



Next-Generation Haptic Technology to Radically Improve Electronic Devices

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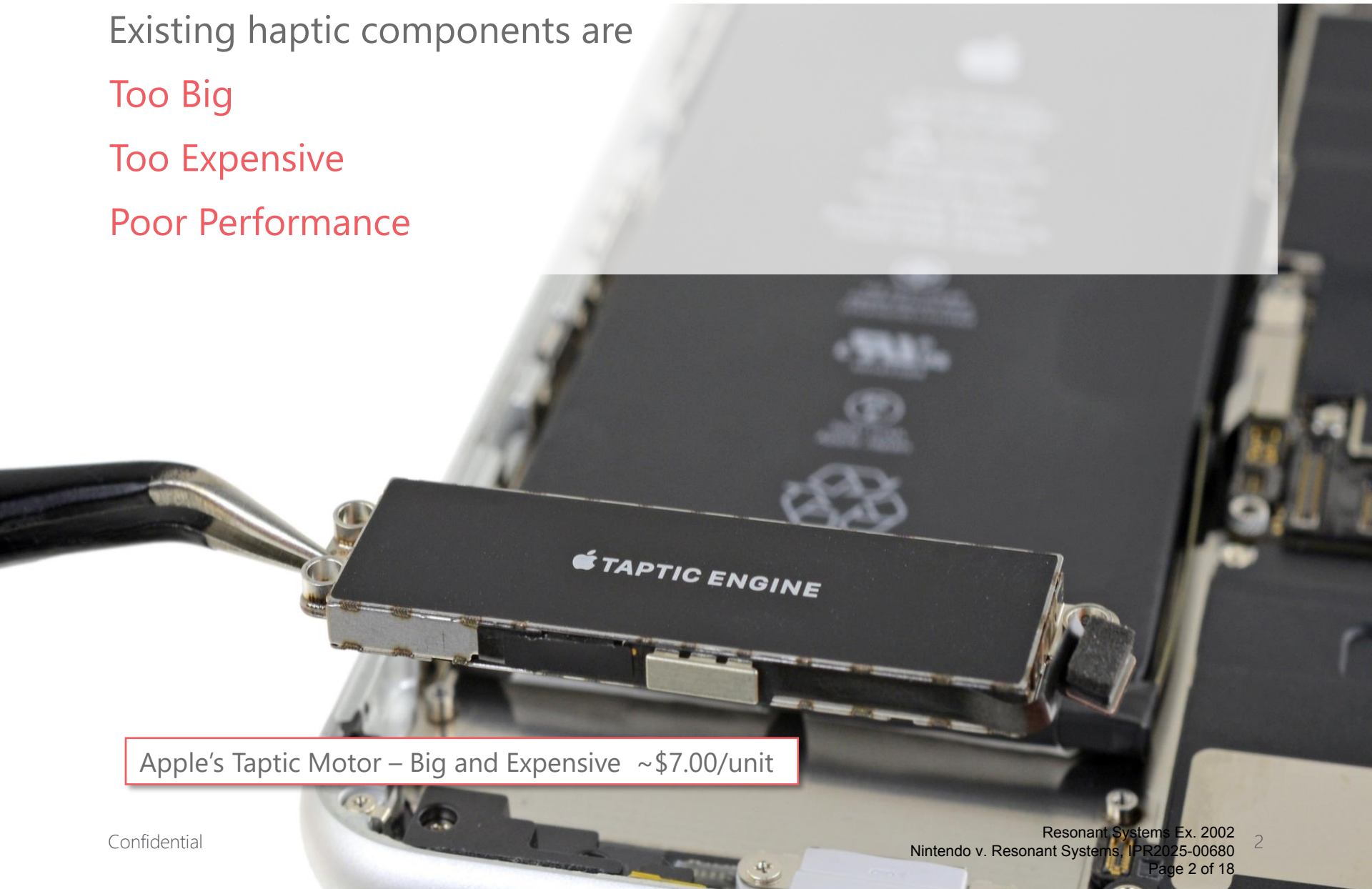
Problem

