

G53MDP

Mobile Device Programming

Lecture 15 – Touch Technology

Touch Technologies

- Inaccurate response
- Image quality affected by touching components
- Single touch with physical pressure



First phone with touch screen¹
(IBM simon, 1992)

- Natural interactions
- Customised input options
- Maximised screen size
- Rich gesture interactions



First iphone² with virtual keyboard & multi-touch 2007

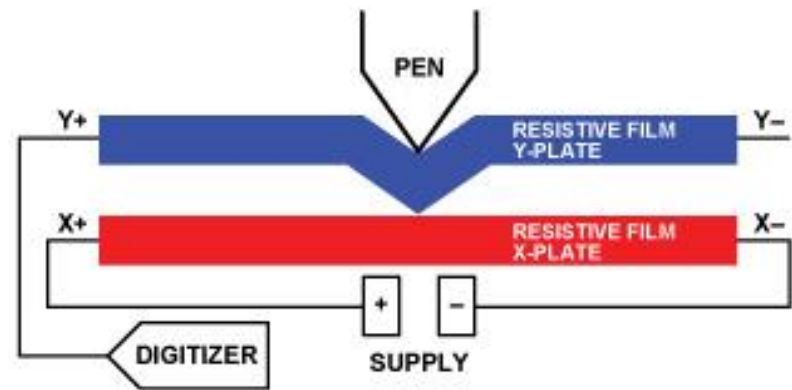
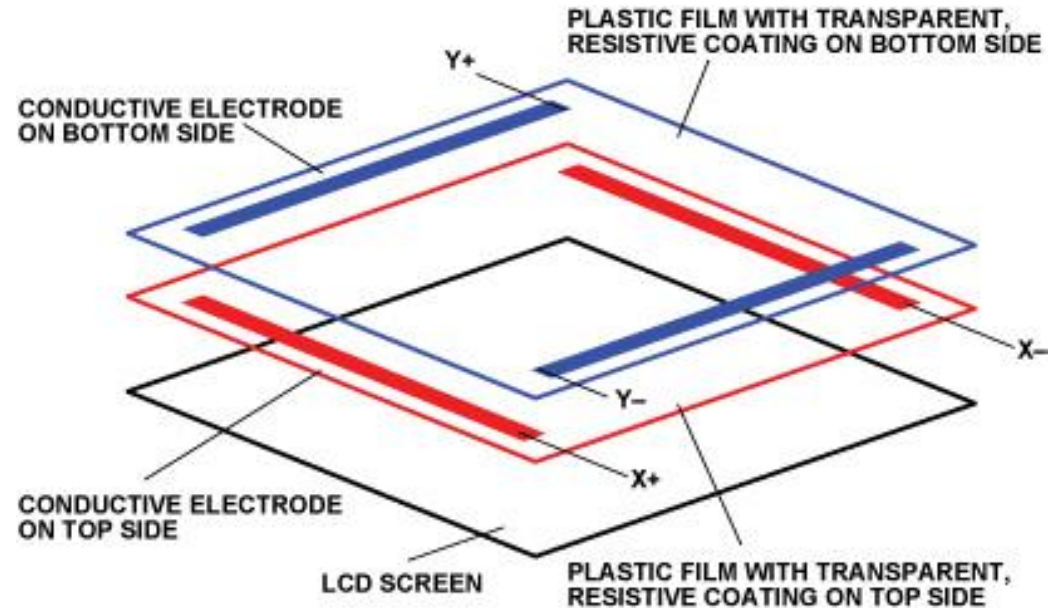
1. <http://home.bt.com/tech-gadgets/phones-tablets/the-ibm-simon-the-first-smartphone-11363997537456>
2. <https://www.technobuffalo.com/2016/06/29/original-iphone-9-years-old-specs-photos/>

Learning Outcomes

- Gain knowledge about working principles of touch screens
 - Resistive
 - Capacitive
- Aware of touch related UI design

Working Principle of Resistive Touch Screen

- Two sheets of transparent layer with metallic (resistive) coating facing each other
- Four wires connection
- Excite alternate axes with voltage
- Touch acts as voltage divider for coordinate estimation



