Opportunities in Mobile Displays
LTPS, OLED and Touch

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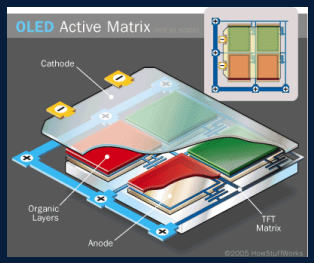
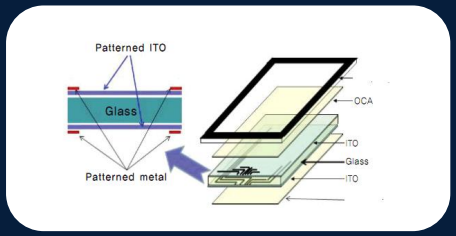
Outline

- The "4th Wave" in Displays
- New mobile display requirements
- High-performance mobile display technologies
  - Low-temperature poly silicon (LTPS)
  - OLED
  - High-performance LCD
  - Equipment opportunities
- Touch panel technologies and equipment opportunities
- Applied's display products

Source: att.com



Courtesy of HowStuffWorks.com



Source: Semiconductor Insight, Dec 2010

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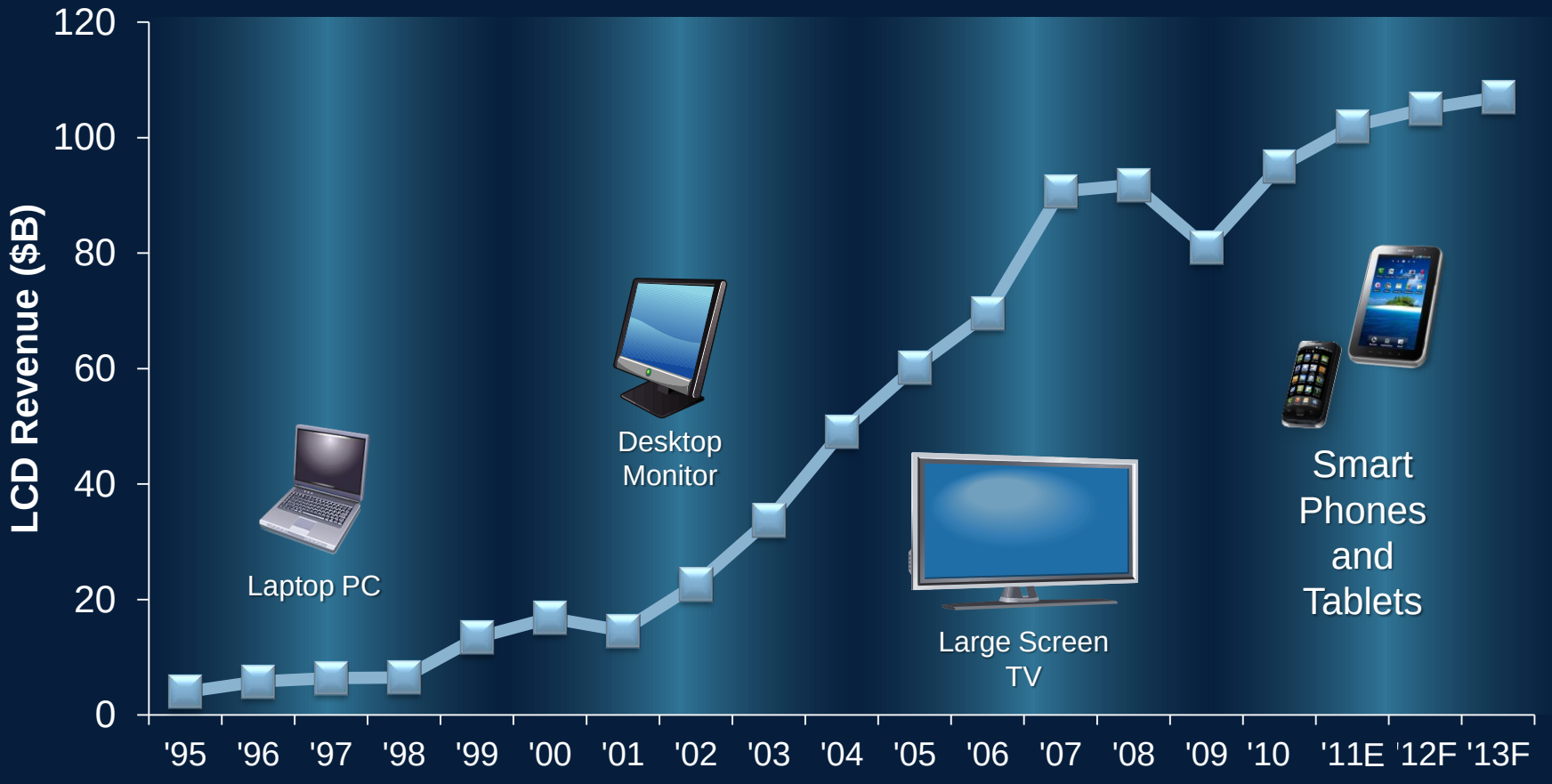
Mobility Creating "Fourth Wave" in Displays