Existing haptic components are

Too Big

Too Expensive

Poor Performance



Apple's Taptic Motor – Big and Expensive ~\$7.00/unit

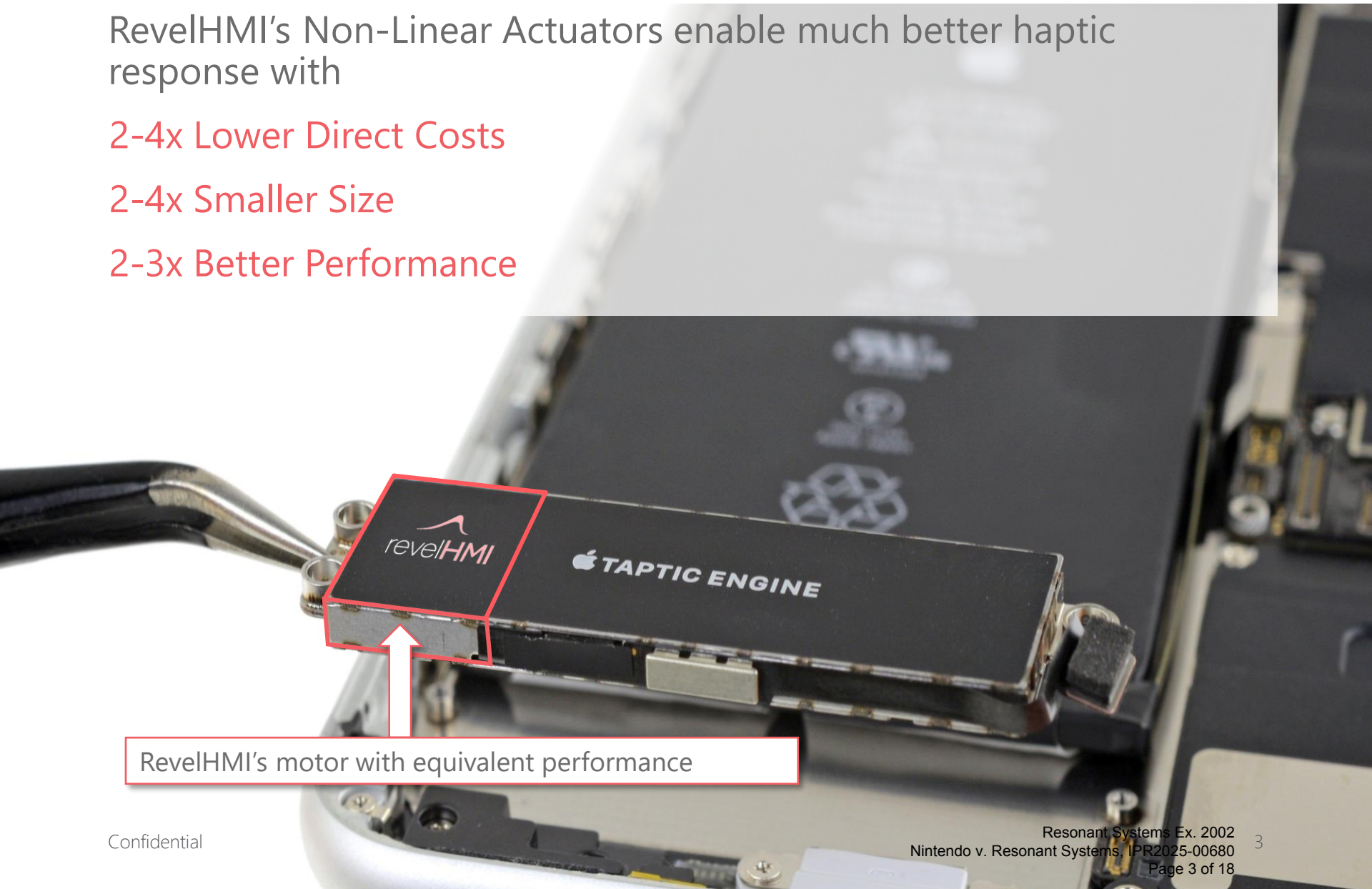
Solution

RevelHMI's Non-Linear Actuators enable much better haptic response with

2-4x Lower Direct Costs

2-4x Smaller Size

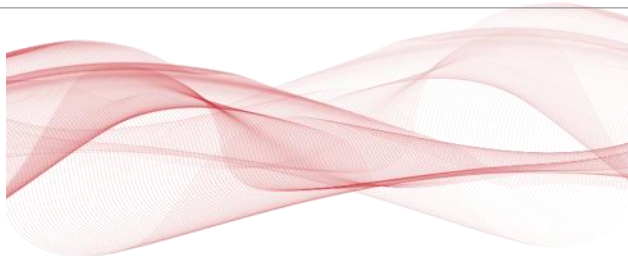
2-3x Better Performance



RevelHMI's motor with equivalent performance

Vision

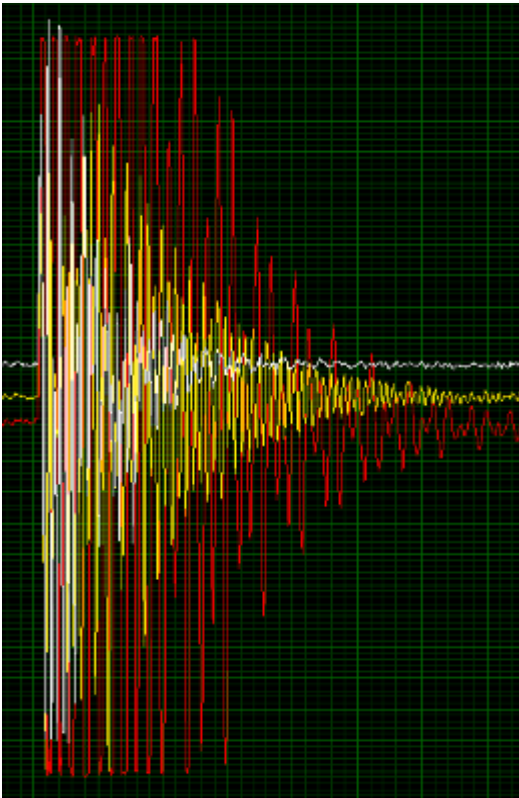
RevelHMI is developing the next-generation haptic interface

Gaming Mobile	State-of-the-Industry	RevelHMI Vision
	 Simple Vibration	 High-Definition Vibration Patterns
	Buzzer alerts user of an issue, but provides no information about the issue	Haptic Language device intuitively communicates information to user
	Buzzer notifies player that they touched an object, but all objects feel the same	Haptic Feedback that feels like “the real thing” creating immersive experience

