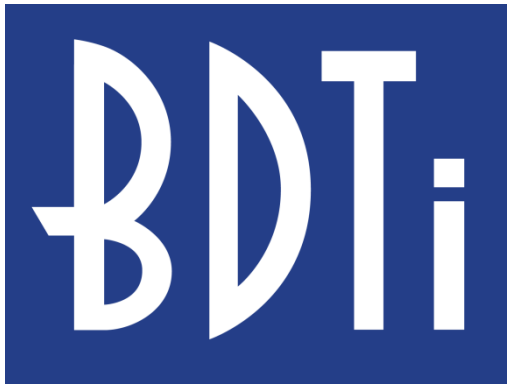


Measuring and Improving User Experience

VPQM 2015

Jeff Bier | February 5, 2015

My Benchmarking Journey

- 1994: Benchmarking processor cores for digital signal processing applications
  - Measuring: Speed, cost, energy efficiency
  - But what about ease of use, support, roadmap risk?

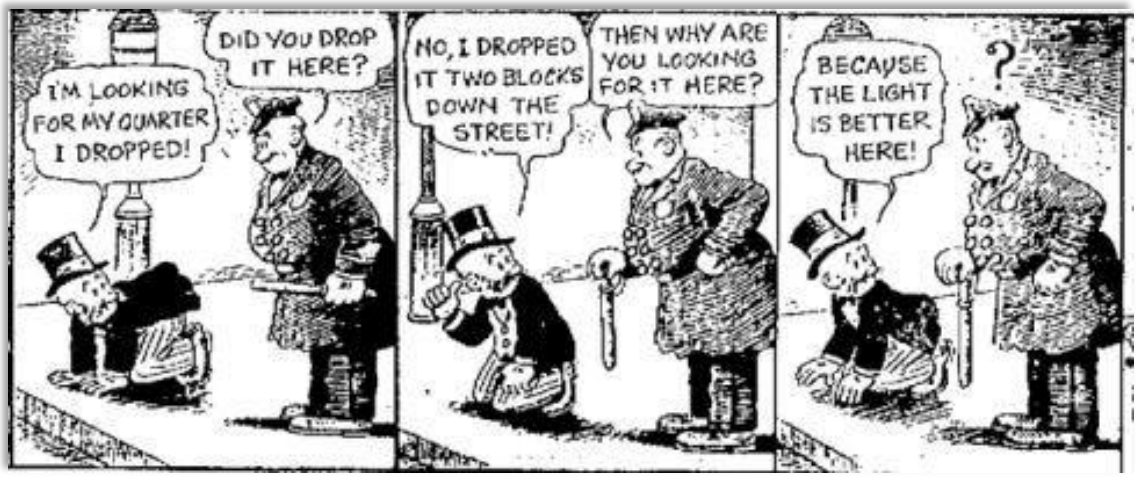
- 2014: Benchmarking smartphones
  - Measuring: User experience
  - But do we really know what "user experience" is?

Pitfall: Whole vs. Parts

The performance (or energy efficiency, or user experience, or…) of a system is not equal to the sum of the performance of the individual elements

www.treehugger.com

Pitfall: No Free Lunch



www.environmentteam.com

For Example

Table 1 Processor	intel Z2580 (CloverTrail+)			Samsung Exynos 5250			Samsung Exynos Octa			Qualcomm APQ8064T			Nvidia Tegra 3		
Phone	Lenovo K900			Samsung Nexus 10			Samsung Galaxy S4 i9500			Samsung Galaxy S4 i377			Asus Nexus 7		
Core	Saltwell x2			Arm A15 x2			Arm A15 x4 + A7 x4			Krait 300 x4			Arm A9 x4		
Speed	2GHz			1.7GHz			1.6GHz			1.9GHz			1.3GHz		
		0.2	Display		0.5	Display		0.18	Display		0.176	Display		0.234	Display
Display	Score	Avg I	Peak I	Score	Avg I	Peak I	Score	Avg I	Peak I	Score	Avg I	Peak I	Score	Avg I	Peak I
RAM	8703	0.55	0.9	2243	1.42	1.63	3838	1.27	1.56	4235	0.563	1.084	1529	0.389	0.682
CPU	5547	0.85	1.05	3104	0.98	1.23	5277	1.38	1.71	5378	1.794	2.104	2886	0.896	1.186
2D graphics	1579	0.235	0.724	1478	0.46	1.15	1624	0.276	0.8	1549	0.409	1.104	298	0.217	0.511
3D graphics	6664	0.27	0.61	3819	0.72	1.37	8653	0.368	0.96	6628	0.578	1.404	1188	0.458	0.826
Pi	1.33	0.366	0.97	1.26	0.459	1.73	1.4	0.483	1.24	1.9	0.233	0.733	1.56	0.38	0.766
1080p Record		0.737	1.27		1.56	3.6		0.772	1.15		0.682	1.13			
Source: ABI Research															

