Event-Based Visual Sensing: Matching Performance to Application Needs

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iniVation
A SynSense Group company

(Alternate title)
Why no volume DVS applications (yet)?

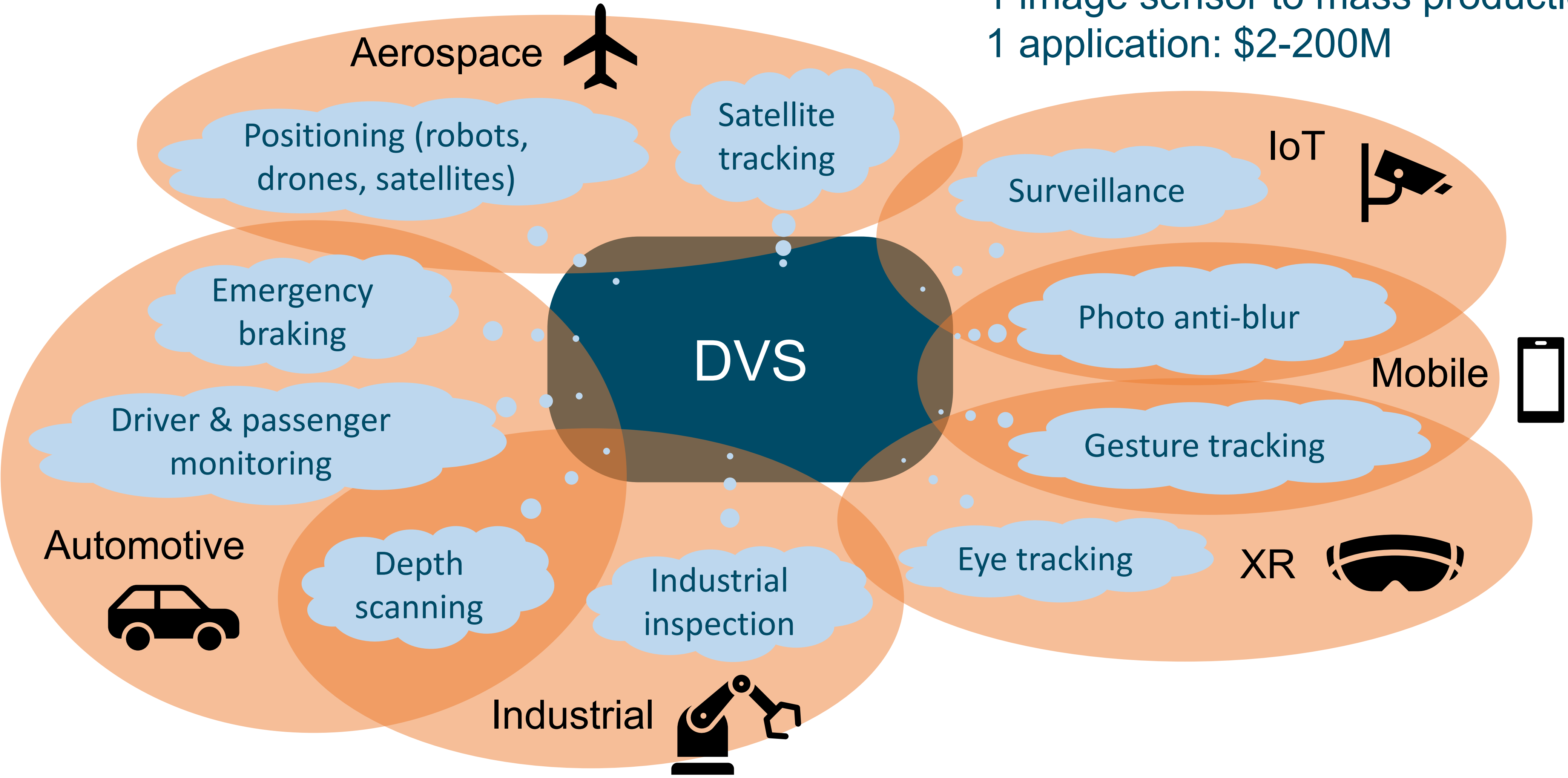
34 years of silicon retina	since 1991
17 years of DVS	since 2008

Approx. \$0.5 – 1B spent so far (mostly R&D)

(Claimed) Applications

How ready for market are these?

