Getting to the Heart of Touch

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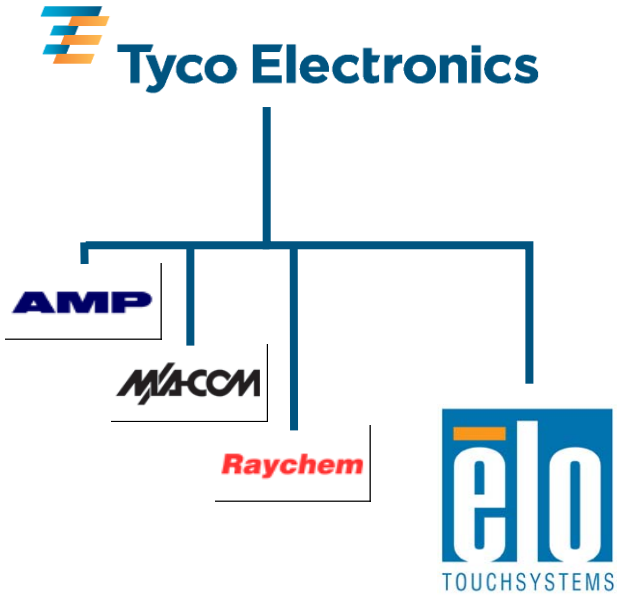
Elo TouchSystems Overview and Mobile Strategy



- Tyco Electronics
  - FY08 revenue: $14.8 billion
  - Operates in more than 54 countries
  - 92,000 employees
    - 34,000 in China
  - One of the world's largest electronic component suppliers

Elo TouchSystems Today

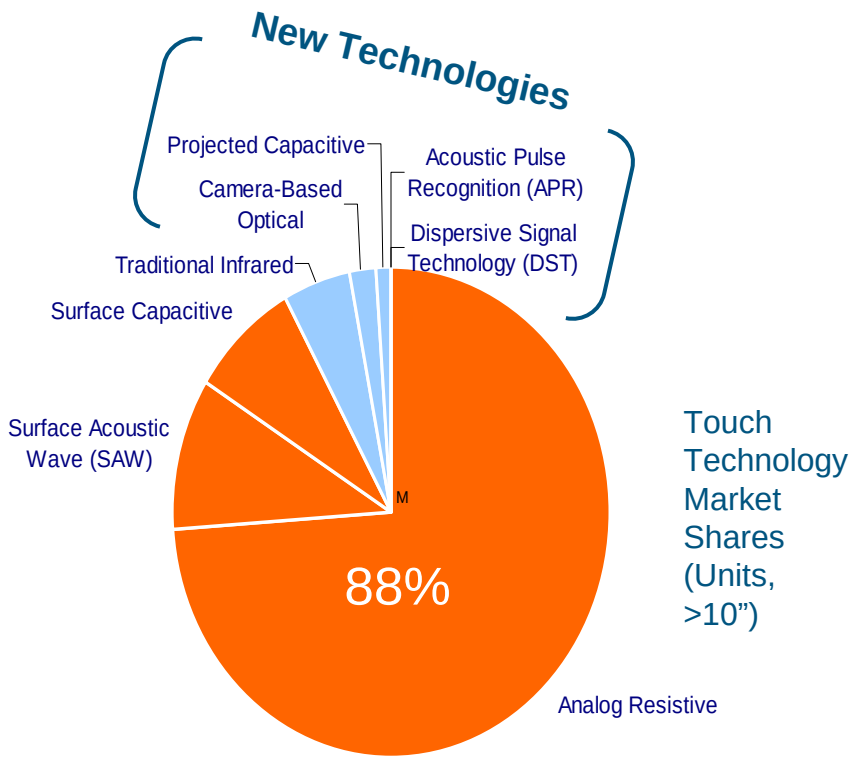
- Founded in 1971; invented the touchscreen
- World's largest revenue for touchscreens
- Global leader in touchscreen solutions
  - Touchscreen, controller, driver, monitor, computer, custom product, service
- Widest selection of touch technologies
  - Analog resistive
  - Surface capacitive
  - Surface acoustic wave
  - Infrared
  - Projected capacitive
  - Acoustic Pulse Recognition (APR)
- Sizes (2-60")
- Multiple multi-touch / gesture options
- Over 50 key patents
- Logistics, manufacturing & integration in China, Japan, Brazil, Belgium, New York & California
- ISO-9001 certified

Agenda

1. Contextual Importance
2. Technology Strengths and Weaknesses
3. Making Touch Decisions
4. Migrating to the Future

Traditional Touch Technologies Account for 88% of the 10”+ Market

Contextual Importance



Touch Technology Market Shares (Units, >10”)