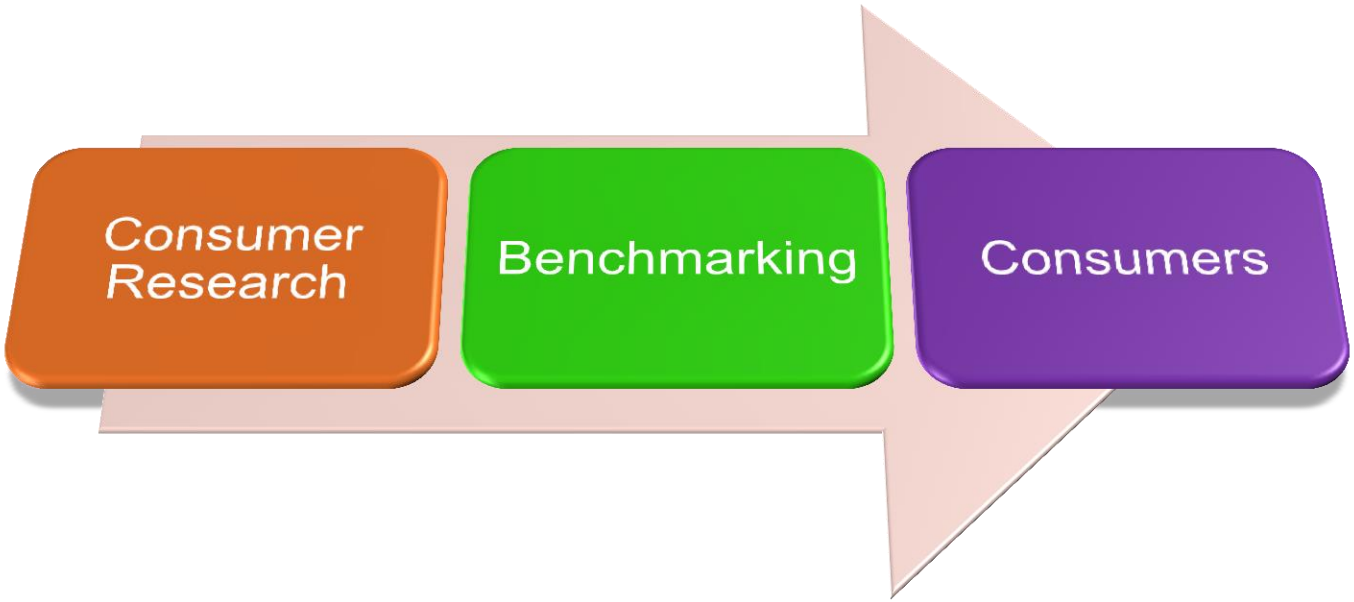
How Should We Benchmark Smartphones?

- Benchmarks should mirror the tasks that users actually perform
- Benchmarks should measure the metrics that users actually observe
- I.e., we should benchmark user experience

Easier Said Than Done…

- There are many types of users with different use patterns and preferences… and regional variations
- Popular apps are generally not suited to use as benchmarks
- Building realistic proxy apps is expensive and time-consuming
- “Performance” is not a simple metric
- Results from different tests must be combined very careful to obtain meaningful aggregate metrics

Certimo: User Experience Ratings For Smart Devices
A Unique Approach



Consumer Research

- User research data
- Consumer usage patterns
- By region

Benchmarking

- Performance, battery and display
- Lab-run tests
- Ratings weighted by UX data
- All ratings certified by BDTI

Consumers

- Educate consumers on UX
- Deliver UX ratings at scale

Certimo™

Certimo Benchmark Design Philosophy

Consumer usage data

- Develop benchmark tests that reflect actual use cases
- Weight benchmark results based on usage data