- Better image quality needed for new mobile content
- Multi-touch interface needed for flexibility w/o mouse and keyboard

Mobile Display Requirements

OLED

- **High contrast ratio**
- Slim form factor
- Viewing angle
- High brightness
- Low power

Source: Samsung

or

Hi-performance LCD

- **High resolution**
- Viewing angle
- High brightness
- Low power

Source: att.com

Multi Touch

- Intuitive user interface
- Remove mouse/keyboard
- More space for larger screen

Source: Samsung

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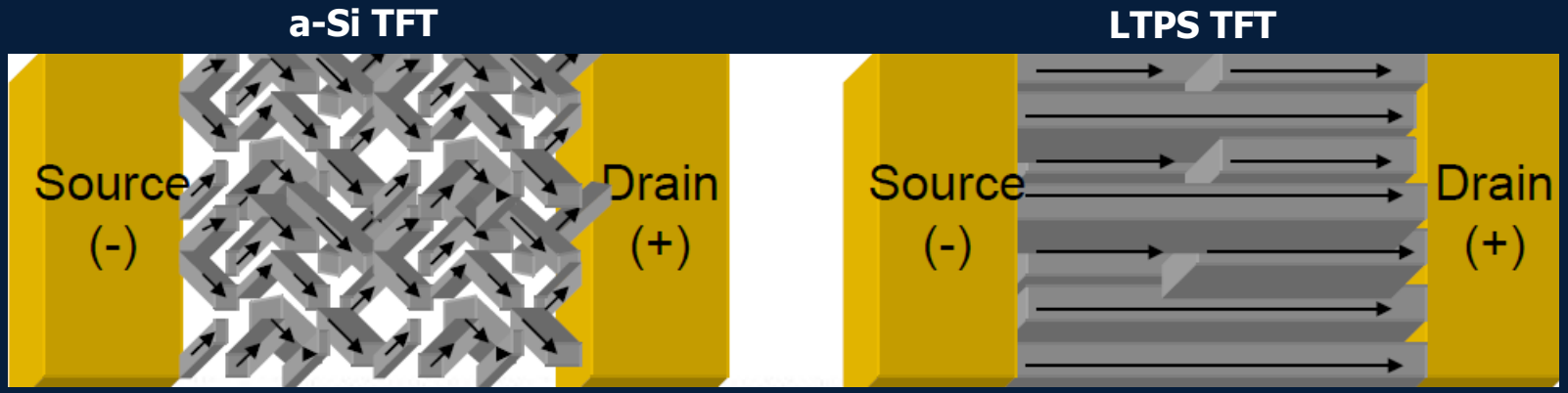
Low Temperature Poly Silicon (LTPS)