- 88% of the touch screens shipped in 2008 [1] were one of the four “traditional” touch technologies
  - Analog resistive
  - Surface capacitive
  - Surface acoustic wave (SAW)
  - Scanning infrared (IR)
- Today there are 8+ additional new technologies competing
  - Projected capacitive
  - Camera-based optical
  - Acoustic Pulse Recognition (APR)
  - Dispersive Signal Technology (DST)
  - Emerging
    - Waveguide infrared
    - Force sensing
    - Digital resistive & hybrid digital-analog resistive
    - LCD in-pixel sensing (“in-cell”; three different varieties)

(1) iSuppli *Touch Screen Special Report*, May 2008

Attributes of Touch Market Drive Many New Technologies

Contextual Importance

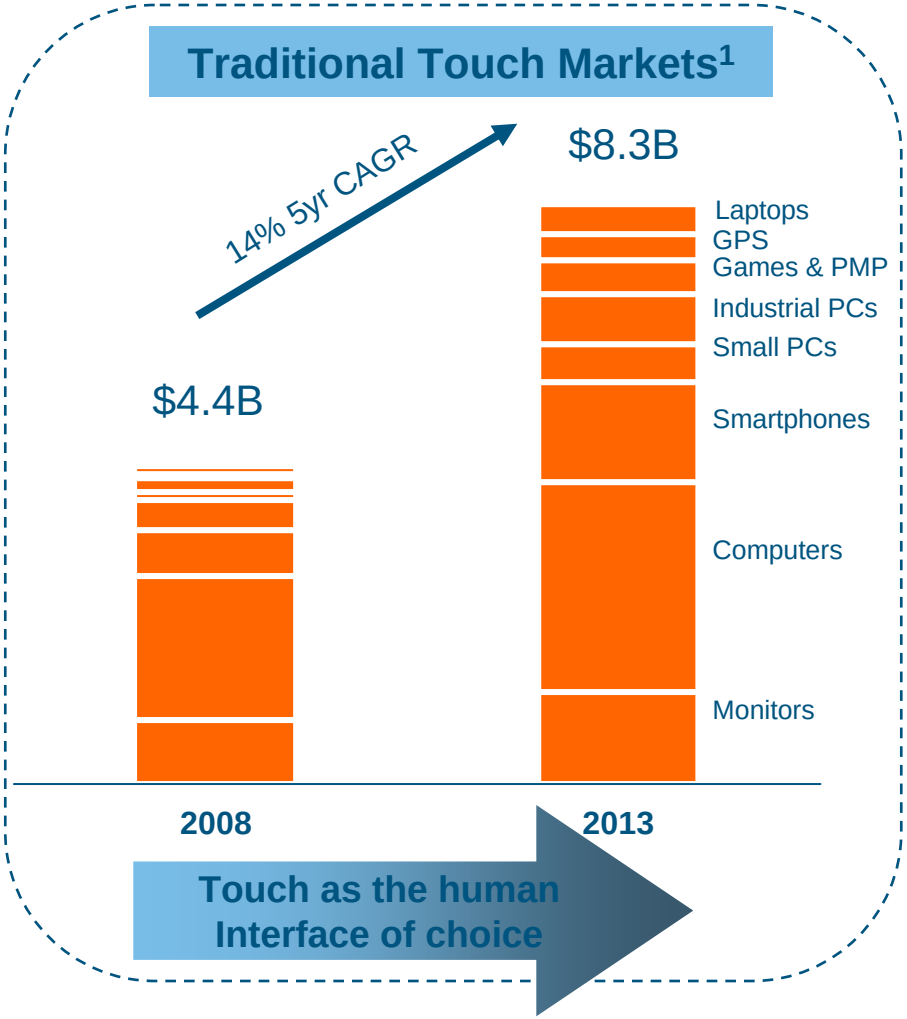
1. Proliferation of touch
2. Touch is an indirect measurement
3. The drive for fundamental intellectual property
4. There is no perfect touch technology
5. Vertical integration

Illustration courtesy of Apple

❶ Proliferation of Touch

Contextual Importance

- Humans cost $$ ➔ Proliferation of self-service
- Increasing display ubiquity & decreasing display cost
- Simplification of the user interface
- Hand-eye coordination
- Shrinking device size
- Single global hardware device
- Increased awareness of value
- Viral behavior (the iPhone effect)
- Increased worker mobility