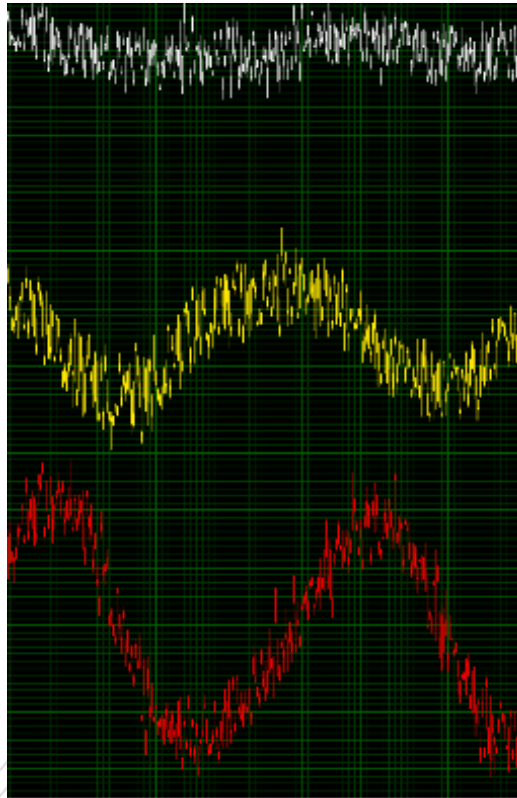
Vision: Immersive Gaming

Requires Better Hardware, Drivers, APIs and Content

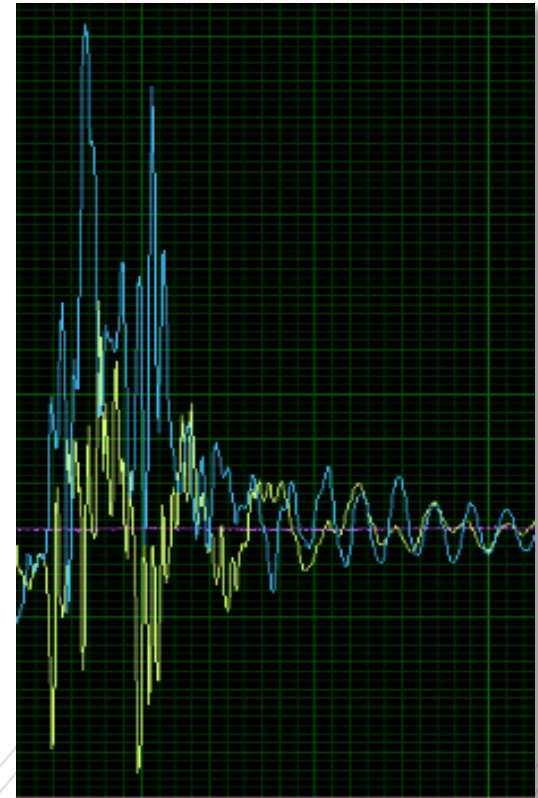
Reality is Complex



Current Haptics are Primitive



RevelHMI's Improved Haptics



RevelHMI's Non-Linear Resonating Actuator

A vibration motor to enable next-generation haptic performance in wide range of devices with industry leading

