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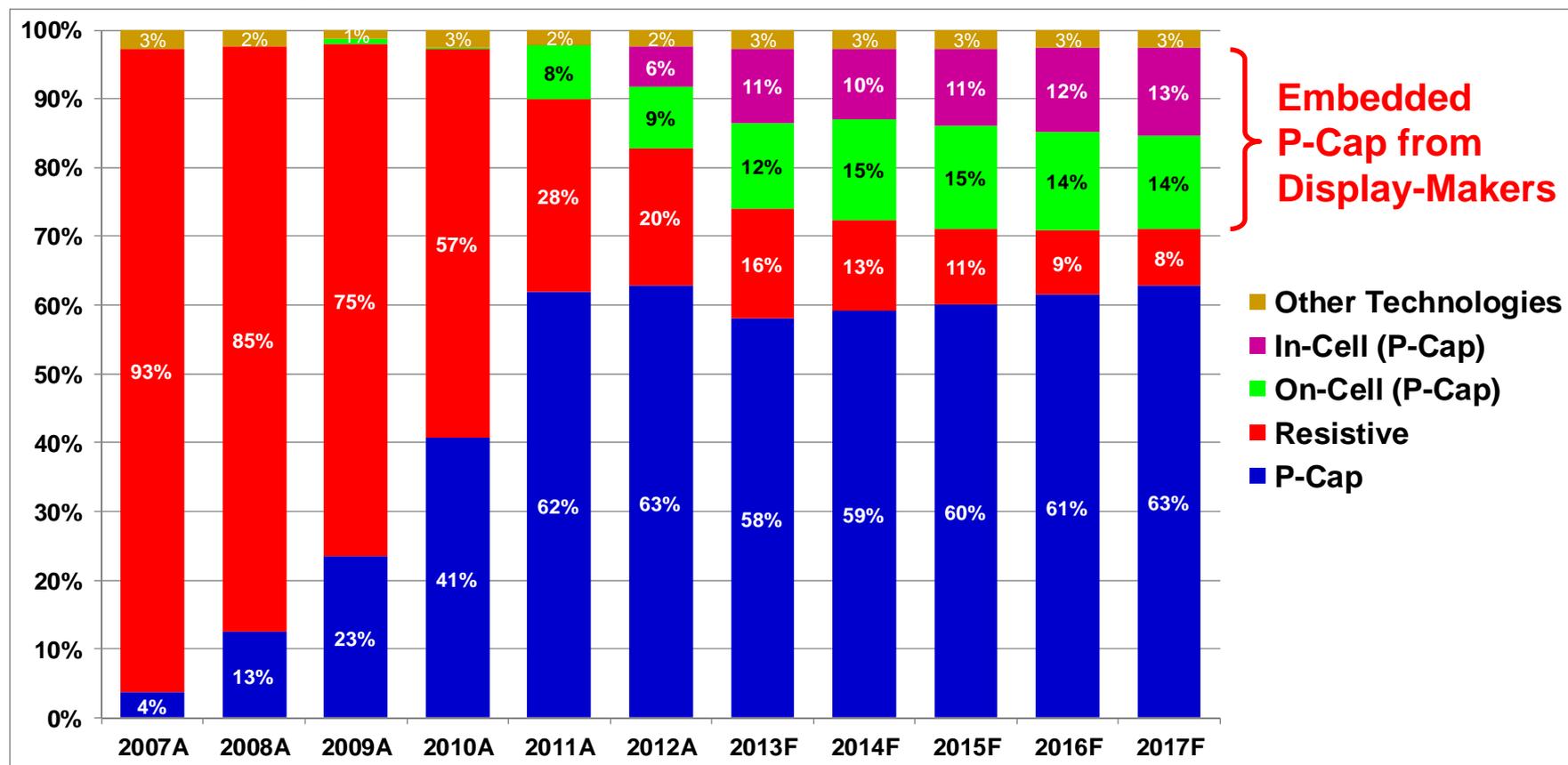
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Embedded Touch:
The Touch-Panel Makers vs. The Display-Makers