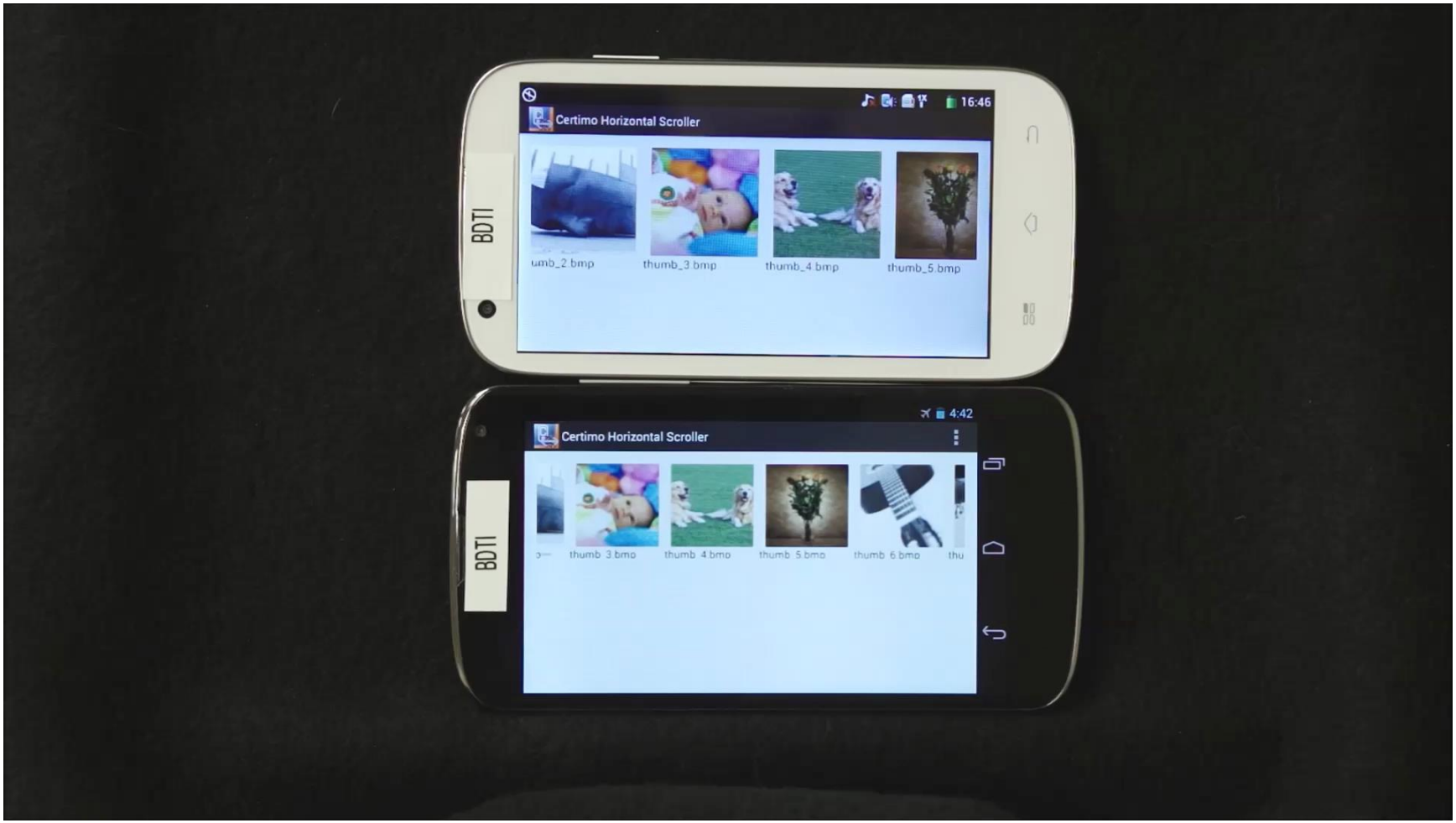
Key factors important to user experience