Performance

Reliability

Cost/Performance

Size/Performance

Highly-Tunable to support specific product requirements

Power/Hz/Efficiency

Size

Drive Signal/Driver Topography

Resonating Actuator Technologies

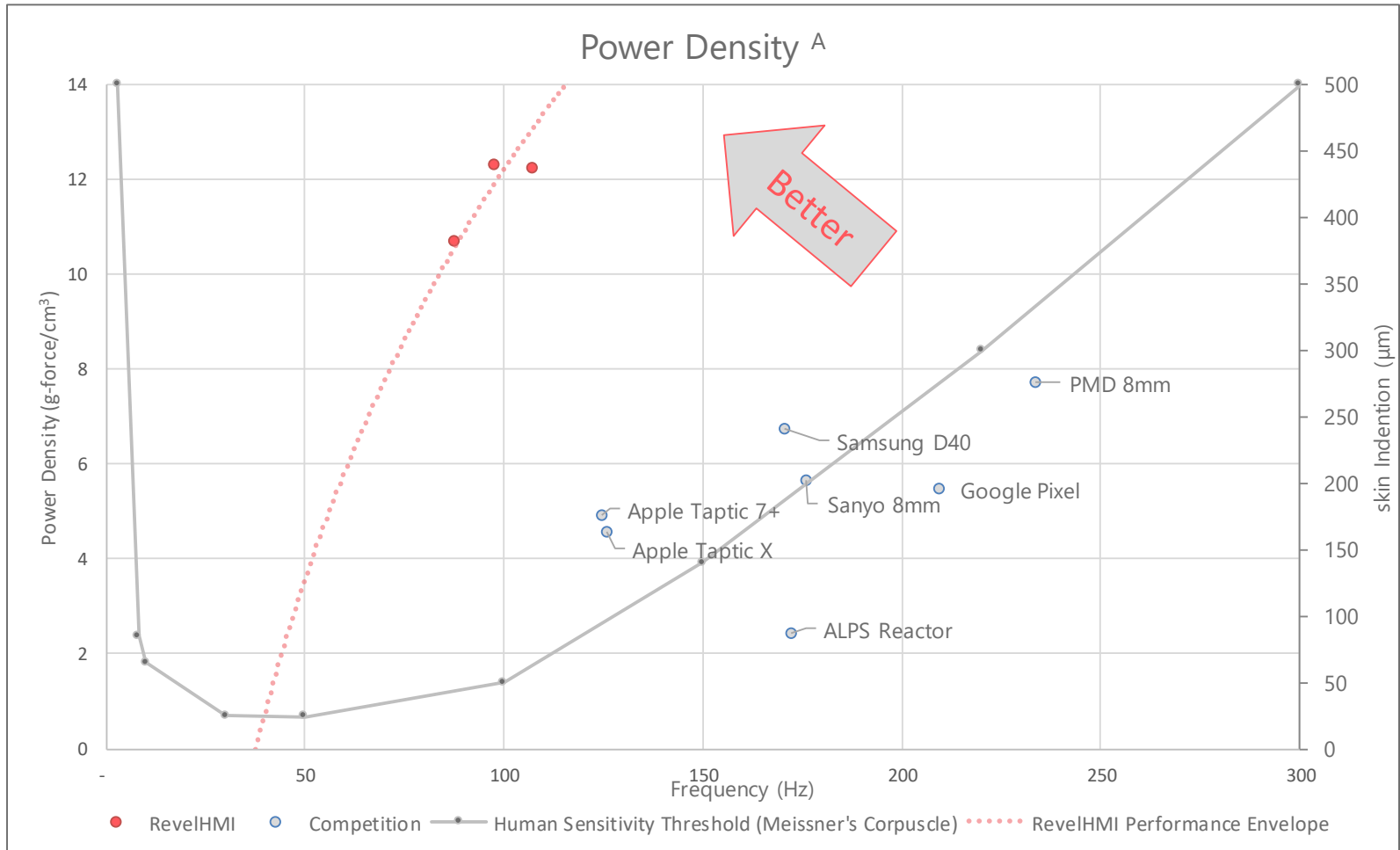


	LRA	AAC Taptic	ALPs Reactor	RevelHMI
Path	Linear (Z-Axis)	Linear (X-Axis)	Linear (2-Axis)	Arc (2-Axis)
Mass	Small	Large	Large	Small
Distance	Small	Small	Small	Large
Kinetic Energy	Low	Medium	Medium	High
Losses	High	High	Medium	Very Low
Power	Low	Medium	Medium	High
Efficiency	Low	Low	Low	High