❷ Touch Is An Indirect Measurement

Contextual Importance

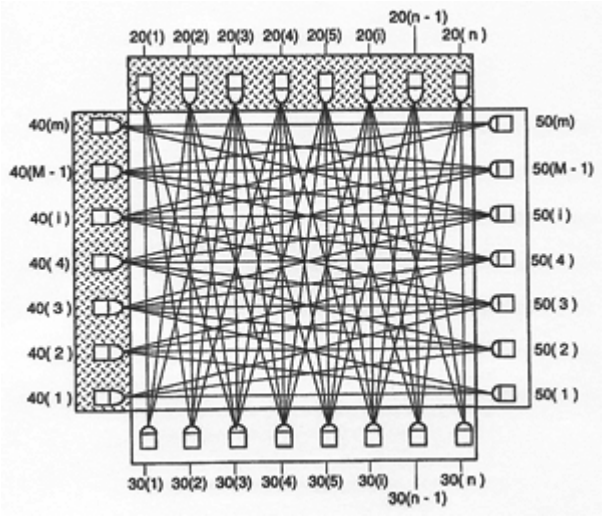
What's Being Measured	Touch Technology
Voltage	Resistive (all forms)
Current	Surface capacitive
Time delay	Surface acoustic wave
Change in capacitance	Projected capacitive; LCD in-cell (capacitive)
Absence of light	Infrared, camera-based optical, LCD in-cell (optical in high ambient)
Presence of light	LCD in-cell (optical in low ambient)
Sound	Acoustic Pulse Recognition (APR)
Bending waves	Dispersive Signal Technology (DST)
Force	Force sensing
Resistance (contact closure)	LCD in-cell (resistive)

The ideal method of detecting touch has yet to be invented!

❸ The Drive for Fundamental IP

Contextual Importance

- The fundamental intellectual property (IP) on all four of the traditional touch technologies has expired
  - New patents tend to be on enhancements



"Cross-beam" light paths increases resolution and fault-tolerance in infrared touchscreens (Elo)

- Companies trying to establish a sustainable competitive advantage in touch create new technologies

❹ There Is No Perfect Touch Technology…by Usability

Strengths & Weaknesses

Desirable Characteristic	Touch Technologies													
	Analog Resistive	Digital Resistive	Surface Capacitive	Projected Capacitive	SAW	Traditional IR	Waveguide IR	Camera-Based Optical	APR	DST	Force Sensing	LCD In-Cell (Optical)	LCD In-Cell (Capacitive)	LCD In-Cell (Resistive)
Usability														
Touch with any object	H	H	L	L	M	H	H	H	H	H	H	L	L	L
No unintended touch	H	H	H	H	H	L	L	L	H	H	H	H	H	H
Multi-touch	L	H	L	H	M	M	M	H	L	L	L	H	H	H
Touch & hold	H	H	H	H	H	H	H	H	M	L	H	H	H	H
High durability	L	L	M	H	H	H	H	H	H	H	H	L	L	L
High sensitivity (light touch)	H	H	H	H	M	H	H	H	H	H	L	H	H	M
Fast response & drag	H	H	H	H	M	M	H	H	H	H	M	M	M	H
Stable calibration	M	M	L	H	H	H	H	H	H	H	H	H	H	H
Very smooth surface	L	L	H	M	M	M	M	M	H	H	M	L	L	L
No liquid crystal pooling	H	H	H	H	H	H	H	H	H	H	H	H	L	L
Resistant to contaminants	H	H	M	H	L	M	M	M	H	H	H	L	L	L
Works in rain, snow & ice	H	H	L	H	L	L	L	L	M	M	H	L	L	L
Works with scratches	L	L	M	H	H	H	H	H	M	H	H	L	L	L

- 13+ more "**Performance**" factors
- 13+ more "**Integration**" factors

❹No Perfect Touch Technology…. Example for a Smartphone

Strengths & Weaknesses

Selecting touch technology for a smartphone…

Characteristic	Analog Resistive	Projected Capacitive	APR	Waveguide Infrared	Traditional Infrared	Digital Resistive	LCD In-Cell
Stylus Independence	☑	🕷	💰	☑	🕷	☑	🕷
Multi-Touch	🕷	💰	🕷	☑	☑	💰	💰
Durability	🕷	💰	💰	💰	💰	🕷	☑
Optical Performance	🕷	☑	💰	💰	💰	🕷	💰
Flush Surface	☑	💰	💰	☑	🕷	☑	💰
Power Consumption	💰	☑	💰	☑	🕷	💰	🕷
Stable Calibration	🕷	💰	💰	💰	💰	🕷	💰
Narrow Borders	☑	☑	💰	☑	🕷	☑	💰
Substrate Independence	☑	💰	☑	💰	💰	☑	💰
Cost	💰	🕷	☑	☑	🕷	☑	🕷

