

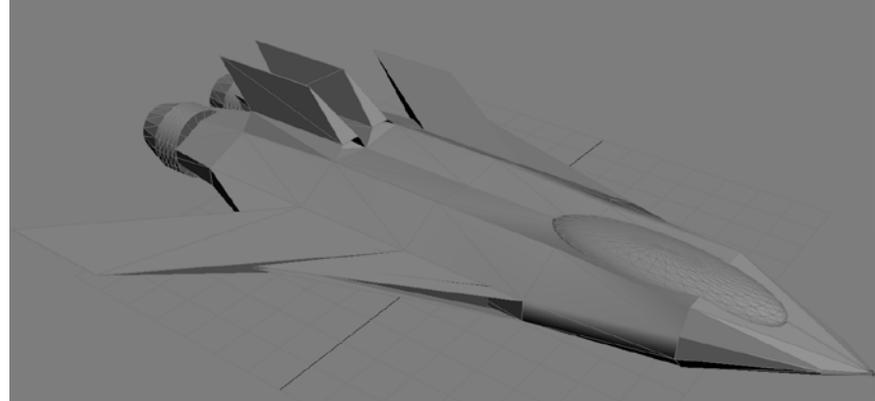
# Solid State Storage Technology

The beginning of a fundamental shift in computing

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# Just imagine the infomercial for a new fighter...



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For 1/10<sup>th</sup> the cost of what you spend today...

Its GREEN!!

Fly at 75,000 MPH while burning less fuel...

Kills the competition

With weapons hitting their targets 10 times faster

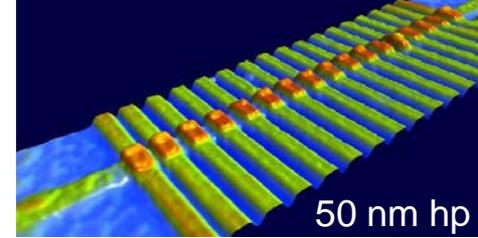
Deploy Anywhere

This rugged design operates in extreme conditions

But wait... if you call in the next 30 minutes we will (just pay separate shipping and handling)

add a ShamWow™ to keep your new fighter bright and shiny

# Memory technology characteristics



	New Technologies			Existing Technologies		
	Memristor	Phase Change	Spin Torque Transfer	DRAM	Flash	HDD
Planar density (F <sup>2</sup> )	4	8–16	37–64	8–10	4–8	~2
Energy per bit <sup>†</sup> (pJ)	1–3	2–27	0.1	2	10 <sup>3</sup> –10 <sup>4</sup>	10 <sup>7</sup> –10 <sup>8</sup>
Read time (ns)	<20	20–70	10–30	10–50	25,000	5–8x10 <sup>6</sup>
Write time (ns)	20–50	50–500	13–95	10–50	200,000	5–8x10 <sup>6</sup>
Retention	years	years	weeks?	<second	years	years
Endurance (cycles)	>10 <sup>6</sup>	10 <sup>7</sup> –10 <sup>8</sup>	10 <sup>15</sup>	>10 <sup>18</sup>	10 <sup>5</sup> –10 <sup>6</sup>	∞

† Range includes read, write, and erase

Caveat: The variance in the published literature is generally large

# Summary

- Some non-volatile technology will gradually replace DRAM and Flash, beginning in 2–4 years
- Spinning media (i.e., HDDs) will gradually be replaced by solid-state nonvolatile “memory”
- Massive changes in “storage” over next 10 years
  - Memory Hierarchy
  - APIs
  - Applications
  - Name-space

