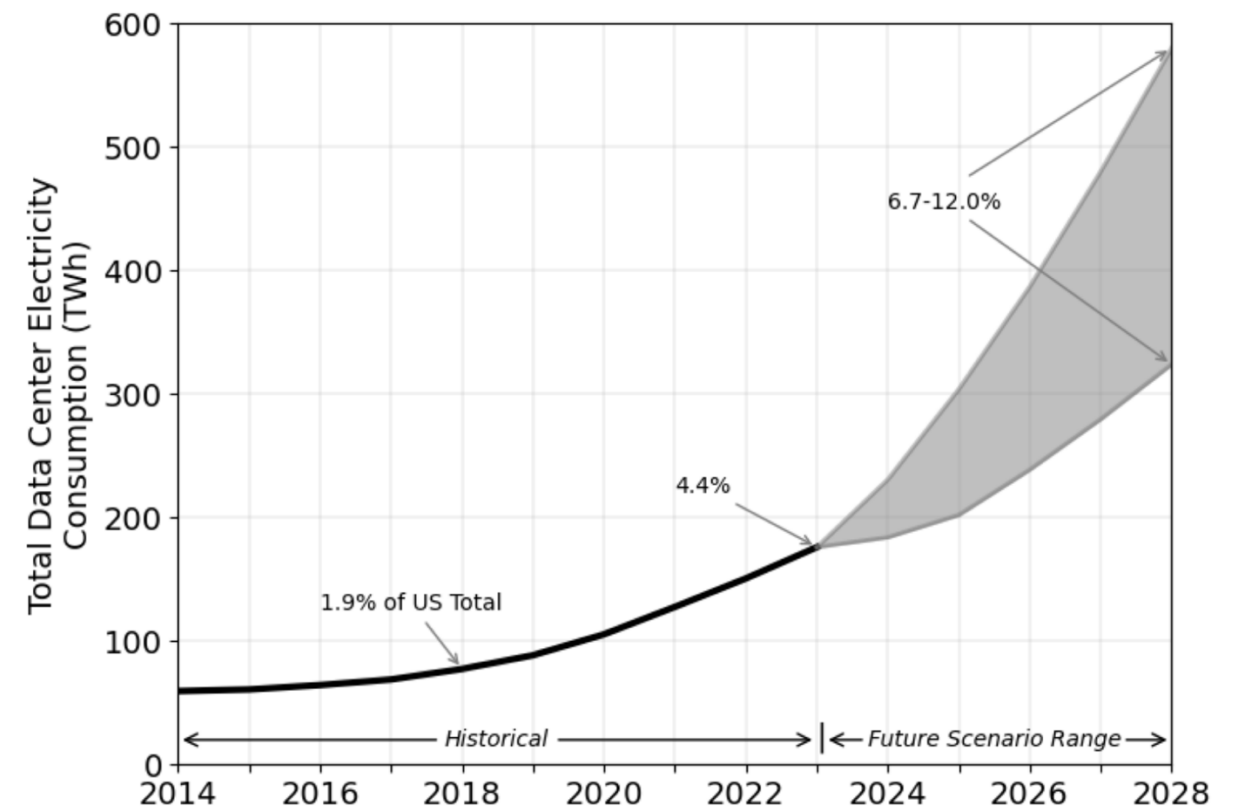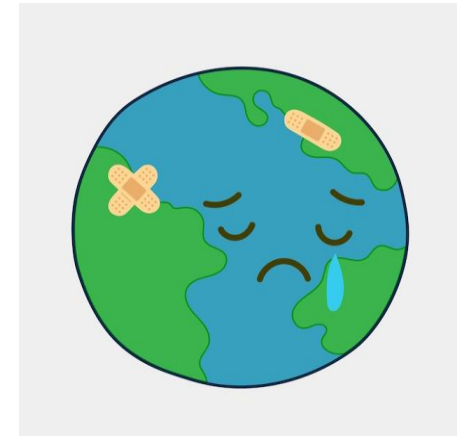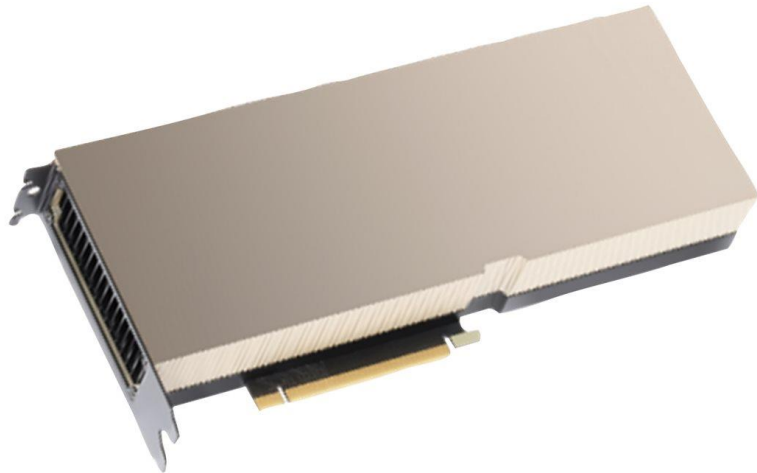Source: McKinsey Data Center Demand model

McKinsey & Company

Figure ES-1. Total U.S. data center electricity use from 2014 through 2028.

