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intel®
The Future of Touch Technology
This talk: Touch-only, mostly hardware, lots of opinions
- No gestures
- No haptics
- No software

Windows 8
- Touch penetration
- P-cap
- Future focus
Windows 8

- Will drive touch in consumer market, not enterprise
- Slow start has the entire PC industry very concerned
  - One major reason for the slow start is lack of Win-8 hardware
- Intel’s user-testing on clamshells produced very surprising results
Touch Penetration…1

- Tablets
  - 100%

- Phones
  - Heading very high, very quickly (DS: 95% in 2018)

- Ultrabooks
  - Just starting, but accelerating rapidly (DS: 37% in notebooks in 2018)
  - Clamshell vs. “hybrid”

- All-in-Ones (AiO)
  - Dropped in 2012 due to Win-7 touch adoption & Win8 anticipation
  - Should rise, particularly with “adaptive” devices (DS: 23% in 2018)
  - Three touch technologies now available for AiOs
What does it take to drive touch into clamshells?

- Lower cost
- Touch apps that create consumer pull
- Touch that’s easier or more convenient than alternative input methods
- Touch that feels natural and responds quickly (low latency!)
- Touch that’s fun and satisfying
- Windows 8
Touch Penetration…3

❖ Large-format

➢ Significant opportunity as displays become even lower-cost, but more work needs to be done on reducing touchscreen cost

➢ Significant competition between touch technologies

▪ Camera-based optical (e.g., NextWindow)
▪ Vision-based (e.g., Samsung SUR40)
▪ FTIR (FlatFrog’s “PSD” & RAPT)
▪ P-cap (currently with wire electrodes)
▪ “Traditional” (1.5-touch) infrared
▪ “High finger-count multi-touch infrared” (no market name yet)

http://www.youtube.com/watch?v=mVEESR8kY0I
Touch Penetration…4

- **Commercial markets**
  - Shrinking share of total touch units & revenue accentuates the gap between commercial and consumer

- **Healthcare**
  - Very long product lead-time is driving strong adoption of p-cap
  - Edge-to-edge glass, multi-touch, & light touch are all important

- **Casino gaming**
  - Casinos want to attract the Millennium Generation
  - Multi-touch is very important; edge-to-edge glass perhaps less

- **Point-of-Sales (POS)**
  - Edge-to-edge glass is the only driver, and “flat-edge” resistive is “good enough”
Dominance in < 15 inches
- 83% p-cap in 2012 (DisplaySearch)

Today’s OEM cost for 13.3” p-cap is $55 to $85

Intel’s touchscreen cost-reduction focus (mostly p-cap)
- ITO-replacement materials
  - Metal mesh, silver nanowires, carbon nanotubes, conductive polymers
  - It’s not really about the material; it’s about the process
- Easier/simpler/higher-yield lamination
- Supply-chain improvements
- Glass ➔ plastic
- Alternative touch technologies
P-Cap…2

- Signal-to-noise ratio (SNR) is critical
  - Today’s “artificial finger” stylus is a lowest-common denominator
  - Very-high SNR enables use with fingernail, #2 pencil, various objects

- Other technical advancement areas
  - EMI/RFI immunity
  - Operation with water on the screen
  - Finger-hover or touch-and-press
  - More coming…
In 2007, Steve Jobs famously said, “Stylus, yeeecchh!”

In 2008, Microsoft decided to emphasize the finger in Windows-7 touch over the stylus from the (perceived) failed Tablet PC.

The result is that for the last six years, we’ve been in an artificially pro-finger-touch world.

- Remember the stylus on the Palm PDA and the Handspring Trio?
  - Stylus has been around a LONG time and it’s NOT going away.

Windows 8 may cause stylus to re-emerge and become important again.
Stylus (with touch, of course)

- Samsung’s Galaxy Notes use Wacom electromagnetic resonance (EMR), which requires a second sensor under the LCD
- EMR may become a legacy technology
  - Expiration of Wacom’s batteryless-pen patent is having an interesting effect
- P-cap stylus (both passive & active) with touch is the future
  - Passive (2 mm tip) vs. active (~1 mm tip + hover)
  - N-Trig is currently the active stylus UX leader, equal to Wacom
  - More than 4 p-cap controller companies have active styli
Active-stylus use cases

- Quick sketches
- Artistic drawings
- Engineering design
- Note-taking with background recognition (searchable)
- Annotating existing documents
- Precision pointing device for Win-8 desktop mode with high-DPI LCDs

Samsung is doing an incredible job of popularizing stylus
In-cell ("embedded touch")

- Shipping in 3+ high-volume smartphones (after 10 years!)
- Sony Xperia P, HTC EVO Design 4G, iPhone 5
- Sony-Synaptics architecture (actually hybrid in-cell/on-cell) should obsolete all other previous in-cell architectures
  - “Pressed” capacitive, light-sensing, contact-sensing, etc.
- Expansion beyond phone-size seemed difficult due to timing, but one SID DisplayWeek 2013 touch-paper documents a 12” version

How it works

- Uses existing internal metal in groups to form drive and sense electrodes; segments the ITO static-shield on IPS displays if needed
- Uses VCOM as the drive signal, changing it from noise to signal
- Touch controller cooperates with the LCD TCON on timing
**On-cell** touch has become the standard for OLED, yet it hasn’t become very popular with LCD makers

- It may not solve enough problems on LCDs
  - It’s still basically like putting a discrete touchscreen on top of the color filter; connectivity is messy with a separate flex and controller
  - Double-sided processing of the color filter/touch sensor is still a problem
- Some experimentation is in progress with ITO-replacement based touch sensors

Display industry is moving towards single-branding for all forms of embedded touch

- For example, “Touch In Display” from CMI
- The key question: Who adds the touch, the display manufacturer or the touch-module maker?
Future Focus

- User experience (UX)
- Front-of-screen coatings
- Cost reduction
- Display manufacturers vs. touch-module manufacturers
- The next big touch market
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