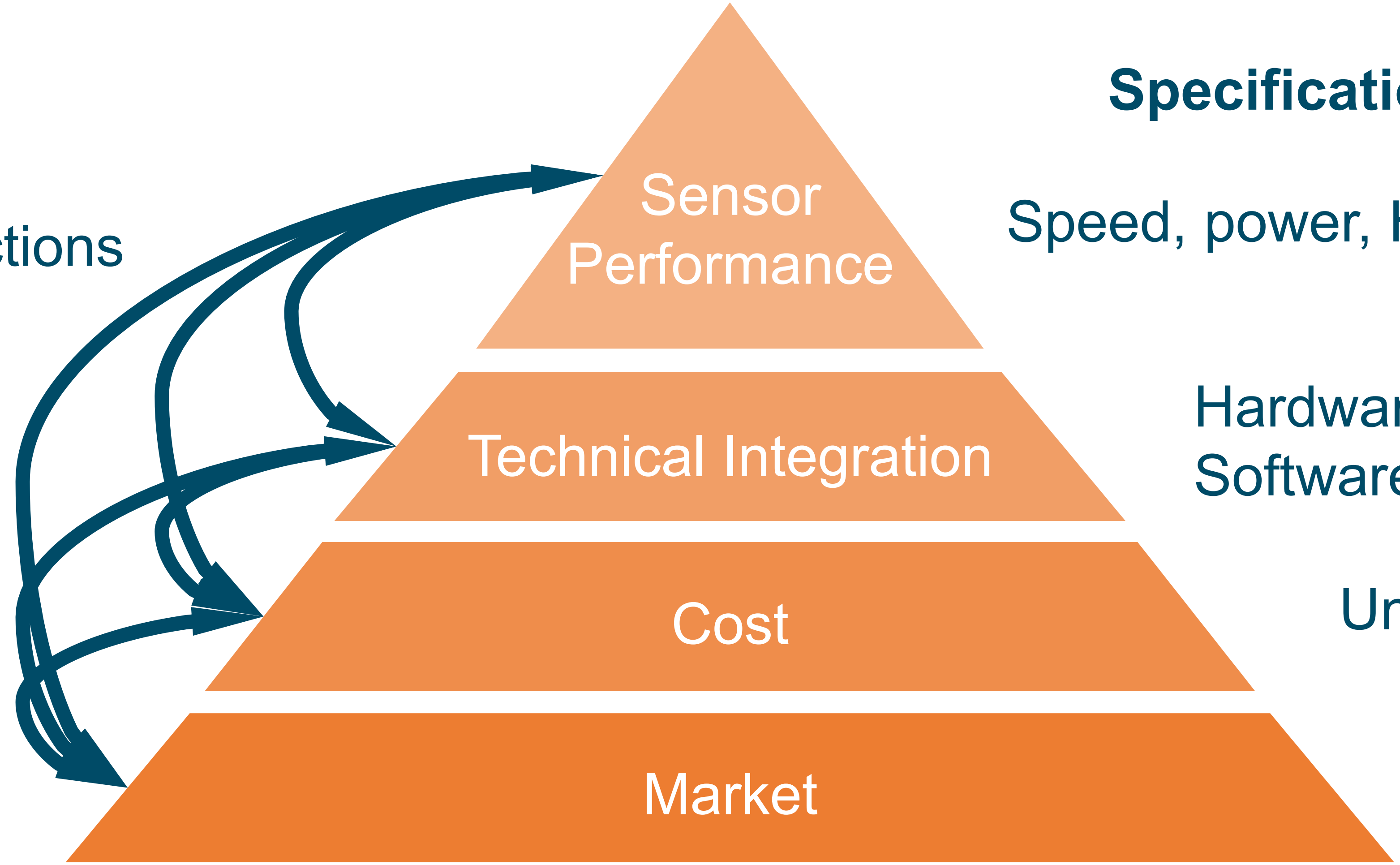
1 image sensor to mass production: $10-30M
1 application: $2-200M



From Technology to Product

Ingredients for Success

Interactions



Specifications

Speed, power, HDR, etc.