Resistive Touch Screen

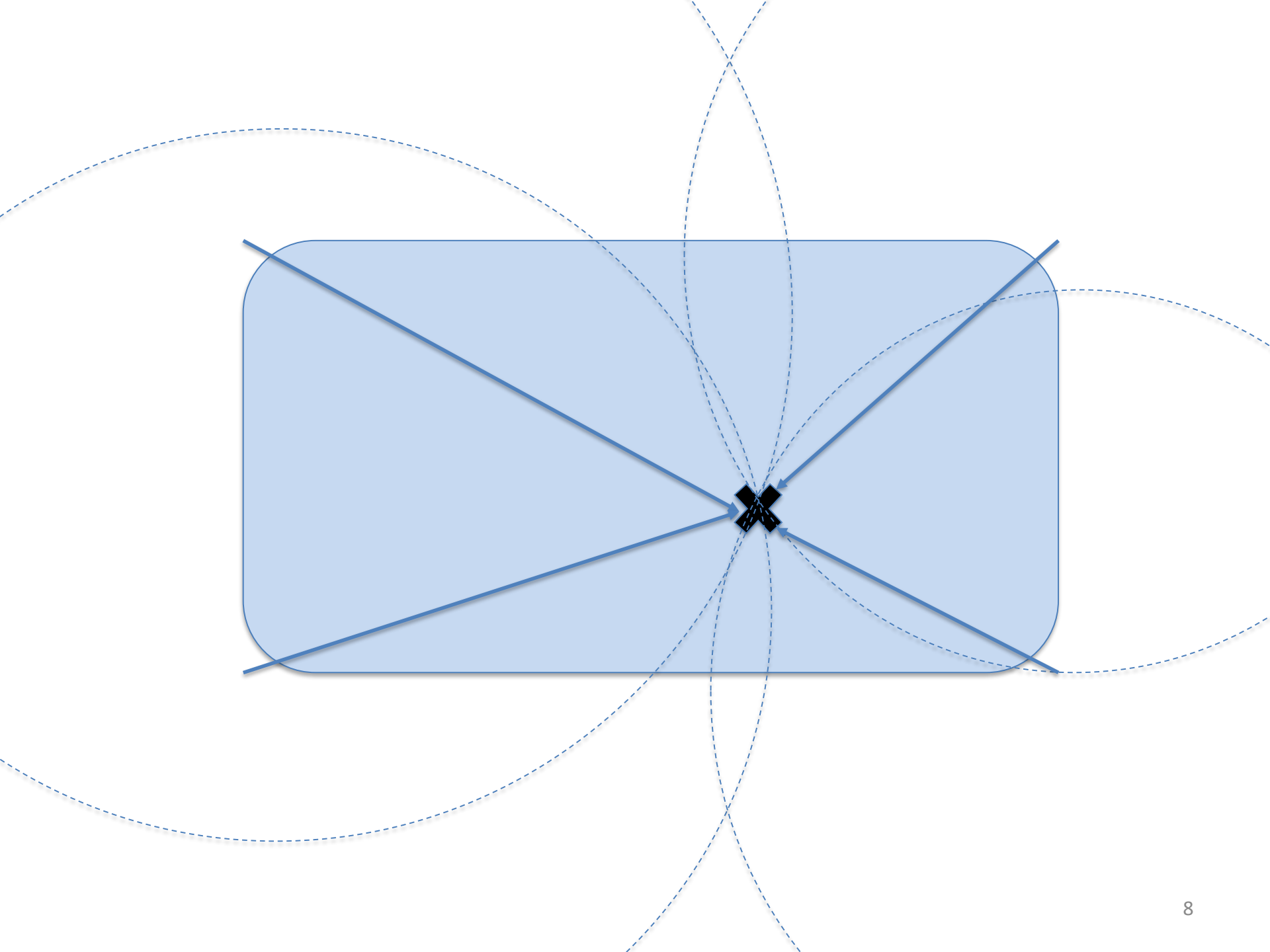
- Used with finger or any pointing device (passive)
- Requires certain amount of pressure (good or bad?)
- Difficult, but can be altered for multi-touch (only two-points touch)