- Data Centers Projected to Consume +10% of US national power demand by 2030
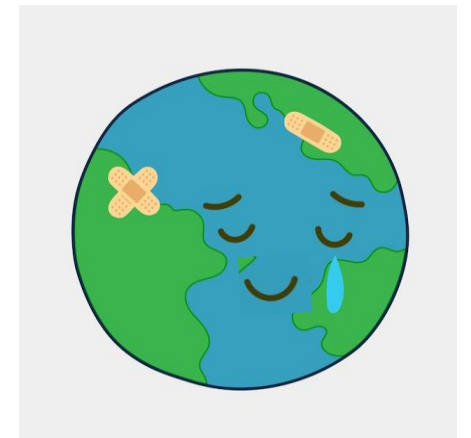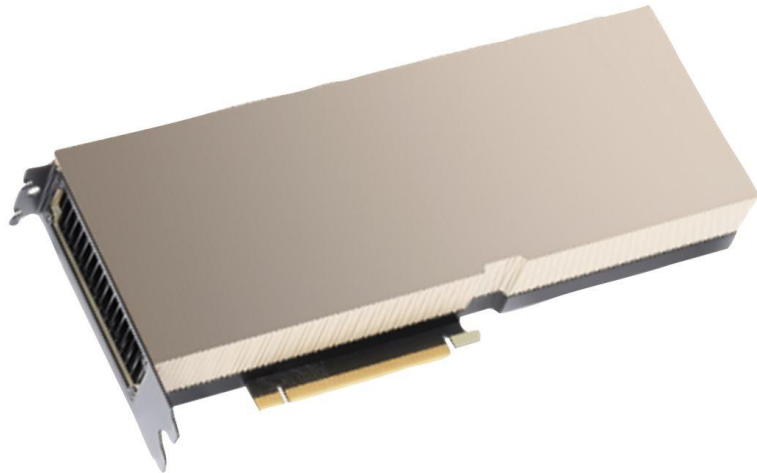
Modern Data Center Hardware is Power Intensive