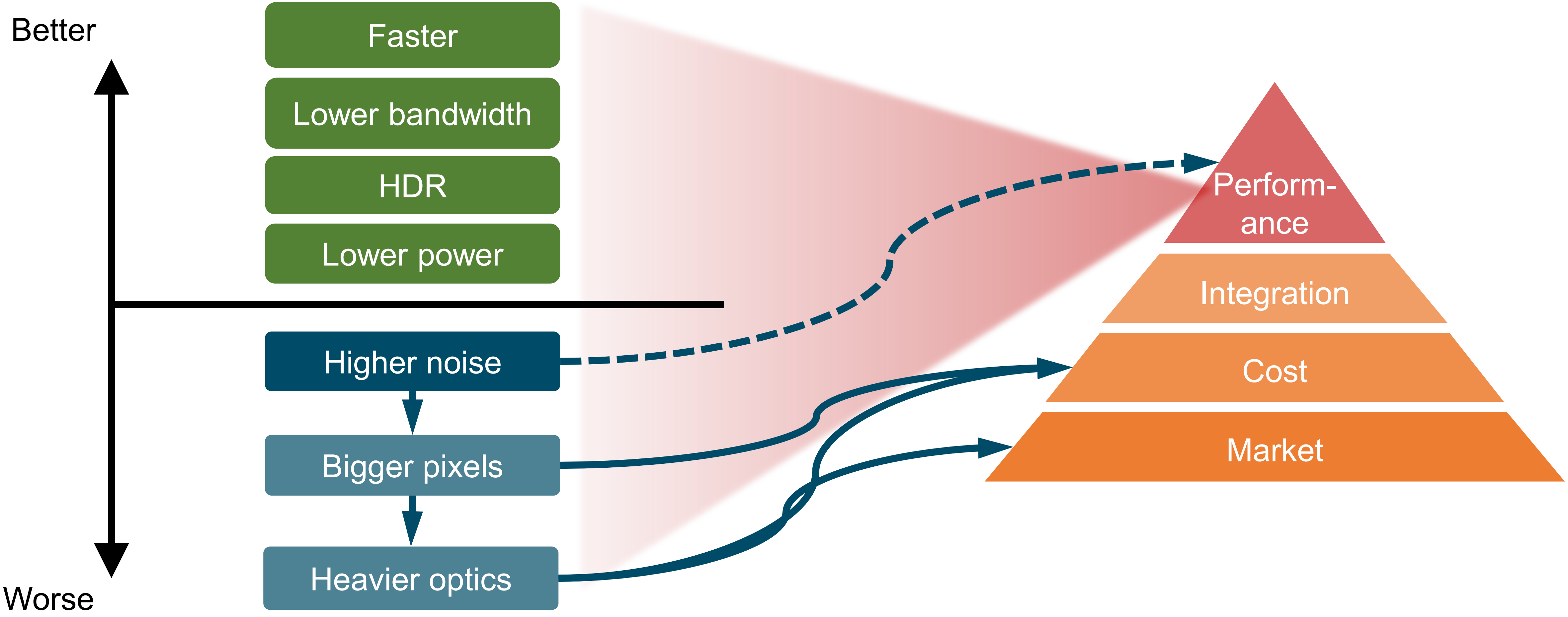
Hardware compatibility
Software compatibility

Unit economics

Making a real difference?