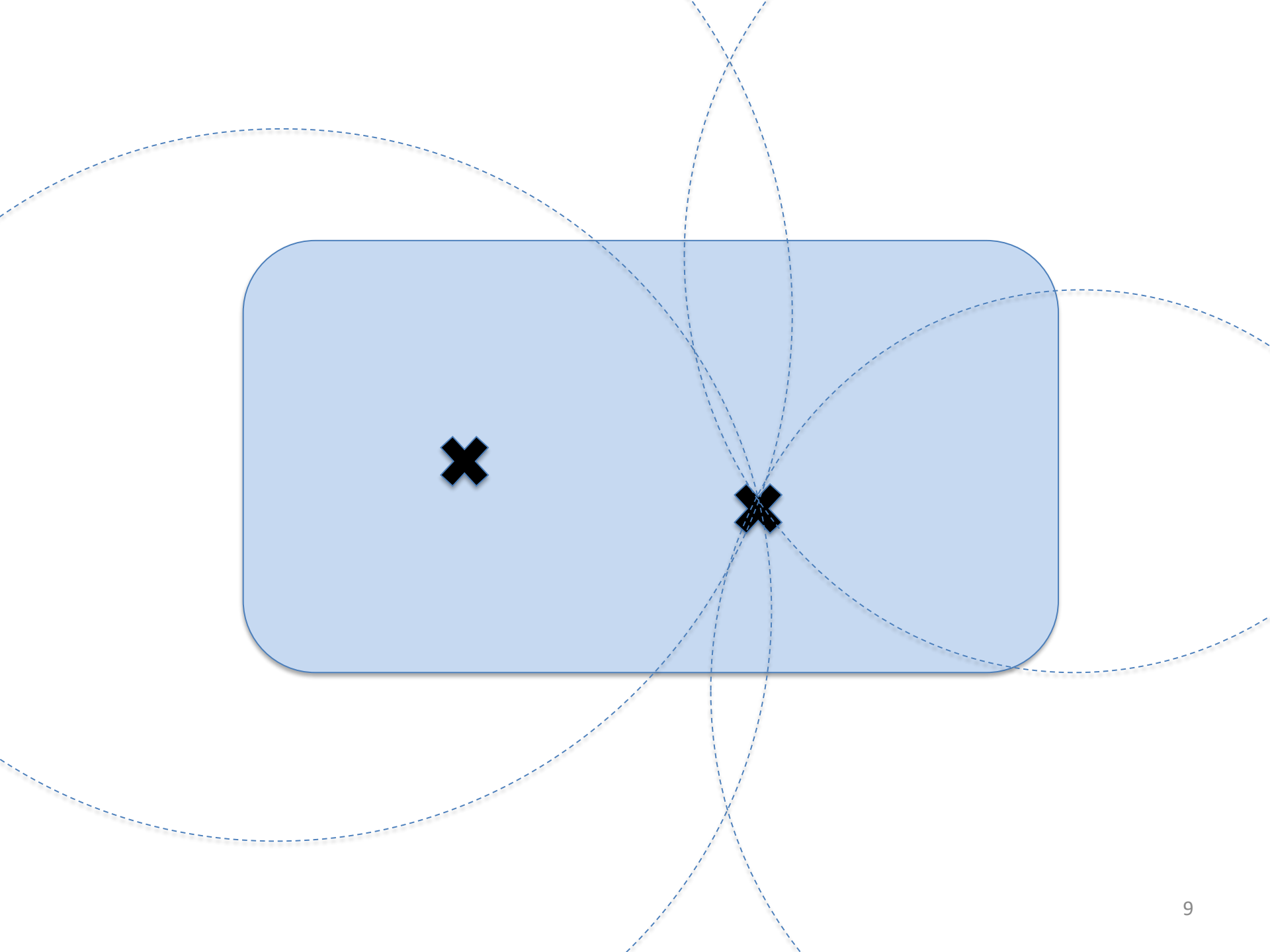
Capacitive Touch Screen

- Screen is covered in a capacitive material: Indium-tin-oxide (conductive, optically 90% transparent)
- Capacitance = ability to store electric charge (Works through glass)
- Human beings act as small capacitors
- Touching the screen modifies its electrostatic field

Surface Capacitance

- Cover the screen with a uniform conductive material
- Apply a small voltage to generate an electrostatic field
 - Touching with a finger creates a dynamic capacitor
- Measure effective capacitance at each corner of the screen
 - The larger the change, the closer to the corner the touch is
 - Combine measurements from all corners = location of the touch