💰	Best
☑	OK
🕷	Worst

❹ There Is No Perfect Touch Technology…by Market

Strengths & Weaknesses

Application	Example	Touch Technologies													
		Analog Resistive	Digital Resistive	Surface Capacitive	Projected Capacitive	SAW	Traditional IR	Waveguide Infrared	Camera-Based Optical	APR	DST	Force Sensing	LCD In-Cell (Optical)	LCD In-Cell (Capacitive)	LCD In-Cell (Resistive)
Amusement Gaming	Bar-top game	X	X	O	X	O	X	X	X	O	X	X	X	X	X
Appliance	Refrigerator door	O	X	X	X	X	X	X	X	O	X	X	X	X	X
Architectural	Elevator control panel	X	O	X	X	X	X	X	X	X	X	O	X	X	X
ATM Machine	ATM machine	X	X	X	O	O	O	X	X	X	X	X	X	X	X
Consumer AiO & Monitor	HP TouchSmart	O	X	X	O	X	X	X	O	X	X	X	X	X	X
Digital Signage	In-store product info	X	X	X	O	O	O	X	O	O	O	X	X	X	X
Healthcare	Patient info monitor	O	X	X	X	O	X	X	X	O	X	X	X	X	X
Industrial Control	Machine control	O	O	O	X	O	O	X	X	X	X	O	X	X	X
In-Vehicle	GPS navigation	O	X	X	O	X	X	O	X	X	X	X	X	X	X
Kiosk Commerce	Digital photo printing	O	X	X	O	O	X	X	X	O	O	X	X	X	X
Kiosk Point of Info (POI)	Museum information	O	X	O	X	O	O	X	O	O	O	X	X	X	X
Kiosk Ruggedized	Gas pump	X	X	O	O	O	O	X	X	X	X	O	X	X	X
Legal Gaming	Casino machine	X	X	O	X	X	X	X	X	X	X	X	X	X	X
Medical Equipment	Medical devices	O	X	X	O	O	X	X	X	O	X	X	X	X	X
Military Fixed & Mobile	Submarine console	O	X	O	X	X	O	X	X	X	X	X	X	X	X
Mobile Device	Smartphone	O	X	X	O	X	O	O	X	O	X	O	O	O	O
Music Controller	Jazz Mutant	O	O	X	O	X	X	X	X	X	X	X	X	X	X
Office Automation	Office monitor	O	X	O	X	O	X	X	X	X	X	X	X	X	X
Point of Sale (POS)	Restaurant; lottery	O	X	O	O	X	O	X	X	O	X	O	X	X	X
Training & Conference	Boardroom display	O	X	X	X	O	X	X	O	X	O	X	X	X	X

❺ Vertical Integration

Strengths & Weaknesses

- LCD in-cell touch
  - When touch was insignificant, LCD manufacturers ignored it
  - Now that it's becoming more significant (~$3B in 2008 [1]), LCD manufacturers want to incorporate it into their products
- Three types
  - Optical – phototransistor in each pixel
    - ✖Can't sense touch on a dark on-screen object in low light
  - "Resistive" – contact-closure sensing in each pixel
    - ✖User must touch the surface of the LCD (poor durability)
  - Capacitive – laminated projected capacitive sensor ("on-cell")
    - ✖Standard shortcomings of projected capacitive (e.g., no stylus)

"There is no perfect touch technology"

(1) iSuppli *Touch Screen Special Report*, May 2008

End User requirements, Technology Attributes should Drive Decisions

Touch Decisions

- What should an OEM who wants to implement touch in a new product do when faced with so many technologies?
  - ❶ Understand the end-user's behavior & the application in depth
  - ❷ Understand the strengths & weaknesses of each technology
    - *Interactive Displays Conference*, April 21-23, San Jose [1]
    - *Touch & Emerging Technologies Conference*, September 3, San Jose [2]
    - Veritas et Visus *Touch Panel* newsletter [2]
  - ❸ Work with a supplier who develops multiple technologies
    - ✖ Force-fit technology
    - ✖ Technology resellers
    - ✖ Biased website information
    - ✖ Herd behavior

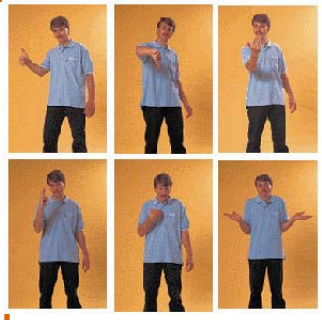
(1) www.int-displays.com
(2) www.displaysearch.com
(3) www.veritasetvisus.com

What's Coming

Future Migration

- The definition of touch
  - Sensing the contact between a human (or a human holding an object) and a target
- The purpose of touch
  - Simplify the interaction between humans and information and/or equipment
- How else can that interaction be simplified?
  - Voice (mobile phones)
  - Gestures (2D & 3D)
  - Face-reading
  - Eye-tracking
  - Brain waves
  - **And more…**

- *iPhone (2D)*
- *Cellphone 3D gestures*
- *Flexible displays*
- *TV remote at CES* [1]
- *Lexus heads-up display*
- *Next Gen Hp TouchSmart* [2]



(1) www.gesturetek.com
(2) Business Week, 04/13/09

Thank You!

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