Enables OLED and Hi-resolution LCD



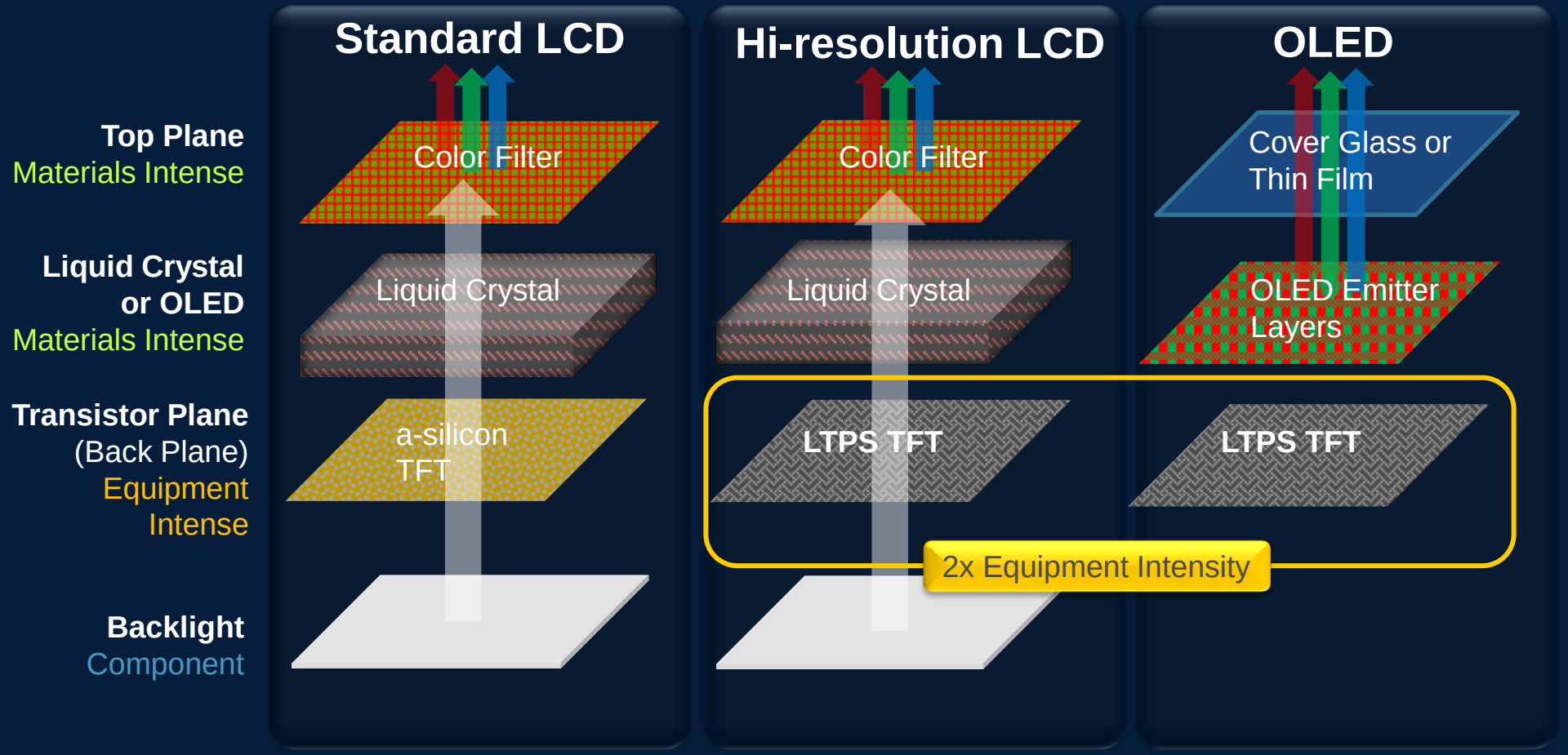
Source: DisplaySearch

LTPS Provides

Higher mobility

LCD		OLED	
Feature	Benefit	Feature	Benefit
Smaller transistor	Smaller pixel/high resolution	High, stable drive current (at lower power)	Bright stable image (at lower power)