File Download: www.walkermobile.com/FPD_International_2013_Touch_Futures.pdf

Touch-Panel Market 2007-2017 by Technology (Units)

% of Units Shipped

Source: DisplaySearch Touch-Panel Market Analysis Reports 2008-2013

Embedded Touch Terminology

Term	Integration Method
In-Cell	Touch sensor is **physically inside the LCD cell** Touch sensor can be: • Capacitive electrodes (same as p-cap) • Light-sensing elements (rare)
On-Cell	Touch sensor is **on top of the color-filter glass (LCD) or the encapsulation glass (OLED)** • Capacitive electrodes (same as p-cap)
Hybrid (In-Cell/ On-Cell)	Touch sensor has **sense electrodes on top of the color-filter glass <u>and</u> drive electrodes inside the cell** • <u>IPS LCD</u>: Segmented Vcom electrodes on the TFT glass • <u>Non-IPS LCD</u>: Segmented Vcom electrodes on the underside of the color filter glass

Comparison of Discrete (OGS) Touch with Embedded Touch…1

❖ **Cost: Is embedded touch really "free"?** *No!*

✦ Barrier to entry
  ● There is much more intellectual property (IP) on embedded touch layer-structure & driving; making sure you don't infringe costs money

✦ Development cost
  ● Embedded touch is much more complex to develop than OGS
  ● High volume is required (5M) to make it practical

✦ Cover glass, decoration & bonding
  ● Similar to discrete (OGS), but embedded cover-glass is just glass & decoration (no ITO), so it's easier to manufacture
  ● Sheet-type OGS may not be as strong as plain cover-glass

✦ Touch controller
  ● No integration = same cost (but performance is poor)
  ● Linked to TCON for timing control = same cost (slightly different chip)
  ● Integrated with TCON = saves $1-$2 in material cost
    ➤ BUT, it adds <u>LCD-specific chip-development cost</u> (amortized NRE)

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Comparison of Discrete (OGS) Touch with Embedded Touch...2

❖ Cost (continued)

✦ FPC to connect electrodes
- On-cell and hybrid = same
- In-cell = none if touch controller is COG; saves another $1-$2

✦ Electrode material
- Discrete OGS currently uses ITO; could move to printed metal-mesh, which could save $10+ in tablet size (once sensor competition gets real)
- On-cell = same as discrete ITO
- Hybrid = only half as much added ITO (little material cost-difference)
- In-cell = no added ITO

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Comparison of Discrete (OGS) Touch with Embedded Touch…3

❖ Performance

- ✦ On-cell = same as discrete or worse
  - If you build the color-filter first (focus on LCD yield) then you can't use high-temperature ITO so touch performance is worse
  - If you build the touch electrodes first for good performance, then you can't thin the color-filter glass
- ✦ Hybrid = same
- ✦ In-cell = worse, but should improve to be same as SNR goes up

❖ Thickness

- ✦ Embedded is typically 100 µm thinner than discrete OGS
- ✦ But <u>the thickness variation between smartphone models with embedded touch is ~1.0 mm due to other features</u>, so 0.1 mm doesn't mean that much to the consumer (it's mostly marketing!)

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Comparison of Discrete (OGS) Touch with Embedded Touch…4

❖ **Weight**

✦ Embedded = discrete (same number of sheets of glass)

❖ **Power consumption**

✦ On-cell & hybrid = same as discrete

✦ In-cell with integrated touch & TCON = probably lower, but touch power consumption is much lower than LCD power-consumption, so the decrease isn't very significant

❖ **Off-screen icons**

✦ Discrete = no problem

✦ Embedded = <u>requires additional circuitry</u>

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Comparison of Discrete (OGS) Touch with Embedded Touch…5

❖ **Conclusion: Embedded touch isn't a clear win in either cost or technology;**
it's all about who gets the touch revenue!