Hz	> 200Hz	> 110Hz	160Hz & 320Hz	50Hz and up
Size	Min Height: 3mm	Very Large	Very Large	Smaller / Flexible
Models	Many	Small Number	1	Infinite

RevelHMI's Secret Sauce: we move a smaller mass further, in a smaller space with less losses, to generate more kinetic energy.

Disruptive Performance

Allows solutions that operate where humans are more sensitive



Legend: (A) More is Power Density is better, and Lower Frequencies are easier to feel and more difficult to achieve

Performance

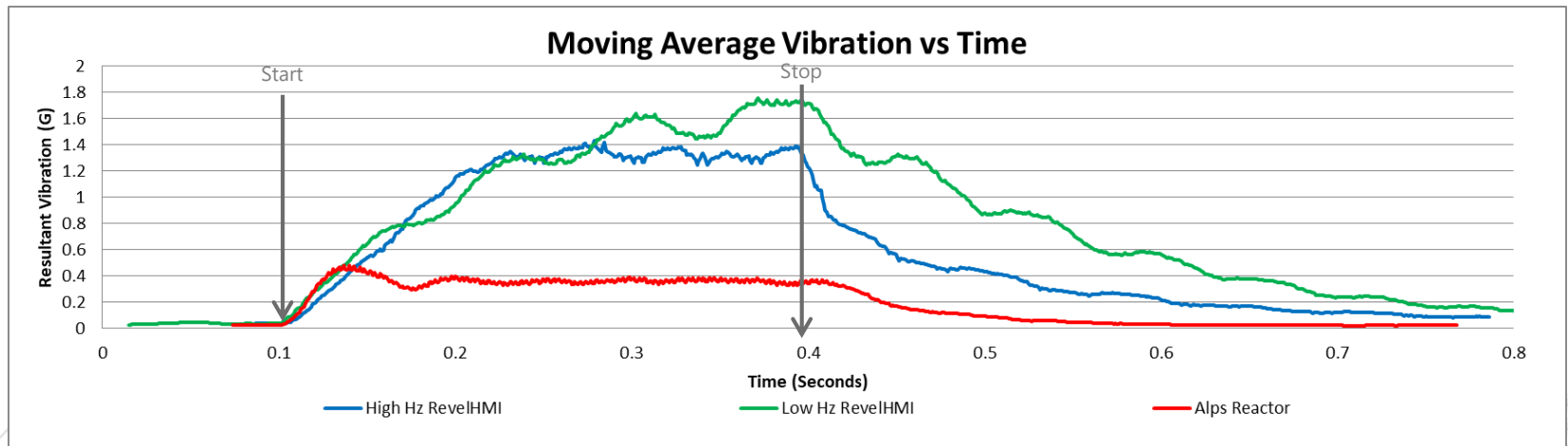
ALPs Reactor versus RevelHMI's latest samples