- Performance
- Battery Life
- Display Quality

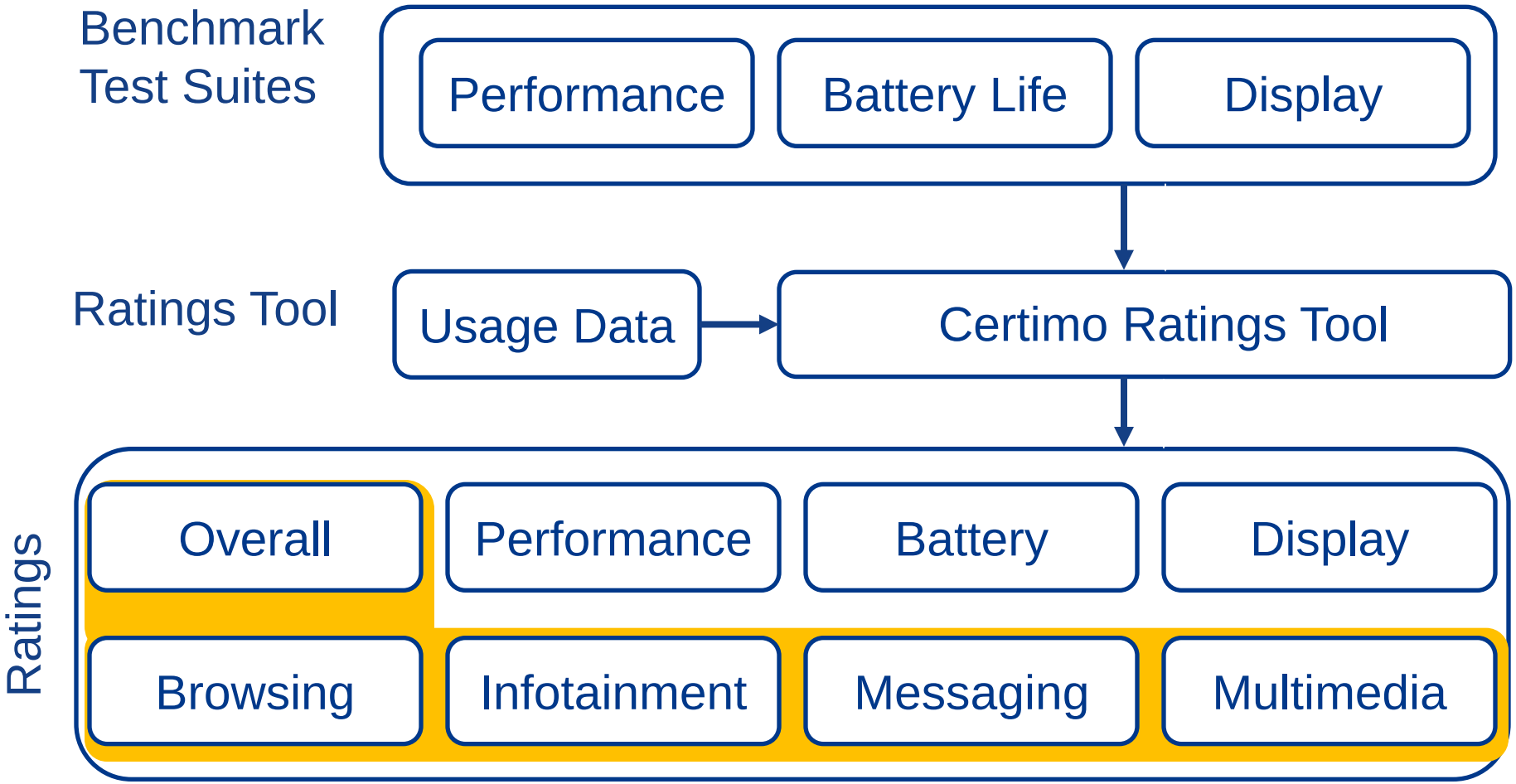
Measure at the system level

- ~40 system-level tests
- Not individual components in isolation
- Sum of the parts *NOT* equal to the whole