High Performance Displays Need High Performance Transistors



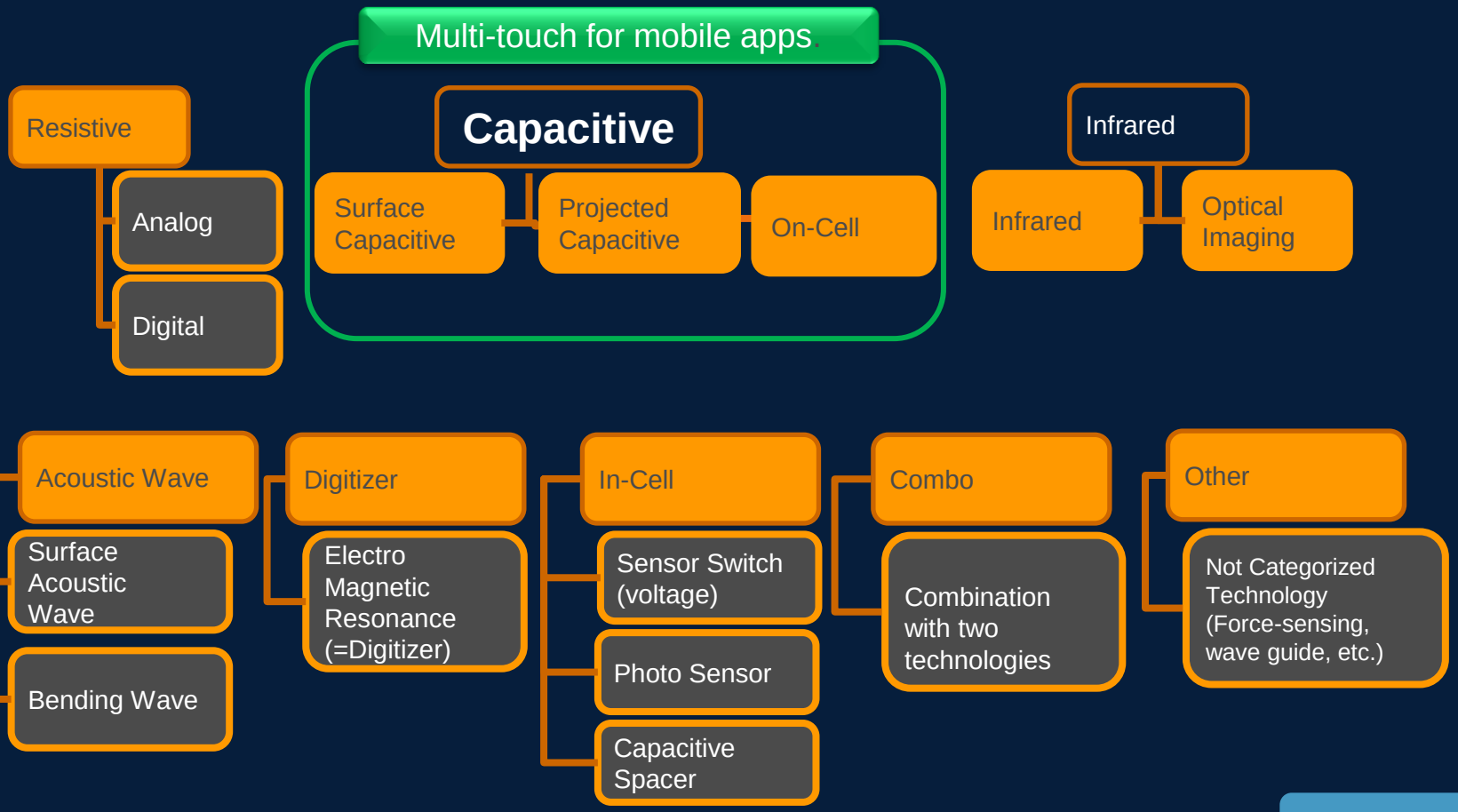
Double the Equipment Intensity with LTPS vs. a-Si