	Size (mm ³)	Frequency (Hz)	Vibration Power (G)	Input Power (W)	Power Density (G/cm ³)
RevelHMI	400	107	4.9	0.46	12.3
ALPs Reactor	2,124	172	5.2	0.62	2.5
RevelHMI	400	140	6.7	0.38	16.7
RevelHMI	800	153	9.6	0.39	12.0
RevelHMI	800	98	9.9	0.66	12.3
RevelHMI	1,200	88	12.9	0.38	10.7
RevelHMI	1,200	173	15.8	0.38	13.2

Rise-Time / Fall-Time Performance

Without driver assisted waveforms

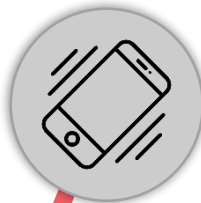
	Rise-Time: 0 to 50% (ms)	Rise-Time: 0 to 100% (ms)	Fall-Time: 100 to 50% (ms)	Fall-Time: 100 to 10% (ms)
Alps Reactor	12.5	36	36	113
RevelHMI - High Hz	55	88	39	210
RevelHMI - Low Hz	72	178	133	243
RevelHMI – High Hz (With Damper)	~18	~29	~13	~70
RevelHMI - Low Hz (With Damper)	~24	~59	~44	~81



Demos

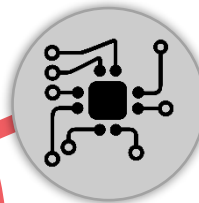
Product

A complete solution to enable next-generation haptics

The logo for revelHMI, featuring a red stylized wave icon above the word "revel" in white and "HMI" in red, all within a dark gray rounded rectangle.

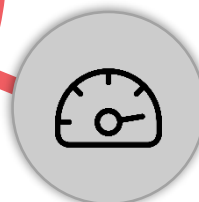
New Non-Linear Actuator Technology

Industry-leading vibration performance in every category allowing a smaller actuator with lower costs



Advanced Haptic Motor Drivers

Dramatically better performance in a lower cost component that can be integrated inside actuator



Haptic Content & Development Tools

Tools and content to enable better haptic systems



Professional Services

Rapid product-optimized solution development and deployment

Team

We have the background, skills and vision to succeed



Robin Elenga, CEO

Multiple Startups, EDS,
Accenture, Deloitte Consulting



Murray Vince, Biz Dev

Intellectual Ventures,
Microsoft, Apple



Dan Knodle, Dev Lead

Iota, Trillium, SpaceLabs,
Cascadia Technology



Steve Meginniss, Advisor

Inventor Sonicare, Clarisonic,
Magic Wheels



Chris Howard, ME

Mechanical Design,
Mechatronics, Robotics



Craig Eisler, Haptic APIs

Microsoft DirectX Developer,
Kinect, Xbox Live



Steve Combest, Testing

Electromagnet design and
Testing



Dave Beecher, EE

BLMC design and optimization,
embedded software

Board of Directors

Paul Cole – T-Mobile, Swype, VoiceStream, Western Wireless

Chris Phillips – GM Server and Azure Division, MSFT

Carl Lombardi – Spacelabs CEO, Multiple Startups

Laurie Lyford – Private Investor

Robin Elenga – CEO

Services / Capabilities

Strong Value Proposition

Motor Development

- Internal / External Actuation
- Low-Q / High-Q
- PWM / Sine-drive
- Impulse / Vibration

Driver Tuning

- Driver Selection / Optimization

Testing and Optimization

- Performance
- Life Testing

Delivery Support

- Vendor Validation
- DFM Management
- Quality Systems / Reporting

Professional Services

Faster Development

- Size/Hz/Power Constraints Removed
- Rapid Design / Optimization
- Rapid Prototype Delivery