700 W per GPU + 300 W per Switch   =   Global Warming

1. Strain on electrical grid infrastructure

2. Carbon emissions → Environmentally harmful

3. Requires knowing computer networking
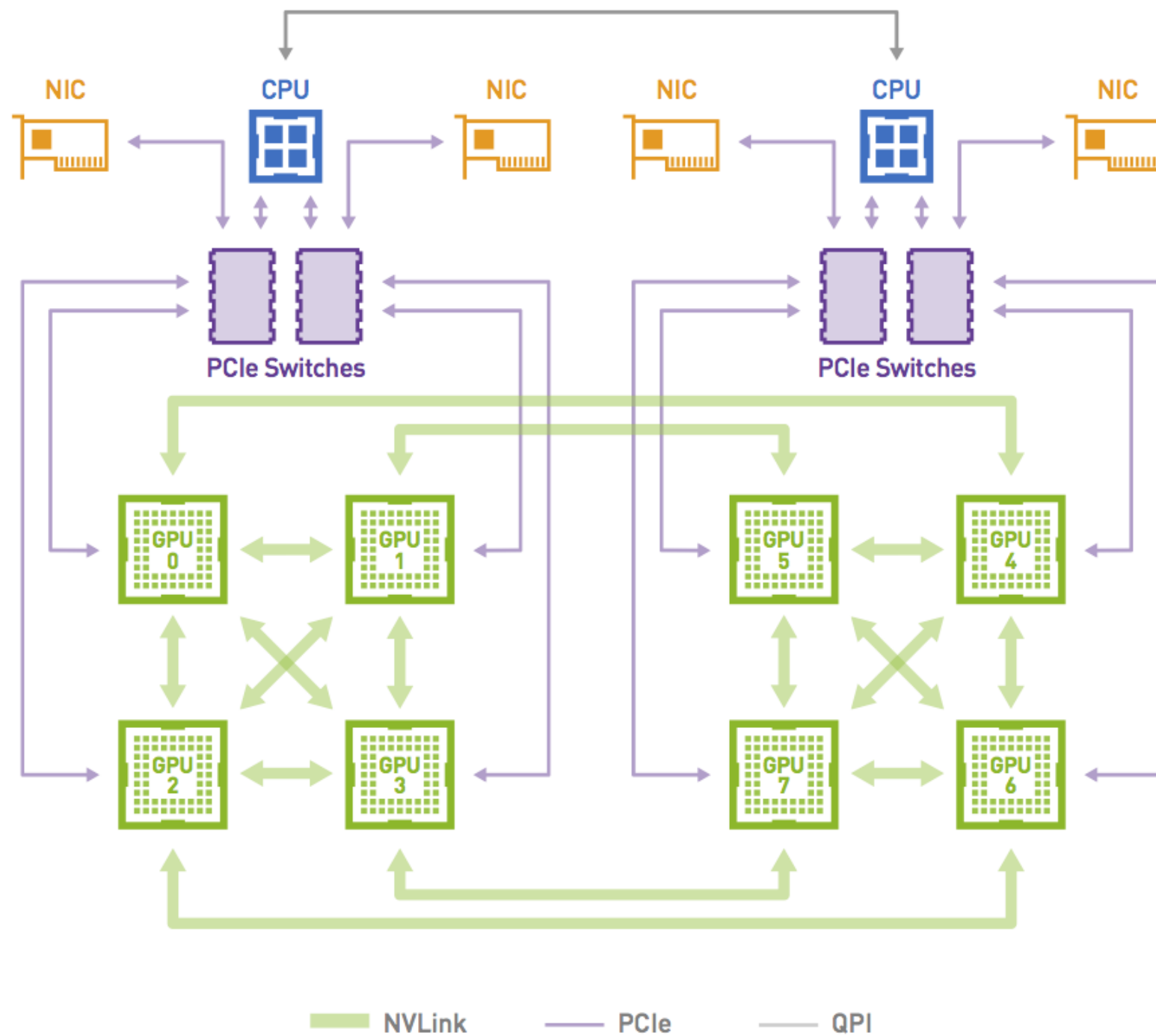
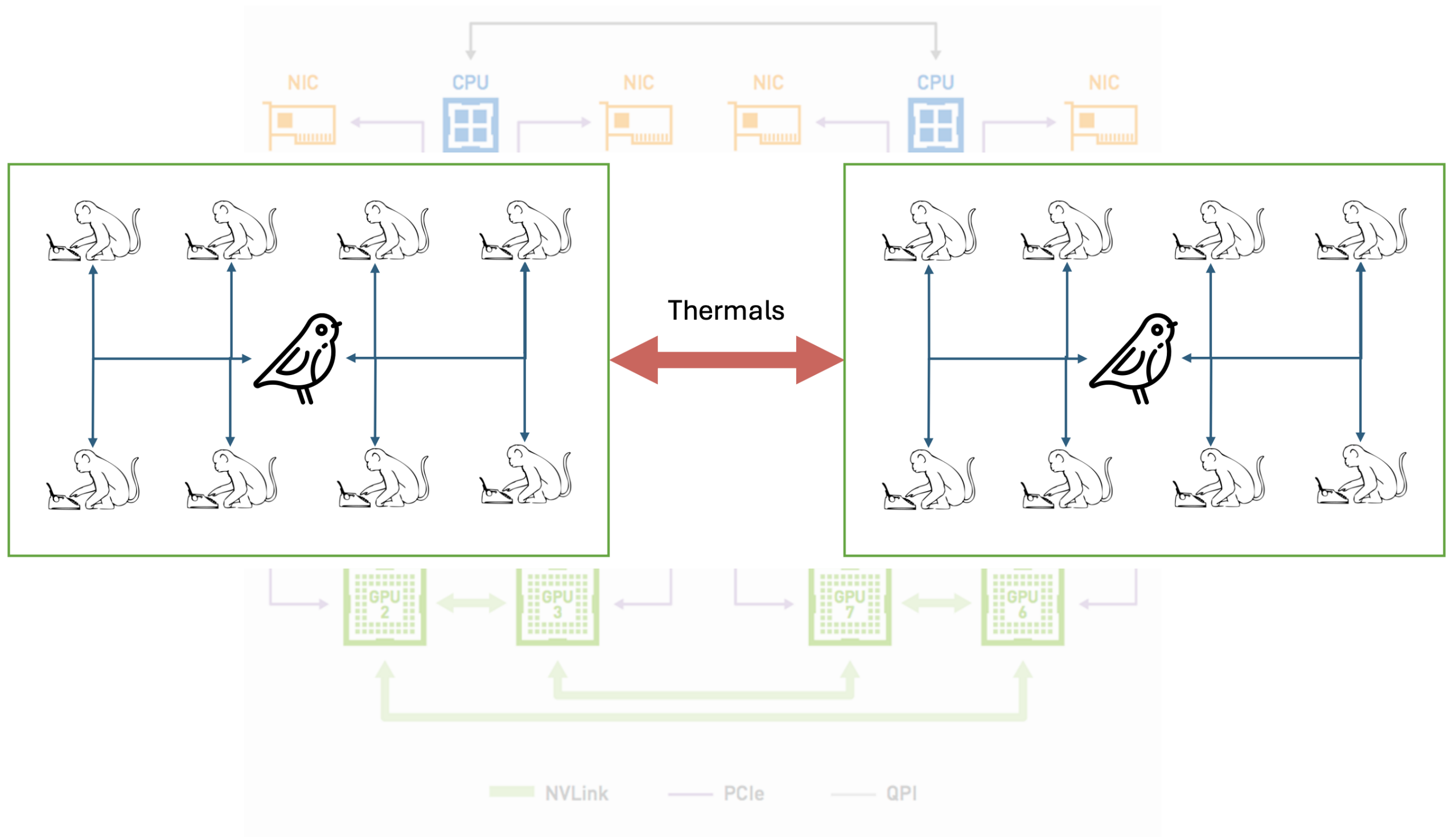700 W per GPU   +   <5 W per Bird[1]   =   Eco LLMs!