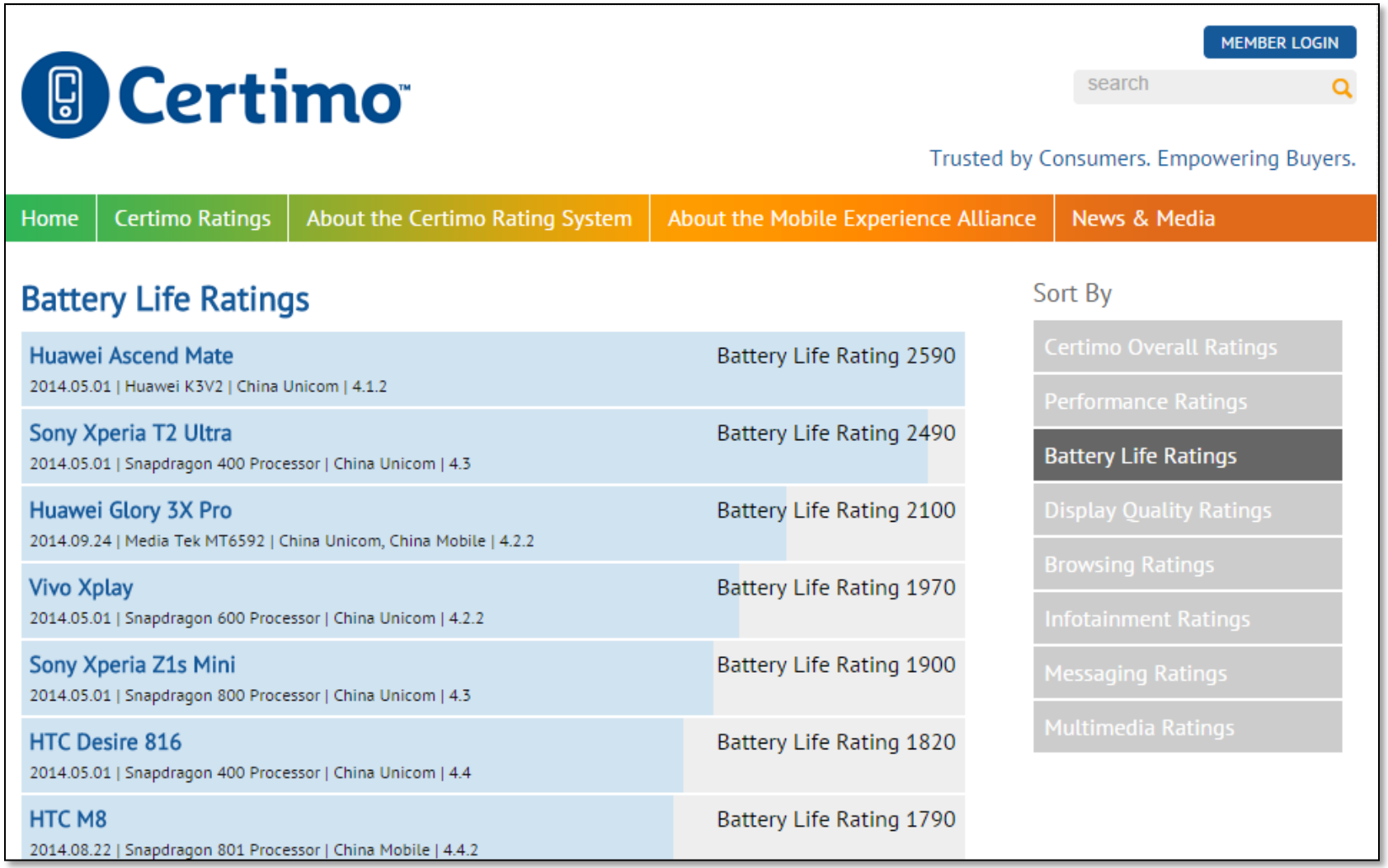
Example: Certimo Photo Scroller Test



Certimo Architecture
Overview



Example Certimo Published Results

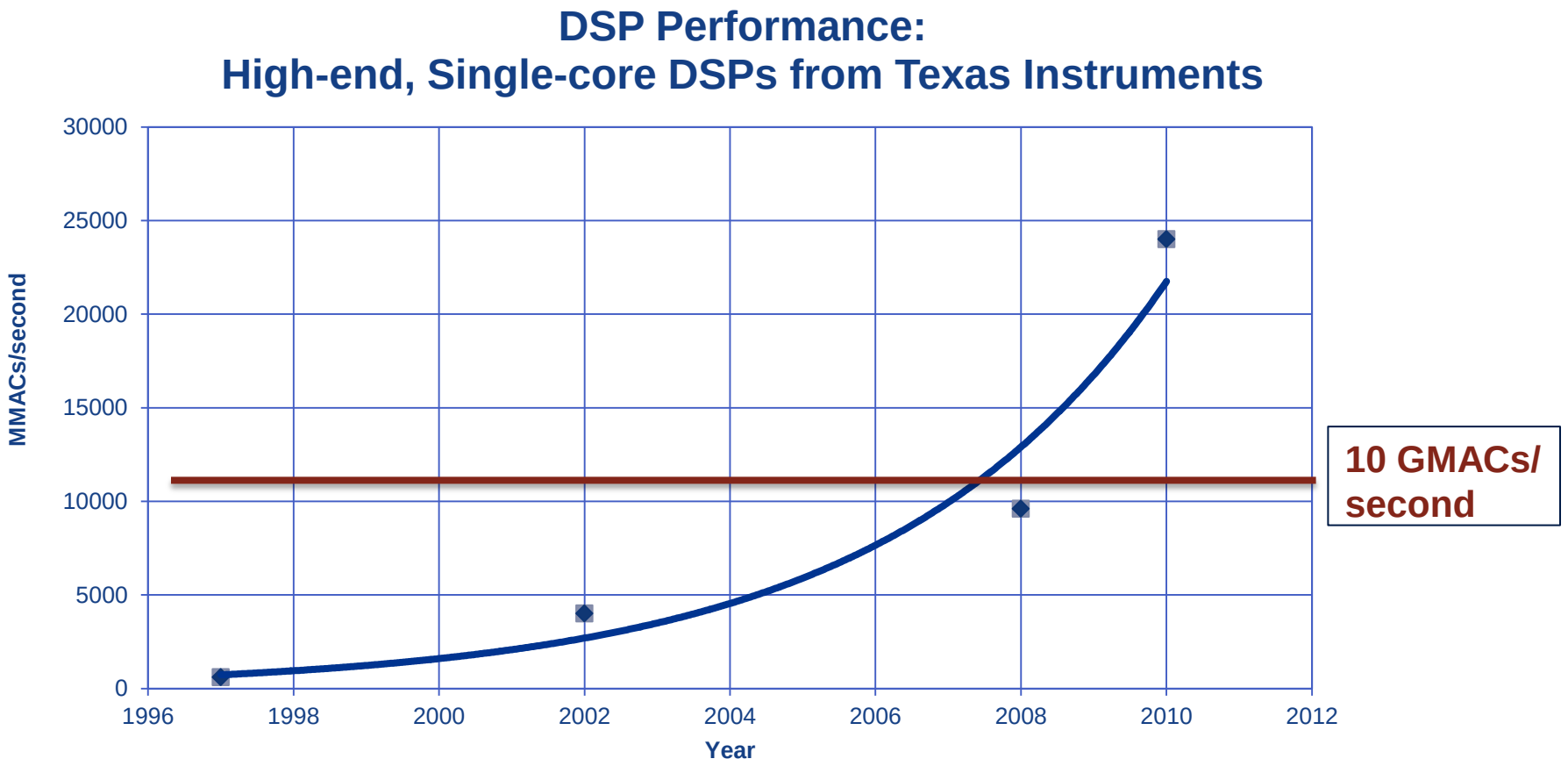


User Experience

- “Forming preferences is akin to riding a bicycle; we can do it easily but cannot easily explain how.” [Wilson and Schooler, 1991]
- “The colour of the mug was shown to influence participants’ rating of the coffee.” [Van Doorn et al., 2014]