Better Solution

- Smaller, Much Better Performance
- Better Quality
- Better Reliability

Patent Protected

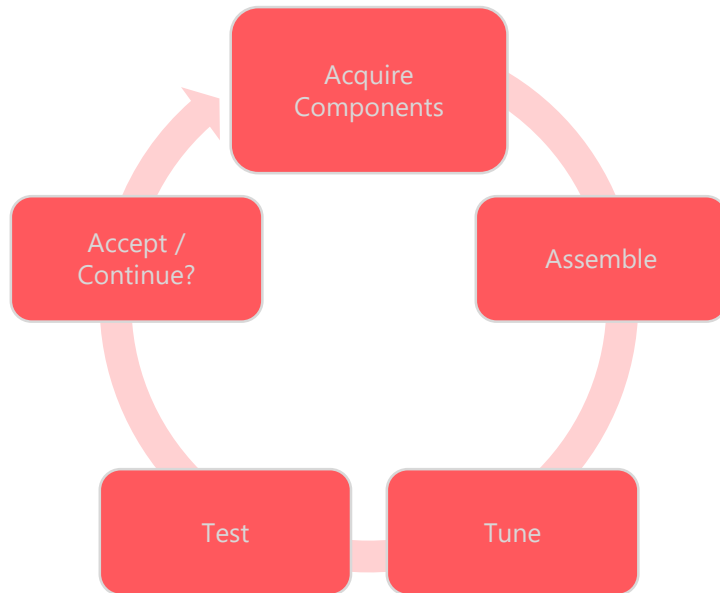
- 6 Utility Grants
- Multiple Office Actions
- Multiple in Process

How can we help?

- Q&A

Development Model

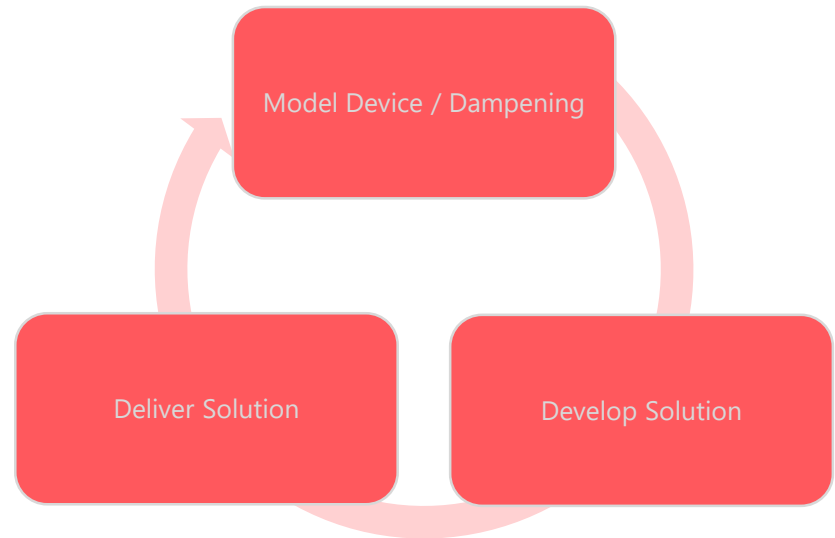
Status Quo - Component Sales



Acceptable (Satisfied) Solution

- Development: Slower / Riskier
- Performance: Compromised
- Solution: Bigger / More Expensive