1. Birds!

Tucker, Vance A. "The energetic cost of moving about: walking and running are extremely inefficient forms of locomotion. Much greater efficiency is achieved by birds, fish—and bicyclists." *American Scientist* 63.4 (1975): 413-419.
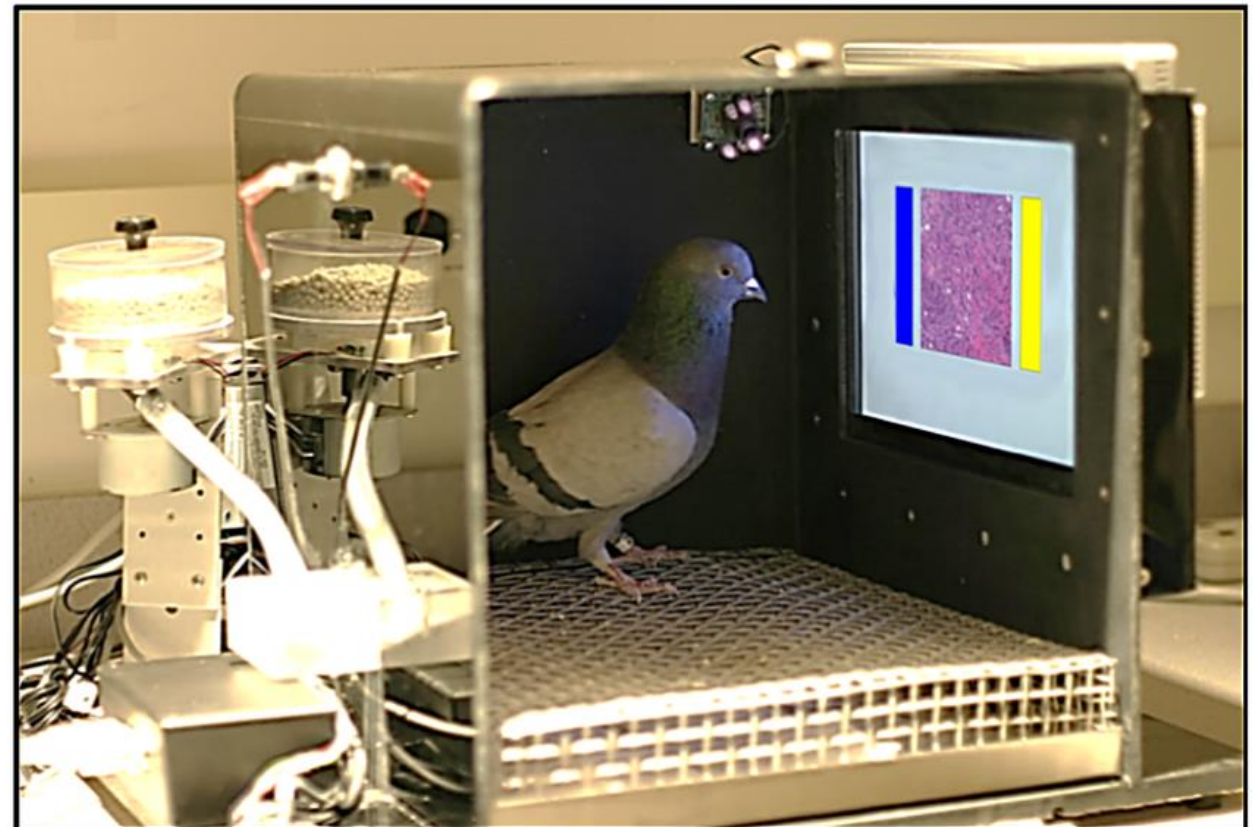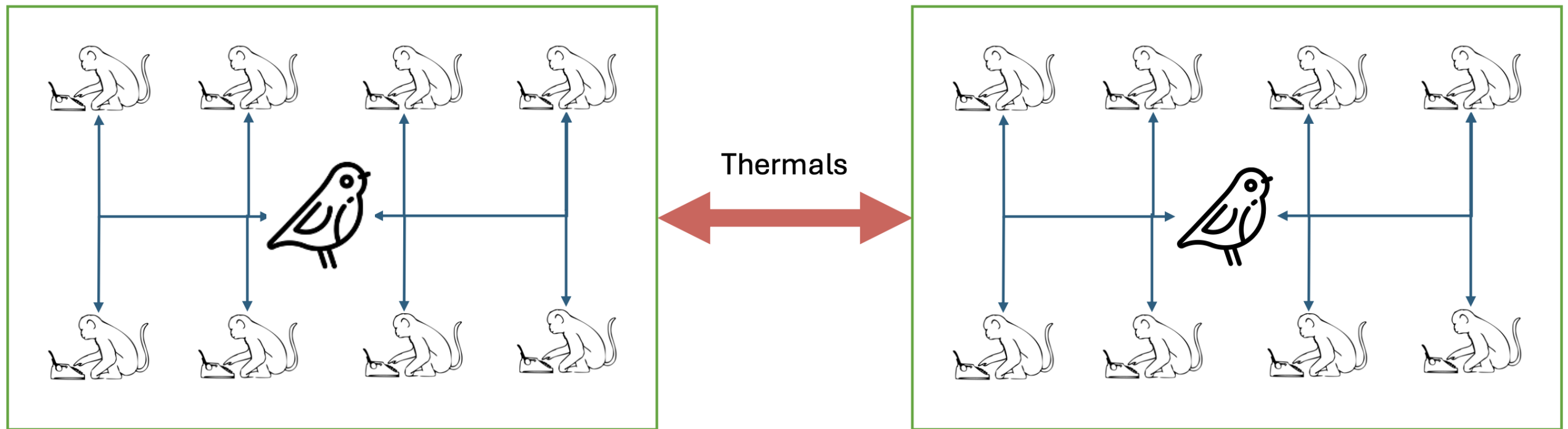
The Solution