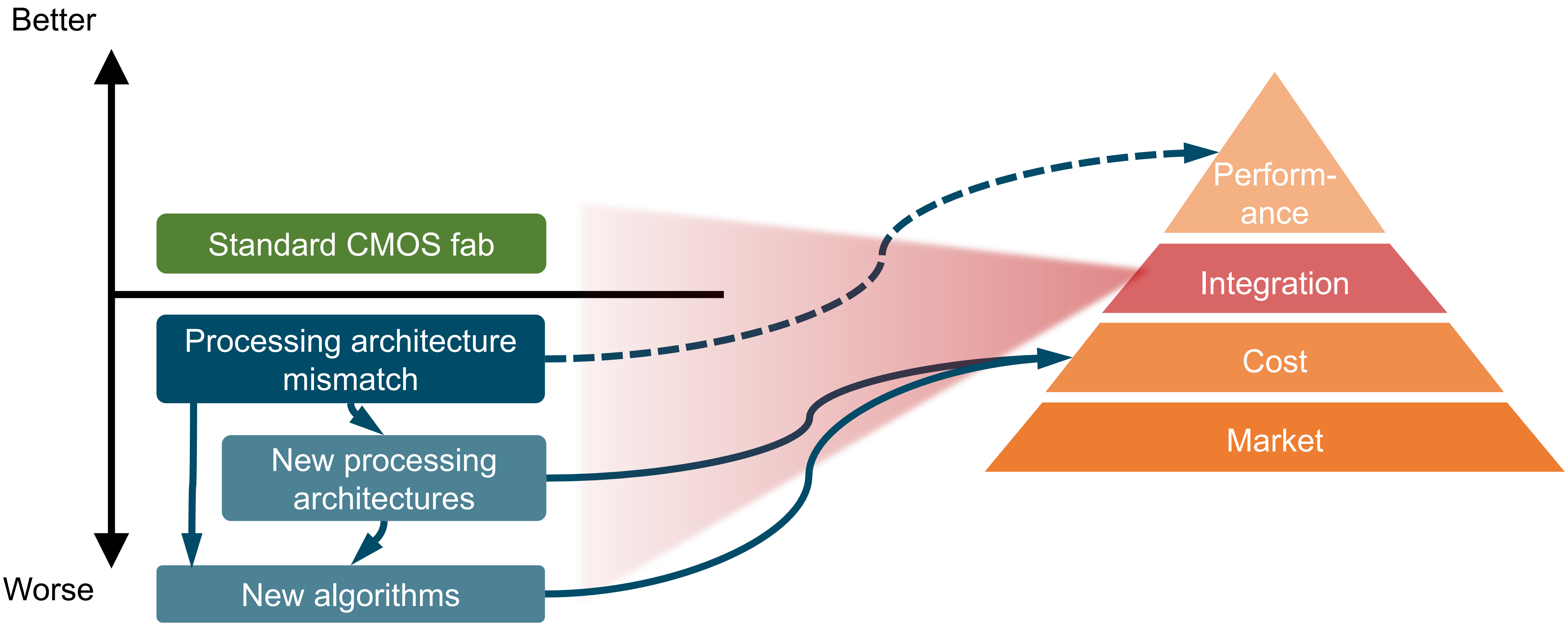
Interaction Analysis: Performance

Technical trade-offs



Interaction Analysis: Integration

Compatibility in supply chain and system integration



Analysis: Market Viability

Roadblocks to application viability

Application	KPI	Sensor	Integration	Cost	Market viable?
Industrial Inspection	Speed >5 kfps Passive cooling	OK	OK	OK	Yes, but: ASICs > DVS
Positioning / SLAM	System power <10 mW	OK	Algorithms too inefficient	OK	Need algorithms & compute hardware
Wireless surveillance	Indoor power harvesting <1 mW	Power too high	OK	OK	Power irrelevant if plugged in
Photo anti-blur	Works <1 lux >12 MP	Noisy in low light	OK	OK	DVS too noisy
Gesture tracking	Works <1 lux HDR	Noisy in low light	New algorithms needed	OK	DVS too noisy
Eye tracking	Power ~2 mW Size 2 mm	Power too high	New algorithms needed?	OK	Need lower power
Collision avoidance	<1 lux, HDR, 4K+ resolution	Noisy in low light	New algorithms needed	OK	DVS too noisy

Application Status

What's needed to unlock applications?

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DVS issue	Needed work	Applications enabled
Noisy in low light Uncontrolled output rate	**Sensor architecture** Better pixels Efficient encoding	Mobile imaging Collision avoidance Eye tracking
Processing algorithm mismatch	**Processing** Better algorithms / processors	SLAM Gesture tracking
-	Spend $	Industrial inspection Tracking (drones, stars, …)

Application: Glasses Eye Tracking

Requirements

	Requirement	Notes	Standard DVS
Die size	<2 x 2 mm	Fit glasses frame	Pixel ~5 µm, noisy Can group 4x → equiv. 2.5 µm
Pixel	2-3 µm (Visible + NIR)	Low light critical	
Resolution	400 x 400	Population coverage and accuracy	
Frame output	Single shot possible	Authentication use case	DAVIS or Hybrid RGB/DVS
Output rate	1-240 fps	Power more critical than speed	Output rate affects power
Power	No lower limit		