LTPS Surge Fueling Equipment Spend

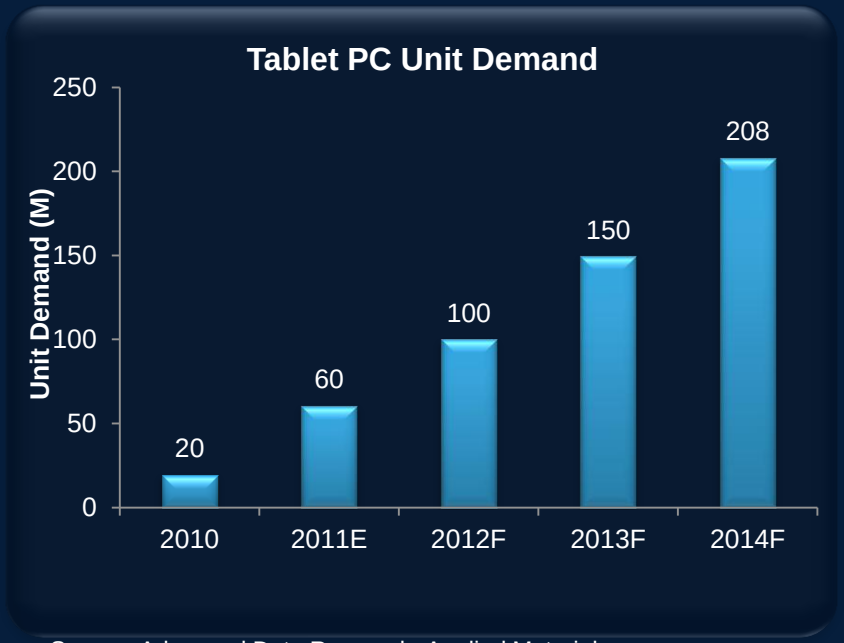
- Up to 2X mask steps; more CVD, lithography, and etch spending
- LTPS equipment spend per output ~2X a-Si
- LTPS CVD equipment spend >2X a-Si
- Delivering ~$250M SAM to Applied in 2011

Touch Screen Technology (DisplaySearch)

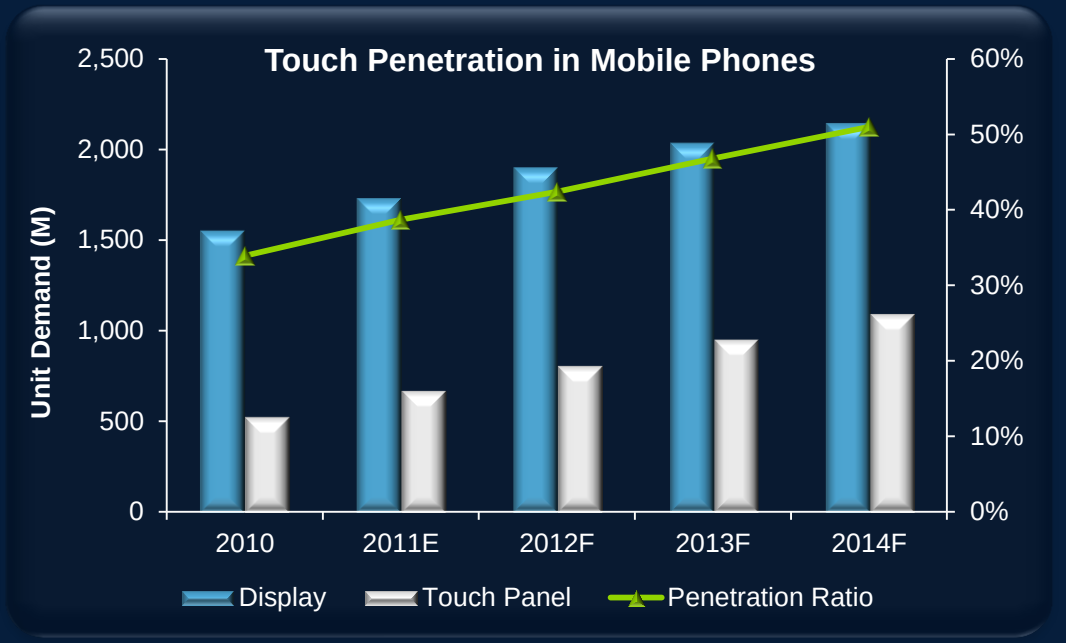
- Over a dozen touch screen technologies
- 11 categories: resistive, surface capacitive, projected capacitive, on-cell, infrared, optical (image sensor) touch, acoustic wave, digitizer, In-cell, combo, others



