



Conflicting Requirements



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What Limits Edge Computing Today?



Modern digital hardware is limited by fetching weight data. Small edge ASICs consumes watts of power.

1) V. Sze: Efficient Processing of Deep Neural Networks 2) Google Edge TPU 3) Modified from "Survey and Benchmarking..." by Albert Reuther et al



Vision: Photonic Edge Computing



A Sludds, S Bandyopadhyay et al. Science 2022 (in press)



Client Energy and Bandwidth



Netcast Client Energy Consumption				
Device	Number	Fan-	Energy	Energy
	of Devices	out	per Device	per MAC
Modulator	1	N	$\sim 1 \text{ pJ}$	$\sim (1/N) \ { m pJ}$
DAC	1	N	$\sim 1 \text{ pJ}$	$\sim (1/N) \ {\rm pJ}$
ADC	1	M	$\sim 1 \mathrm{~pJ}$	$\sim (1/M) \text{ pJ}$
Integrator	N	M	$\sim 1~{ m fJ}$	$\sim (1/M) ~{ m fJ}$
Total	_	_	_	$\sim (1/N) ~{ m pJ}$



TeraMAC/s possible on client with single modulator

10fJ/MAC possible in near-term deployed systems

Experiment





Silicon Smart Transceiver





422mm² (half reticle) 48 carrier depletion modulators 50 Gbps each 2.4 Tbps total bandwidth Made in commercial CMOS foundry

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PHOTONICS.



Dataflow and Accuracy



Accurate computation with 86 km deployed fiber with 3 THz bandwidth

Time Integration Improves Sensitivity

PHOTONICS.





Fundamental Limits to Netcast



Summary



Demonstrated photonic edge computing

Using a 2.4 Tbps silicon smart transceiver

Made in a commercial CMOS foundry

8-bit accurate computing

Deployment over 86 km of real fiber

Using 3 THz of bandwidth

Time integrating receivers at ~10aJ/MAC

Capable of scaling to <1 photon per MAC

For TeraMAC/s computing on edge devices

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Slides Past This Point Are Supplemental



Time (A.U)

QUANTUM Photonics



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