Existing Eye Tracking Sensors

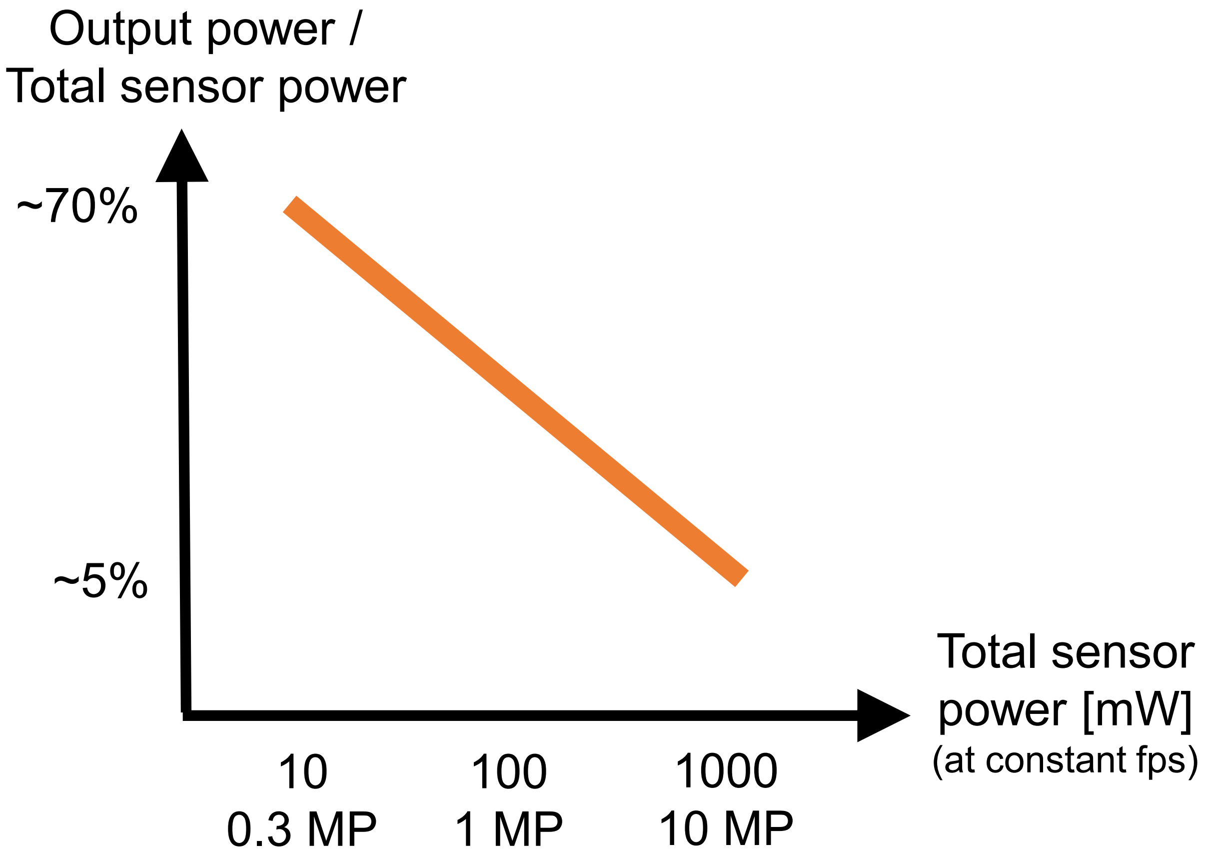
Example state-of-the-art sensors

	Company A	Company B
Die size	1.8 x 1.8 mm	1.69 x 1.69 mm
Resolution	400 x 400 px	400 x 400 px
Frame output	Yes	Yes
Output rate	max. 360 fps	max. 240 fps
Pixel	Frames 2.79 µm BSI	Frames 2.2 µm BSI
Power	7 mW (30 fps)	7.2 mW (30 fps)

Eye Tracking Sensor Design

Achieving lowest possible power

Total Sensor Power = Pixel array, readout
+ On-chip processing
+ Data output (MIPI)



Reducing Sensor Data Output Power

- **MIPI hacks**
  - Standard ~5 mW
- **Reduce data**
  - Discard DVS events
  - Other methods?

Aeveon vs Legacy DVS

Aeveon superior noise performance at smaller pixel pitch

	Legacy DVS	Aeveon
Change detection	Analog, fixed Leaky, noise and mismatch	Digital, adjustable Very low noise
Minimum pixel pitch	~5 μm	Events: <1 μm Frames: <1 μm
Data reduction	Legacy events	Multi-bit digital selectable
Slow signal change detection	Limited Leaky analog circuit	Unlimited
Design flexibility	Requires custom pixel Full redesign for every variant	Standard pixels Simple design adaptation