- “… reasoning interferes with better initial choice among non-experts.” [Lopes, 2014]

www.iseekggolf.com

Meanwhile, Processor Performance Advances



Source: BDTI Analysis

The Evolution of Vision Technology

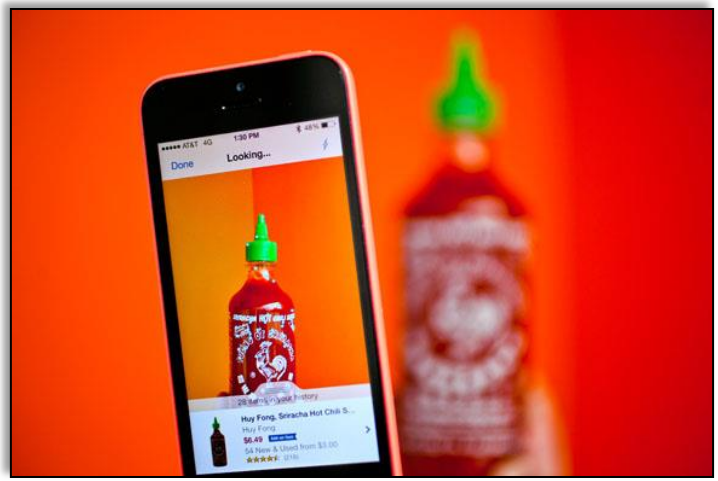
***Computer vision*:** research and fundamental technology for extracting meaning from images