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Comparison of Discrete (OGS) Touch with Embedded Touch…6

❖ **What the device OEM wants**

  ✦ An integrated module with display, touch, and unique cover-glass, ready to drop into each model

❖ **What the touch-panel makers deliver**

  ✦ Increasingly, what the device OEM wants

  ✦ TPK is a good example
   ● $5B revenue in 2012 was $3B of touch and $2B of displays
   ● TPK spent $250M in 2011 on cover-glass manufacturing equipment (i.e., vertical integration)

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Comparison of Discrete (OGS) Touch with Embedded Touch…7

❖ **Display-makers have some problems delivering what the device OEMs want**

- ✦ Display-makers would like to ship (for example) 50M identical displays, not 5M each with 10 unique cover-glasses

- ✦ Each 5M displays with a unique cover-glass is a different SKU, which adds product-management cost
  - There's probably also a non-touch version of the same LCD (another SKU)!

- ✦ If the display-maker doesn't want to be in the cover-glass business (vertically integrated), outsourcing it adds cost due to the cover-glass maker's margin

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Comparison of Discrete (OGS) Touch with Embedded Touch…8

❖ **The touch-panel makers are already making changes to fight embedded touch**

- ✦ Film type
  - Low price, fast development & supply, flexible production volume even when demand is low
  - Switching from GFF to GF1 (thinner)
  - Adding photolithography equipment to achieve narrow borders
- ✦ Glass (GG) type
  - Doing part of OGS process for somebody else
  - Converting their entire production line to OGS
- ✦ OGS type
  - Investing in ITO-replacements (e.g., TPK & silver nanowires)

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Where the Touch-Controller Suppliers Fit in this Battle

❖ **It seems clear that neither the touch-panel makers nor the display-makers are going to easily beat the other**

✦ Controller suppliers must therefore support <u>both</u> discrete touch and embedded touch, and market to both sides
  - This adds more complex requirements to new controller designs, which adds cost overall

✦ Most controller suppliers seem agnostic

✦ The exception is Synaptics, who clearly favors embedded touch
  - They even bought a TCON company in order to be able to become expert at integrating the touch controller with the display controller

✦ It remains to be seen whether picking a side makes sense

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More Conclusions…1

❖ **The driving force in embedded touch is the display-makers' need to add value in order to increase their *revenue and profitability***

❖ **Embedded touch provides *little advantage* to the end-user (consumer)**

❖ **It's not clear that embedded touch will offer *significant cost-savings* to the device OEM, since OGS can be further cost-reduced with ITO-replacement materials**

More Conclusions…2

❖ **It may actually be <u>harder</u> for the display-makers to take advantage of the continuous innovations expected from the major touch-controller suppliers in the next few years**

- ✦ Active stylus support (important for Windows)
- ✦ Integration of touch algorithms into the CPU chipset
- ✦ Finger-hover
- ✦ Water-resistance
- ✦ Other touch objects
- ✦ Touch feedback (real haptics, not just a vibrator)
- ✦ Decreased latency (faster response)
- ✦ And more…

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More Conclusions…3

❖ **The Bottom Line**

  ✦ The display-makers will take some market share with embedded touch in high-volume products (DisplaySearch says 30% in 2017) but <u>embedded touch is unlikely to become dominant</u> because the touch-panel makers simply won't let their business be destroyed

  ✦ **It's going to be a hard-fought WAR**

Looking Beyond the *War* at the Entire Touch Industry

❖ **What matters most is the *user experience* with the device, and the touch-panel is a critical part of it**

❖ **Touch Should Always "Just Work"**

  ✦ It shouldn't fail to highlight a touched link 1 time out of 10

  ✦ It shouldn't stop working when it's near a florescent desk lamp

  ✦ It shouldn't work erratically when you're using a cheap charger

  ✦ It shouldn't stop working when the screen gets sweaty

  ✦ It shouldn't work erratically when you touch with two close fingers

  ✦ It shouldn't stop working when your thumb is on the screen

  ✦ Etc…

❖ **"Good Enough" sometimes isn't…**

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Thank You!

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