Aeveon Emulator Pipeline

1/20 speed, 1:30 frames + events

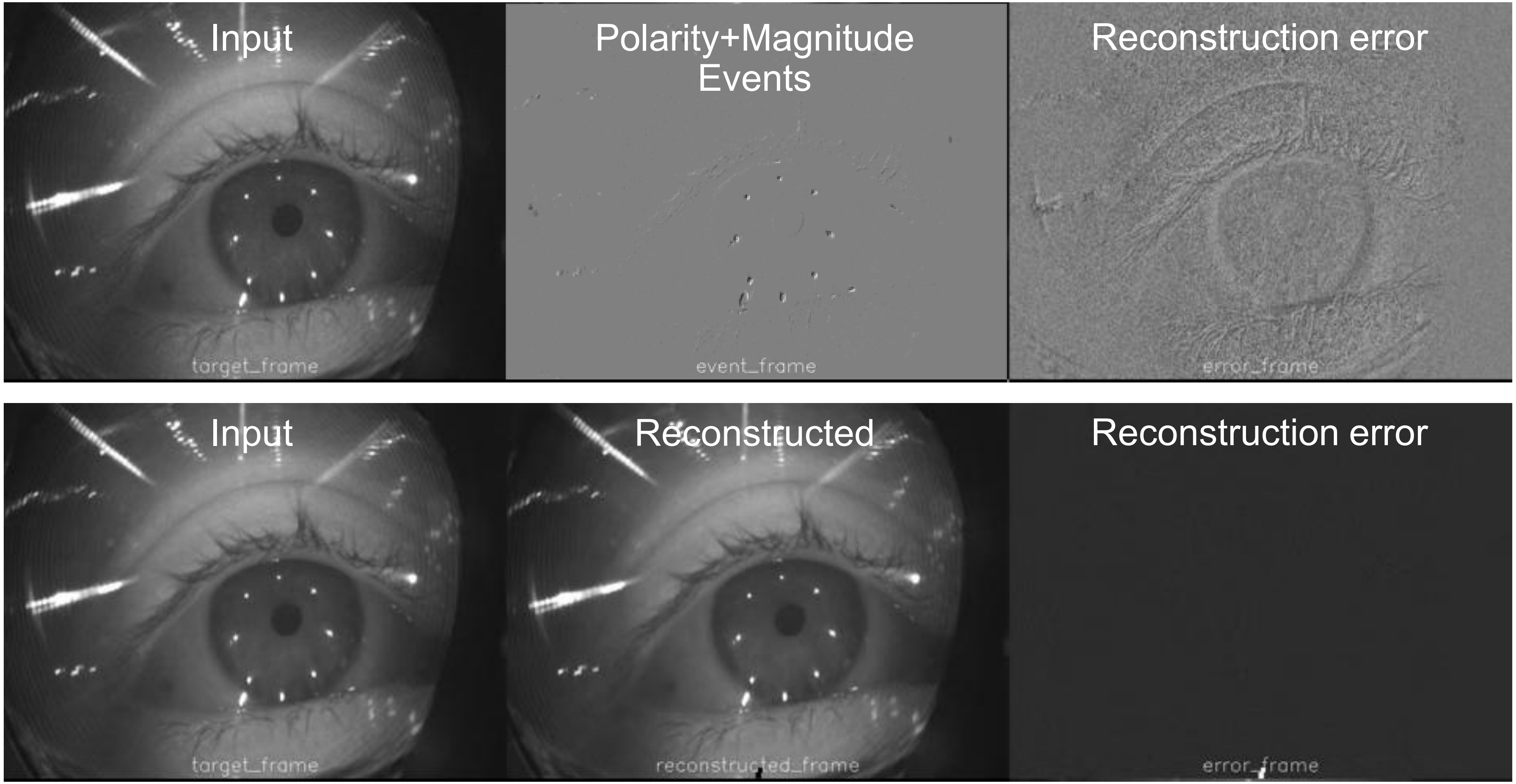
Legacy Temporal Pixel Events

Change polarity + magnitude

Same bit rate

Rich Events

Area change encoding



CVPR Stand 1029

Visit us!

Aeveon Eye Tracking

Early Adopter Program

- Software emulator
- Silicon early access

Die size	2.x mm
Resolution	VGA
Output types	Frames & rich events
Output rate	10-1000 fps
Pixel	<3 µm BSI
Power	<3 mW

Speck DVS+SNN SoC

- All-in-one, fully async event-driven
- DVS 128x128
- SNN up to 9 layers

Thanks!

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