***Machine vision*:** factory applications

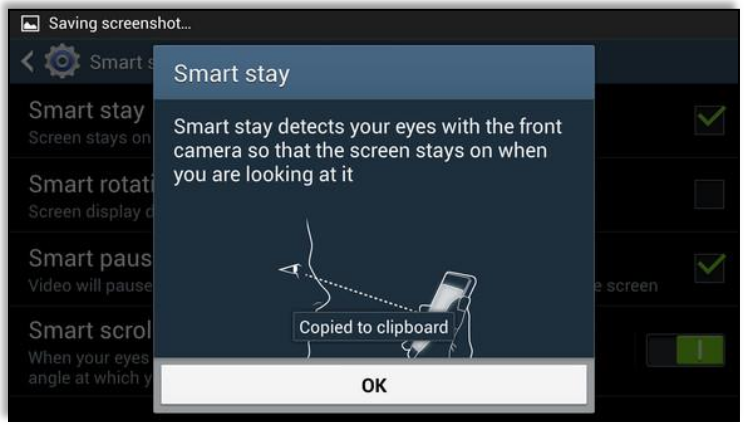
Embedded vision: thousands of applications

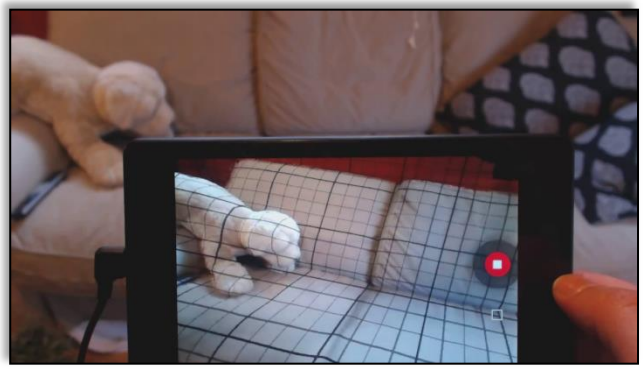
- Consumer, automotive, medical, defense, retail, gaming, security, education, transportation, …
- Embedded systems, mobile devices, PCs and the cloud

Embedded Vision Will Change User Experience



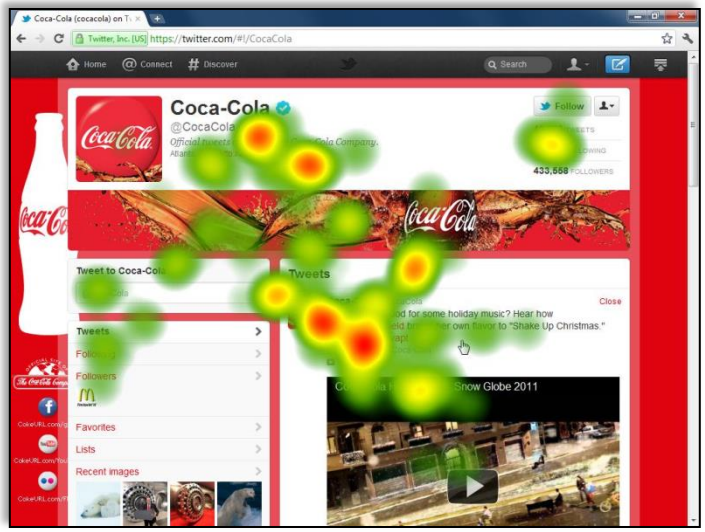
www.incrediblethings.com





Abound Labs

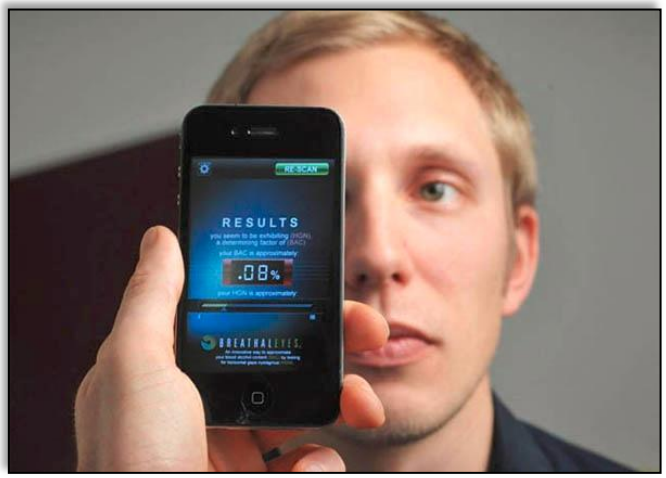
How Embedded Vision Can Help Us Understand User Experience