Touch Panel Demand Growth Drivers



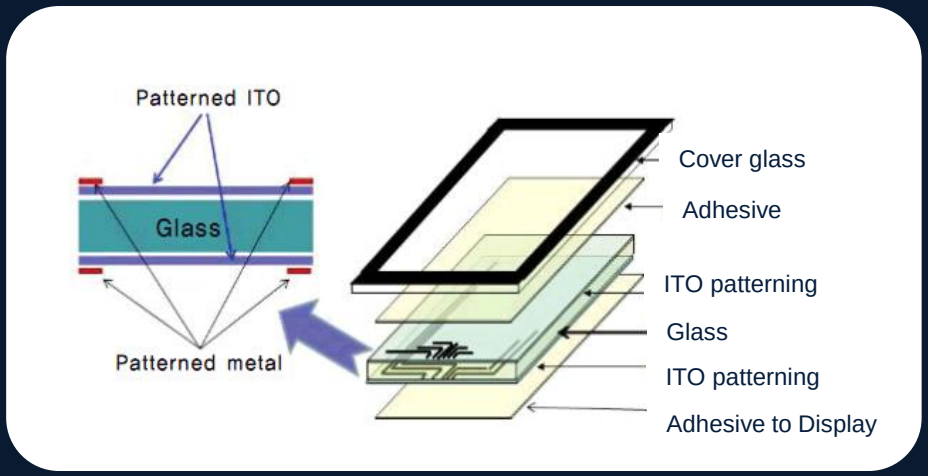
Source: Advanced Data Research, Applied Materials



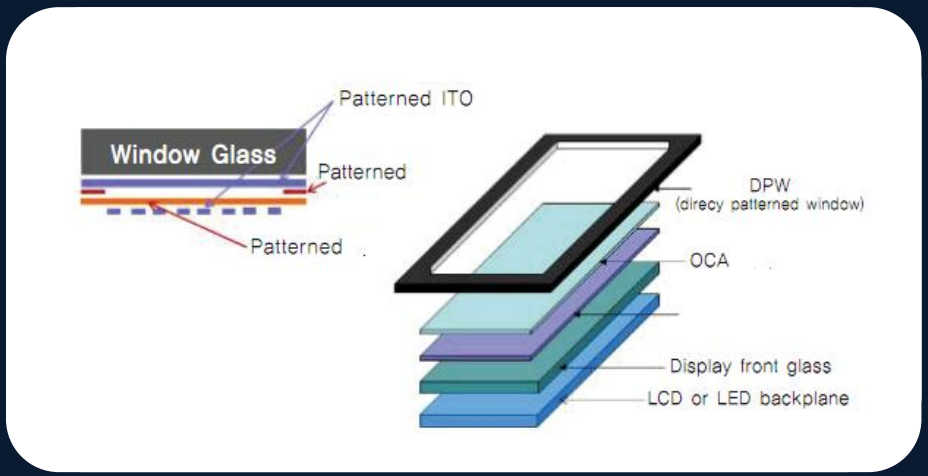
Source: DisplaySearch

- Becoming consumer “expectation” for most mobile devices
- Multi-touch becoming mainstream

Capacitive Touch Panel Technologies



Source: Semiconductor Insight, Dec 2010



Source: Semiconductor Insight, Dec 2010

- Many ways to make capacitive touch
- Most require 4~5 PVD layers
  - PVD on glass or film
  - CVD insulator for some on-cell types
- Delivering $150M SAM in 2011

Display Product Landscape

Major End Products	Core Applications	Applied Materials Products	
TV, Monitor & Notebook, Mobile phone	CVD Array	PECVD	
	Array Test	EBT	
	PVD Array	PiVot	
	PVD Color Filter	NAR CF	
Tablet, Smart phone, Other high-performance mobile	+ LTPS	KPX CVD	
	+ Touch	NAR TP PVD	
		SmartWeb	

Core TFT-LCD Equipment

Adapting

New Equipment Segments

Expanding portfolio to seven products to grow in new segments

Summary

- New mobile requirements driving adoption of high-performance LCD, OLED, and Touch
- LTPS backplane enables high-resolution LCD and OLED
  - Expect surging investment starting in 2011
  - Higher equipment intensity, with more than 2x PECVD SAM
- Capacitive multi-touch preferred solution for mobility apps.
  - Applied SAM increased by ~4-5 deposition layers per display
- Applied leveraging core equipment technology into new mobility segments

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