The Solution

Man's best friend
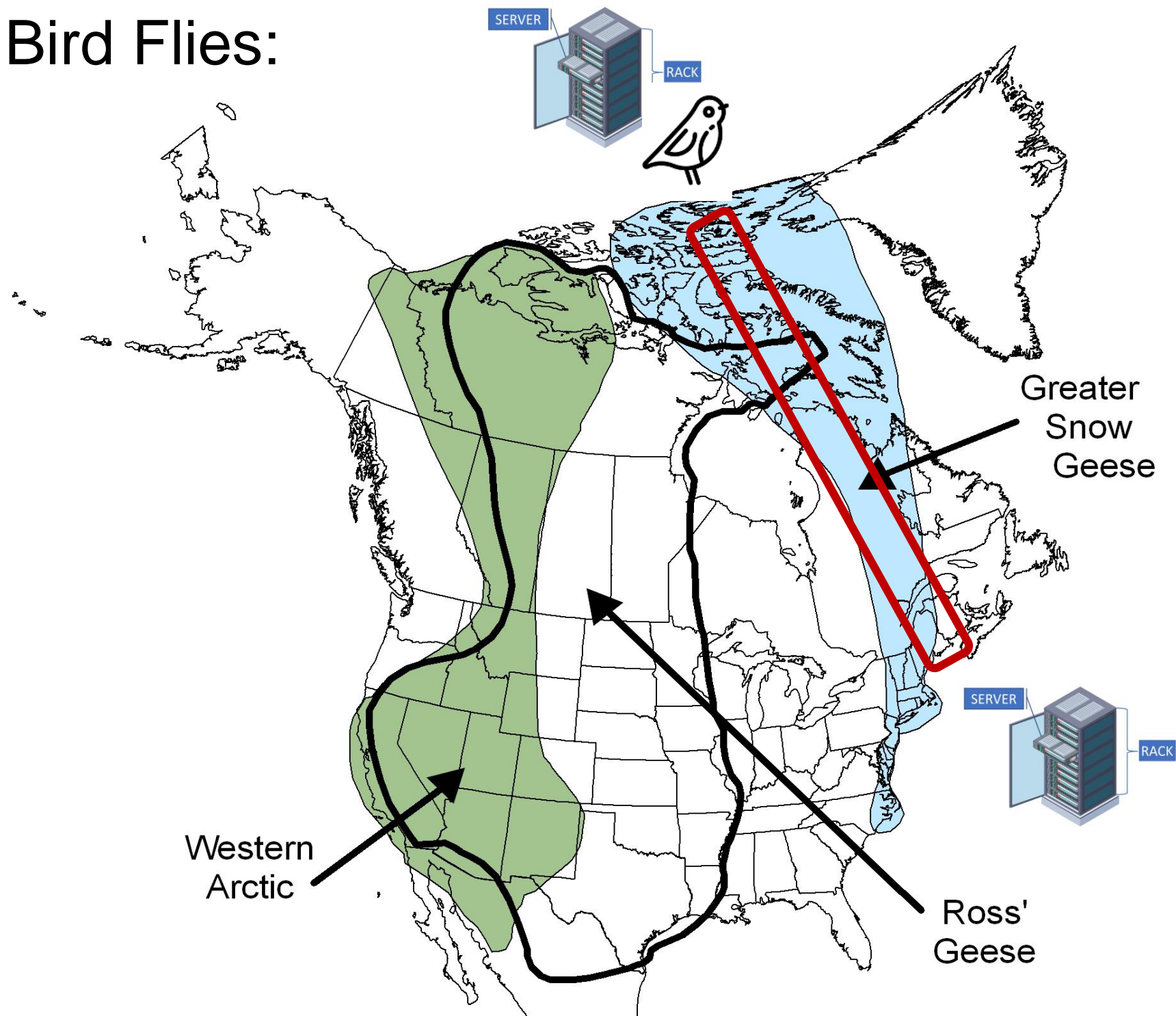
A modest proposal:
Avian Message Passing

1. Replacement of costly electrical networking infrastructure with avian transmitters

2. Relocation of data centers along migratory pathways

See paper for more details

As the Bird Flies:

SERVER

RACK

Greater
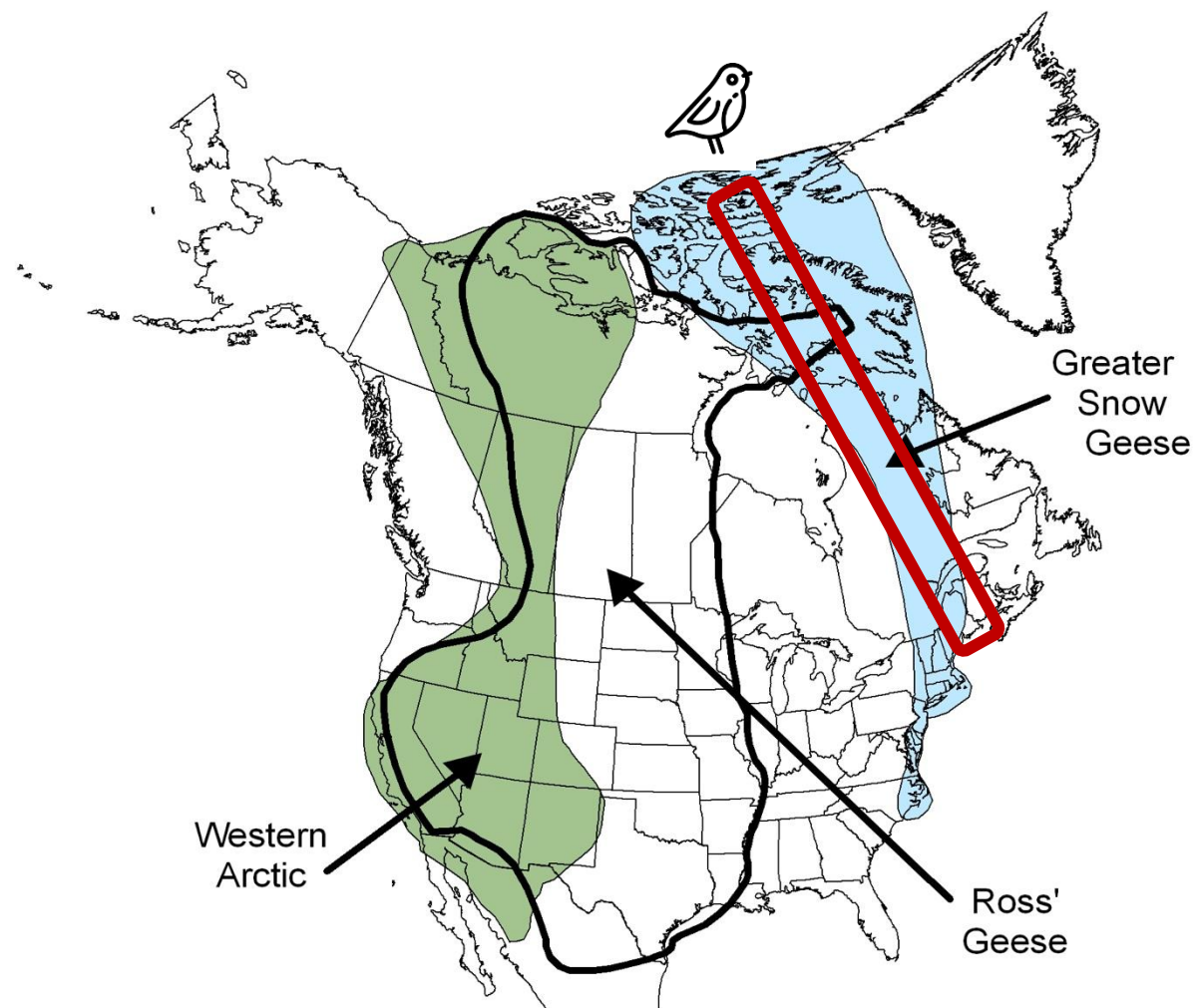Snow
Geese

SERVER

RACK

Western
Arctic

Ross'
Geese

Challenges: Packet loss

Packet loss

- Consider the Greater Snow Goose

- 3,000 km trip

- > 98% survival rate

- Per-km goose loss rate of 4.58×10^{-6}

How far can a bird fly without rest?