RevelHMI – Mass Customization

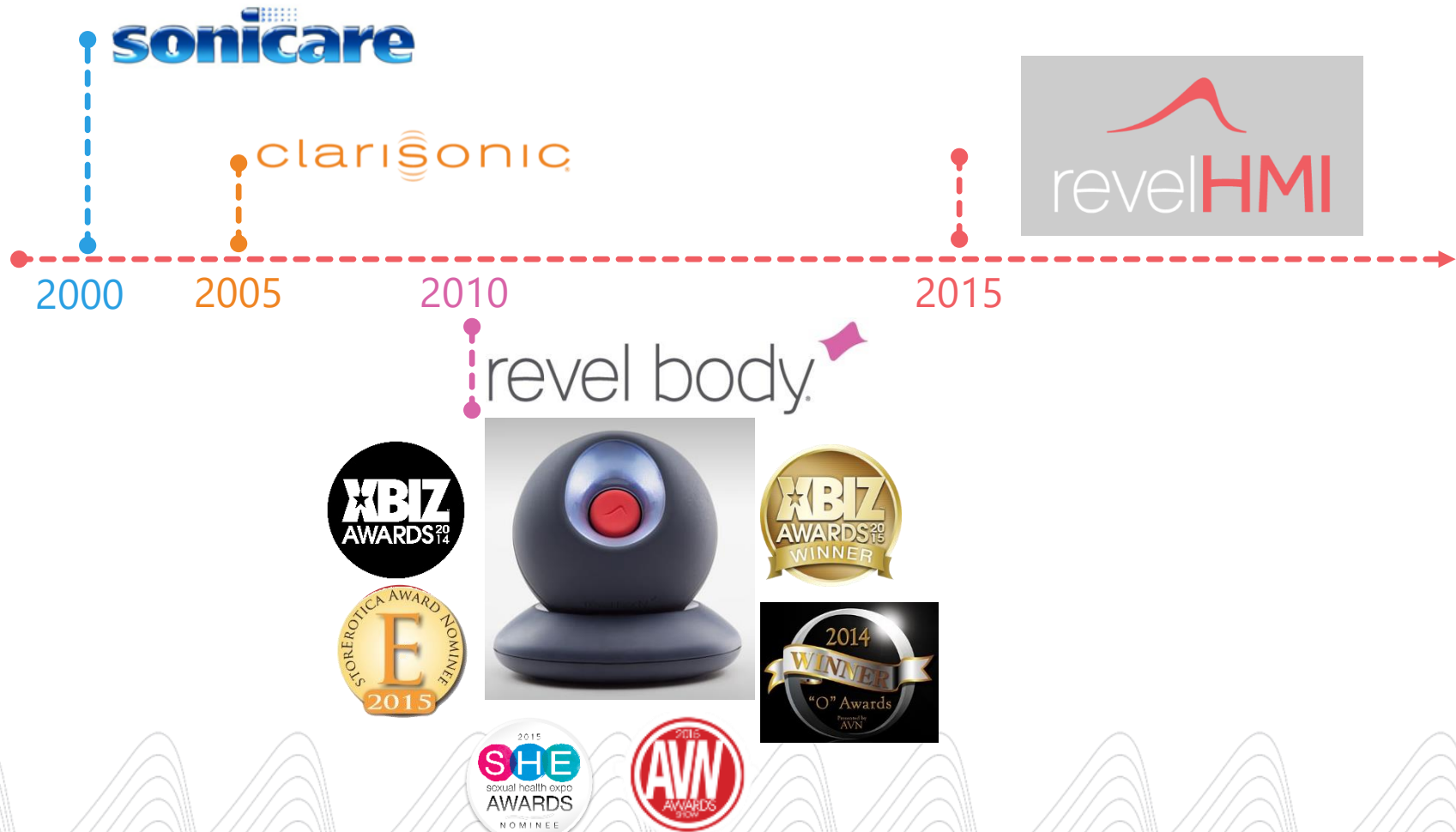


Optimized Solution

- Development: Faster
- Performance: Goals Met
- Solution: Lower Costs / Smaller

History

Deep Vibration Technology Domain Experience



IP Status

Granted

- 8,093,767 - Linear-resonant vibration module - USA
- 8,860,337 - Linear vibration modules and linear-resonant vibration modules - USA
- 9,369,081 - Linear vibration modules and linear-resonant vibration modules - USA
- 9,768,674 - Printed-circuit board motor - USA
- 9,941,830 - Linear vibration modules and linear-resonant vibration modules - USA
- 11201601118W – Printed-Circuit Board Motor - Singapore

Office Action

- 14843684.3 - PRINTED-CIRCUIT BOARD MOTOR – Europe
- 2,922,566 - PRINTED-CIRCUIT BOARD MOTOR – Canada
- 15/043,584 - Oscillating-Resonant-Module Controller - USA
- 201680009731.X - Oscillating-Resonant-Module Controller – China
- 62/509,644 – Efficient Haptic Actuator

Waiting for Prosecution (partial list)

- CN105765834A - PRINTED-CIRCUIT BOARD MOTOR – China
- P-00201602364 - PRINTED-CIRCUIT BOARD MOTOR – Indonesia
- 2016-542859 - PRINTED-CIRCUIT BOARD MOTOR – Japan
- 2016-7008110 - PRINTED-CIRCUIT BOARD MOTOR – Korea
- PI2016700845 - PRINTED-CIRCUIT BOARD MOTOR – Malaysia
- TBD - Oscillating-Resonant-Module Controller – Europe
- TBD – High-Performance Haptic Actuator - PCT