Living Website Technologies

Philips

Fraunhofer



HomeHealthTesting.com

Empowering Product Creators to Harness Embedded Vision

The Embedded Vision Alliance (www.Embedded-Vision.com) is a partnership of 47 leading embedded vision technology suppliers

Mission: Inspire and empower product creators to incorporate visual intelligence into their products

- The Alliance provides low-cost, high-quality technical educational resources for engineers
- Member companies position themselves as leaders to thousands of product creators via the Alliance web site and conferences
- Members meet quarterly to develop business partnerships and gain insights into markets and technologies
- We secure frequent press coverage on embedded vision topics, gaining exposure for our members as thought leaders

Alliance Member Companies

For more information, visit www.Embedded-Vision.com

Embedded Vision Summit: May 12, 2015 — Santa Clara, CA

The only industry event focused on enabling engineers to create "machines that see"

- *"Good balance of technical content and application-driven examples."*

Ren Wu, Baidu

Embedded Vision Summit 2015 highlights:

- Inspiring keynotes by leading innovators
- Full day of high-quality, practically-oriented technical talks
- Demos of the latest apps and technologies
- In-depth pre- and post-Summit workshops

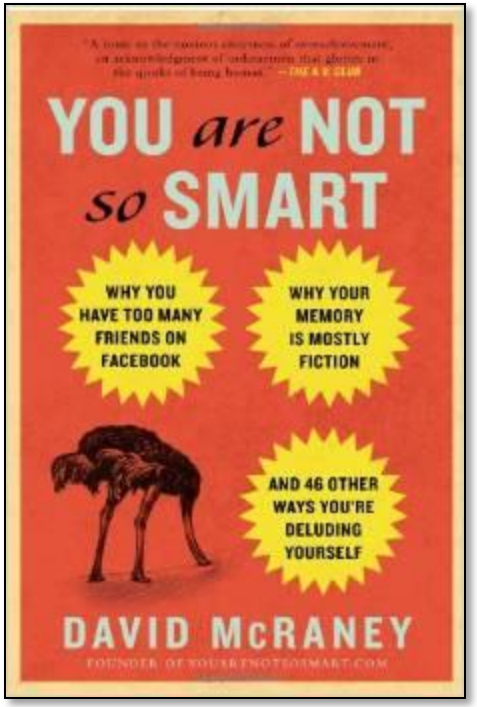
Mike Aldred, Dyson

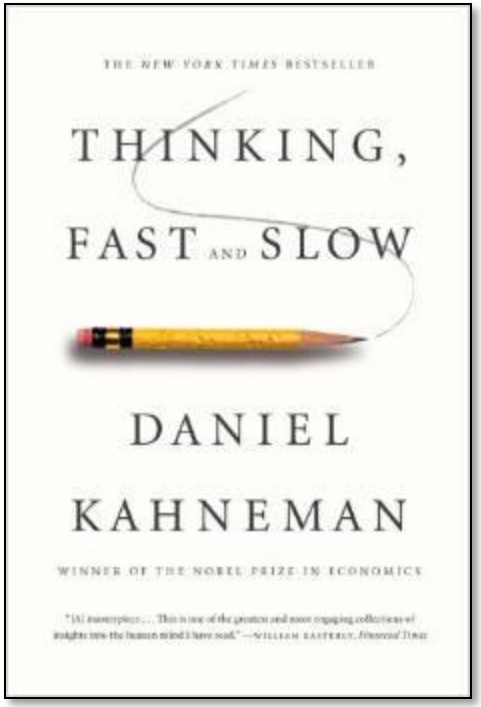
Registration open at www.EmbeddedVisionSummit.com

Conclusions

- We need a better understanding of what drives user satisfaction
- Embedded vision can help with this…
- While also complicating it, by enabling new types of products, capabilities and interactions
- Benchmarks must be thoughtfully designed and carefully executed
- Benchmark design should be driven by user experience

Recommended Reading





THANK YOU

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