437 km

2,120 km

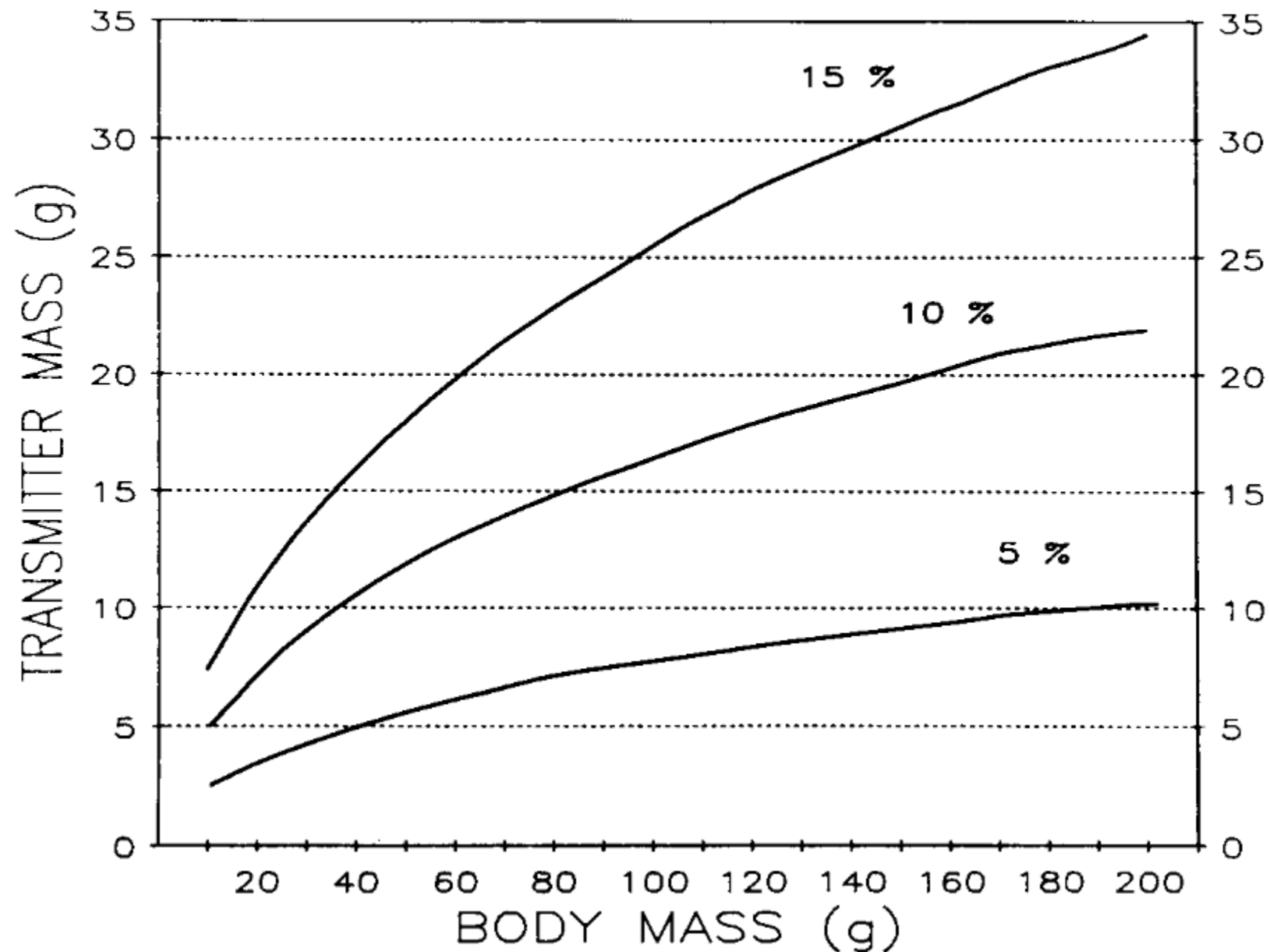11,000 km

How heavy of a transponder can a bird comfortably carry?

AN AERODYNAMIC BASIS FOR SELECTING TRANSMITTER LOADS IN BIRDS

DONALD F. CACCAMISE AND ROBERT S. HEDIN
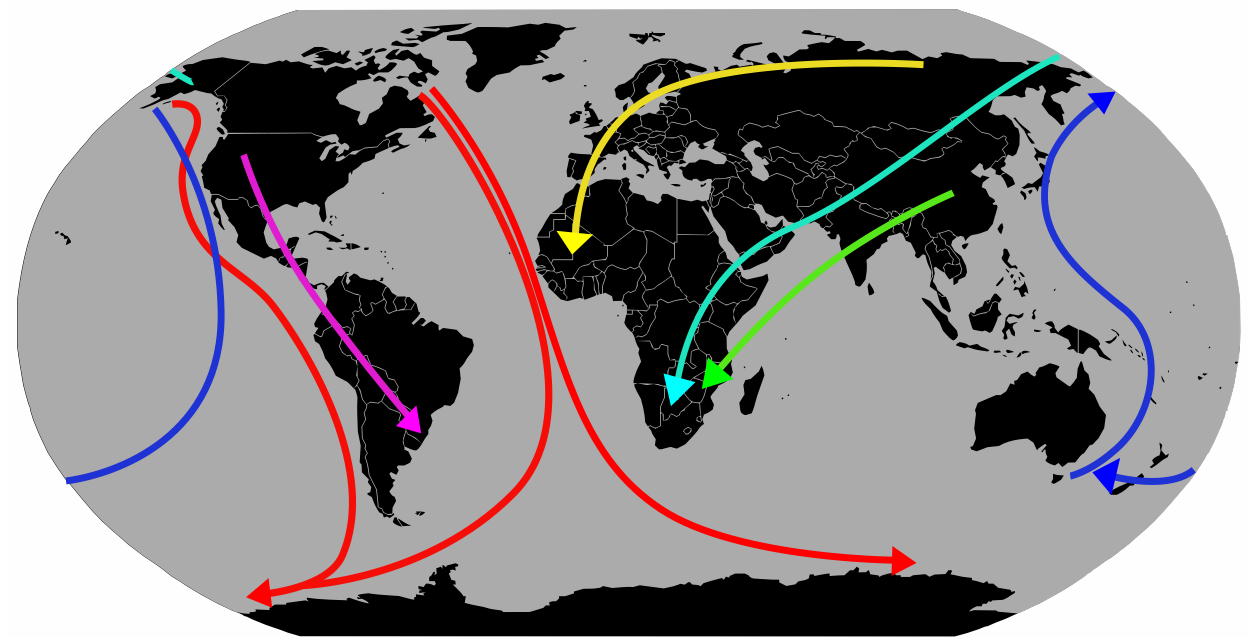
How much can a bird carry?

- Horizontally or vertically?

Oenanthe oenanthe	▬	Northern Wheatear
Sterna paradisaea	▬	Arctic Tern
Falco amurensis	▬	Amur Falcon
Puffinus tenuirostris	▬	Short-tailed Shearwater
Philomachus pugnax	▬	Ruff
Buteo swainsoni	▬	Swainson's Hawk

Computing bandwidth

$$bw = \frac{s \times d}{m}$$

Sample bird bandwidths

- Over a 100km journey:

373 Mb/s

2520 Mb/s

The voice is described as a faint *yeah*.