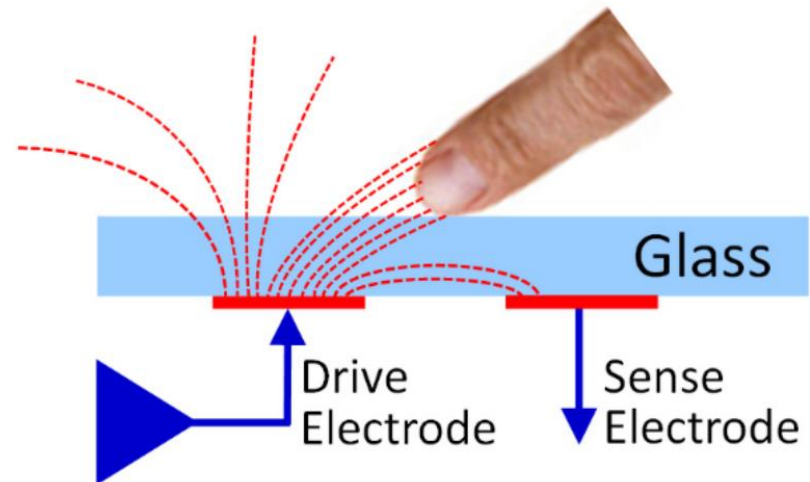
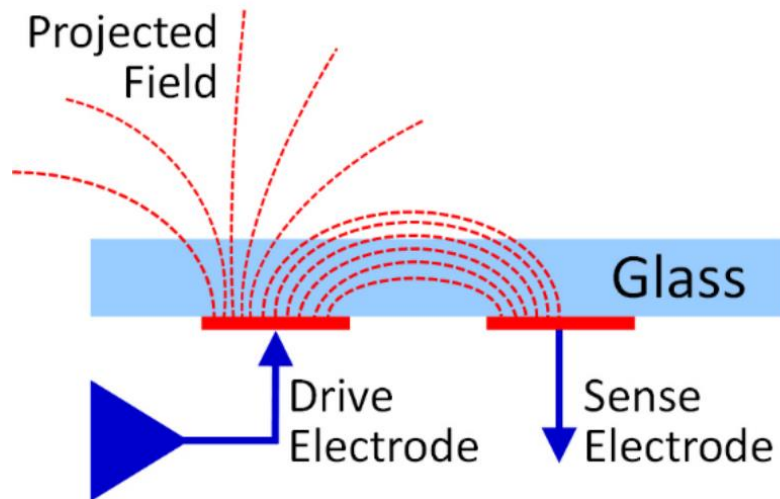
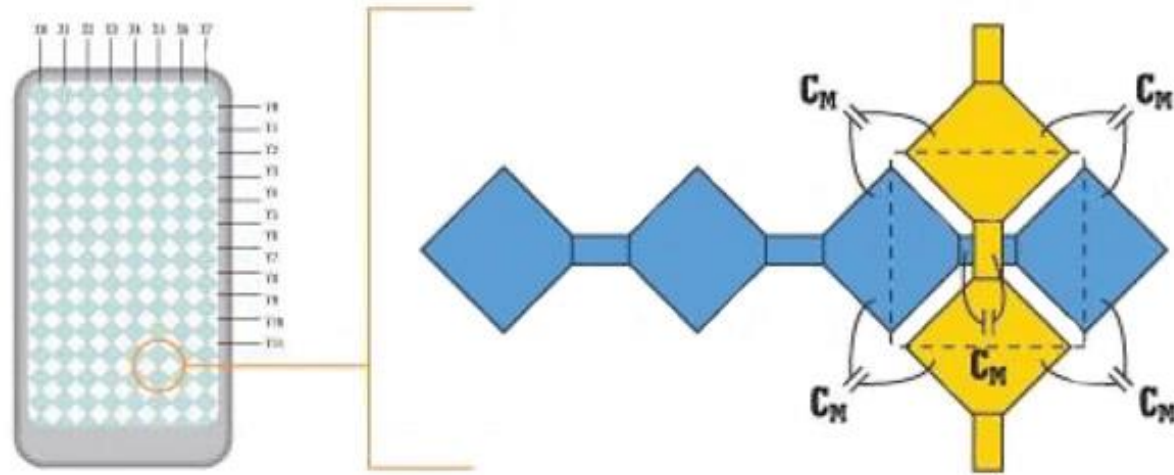




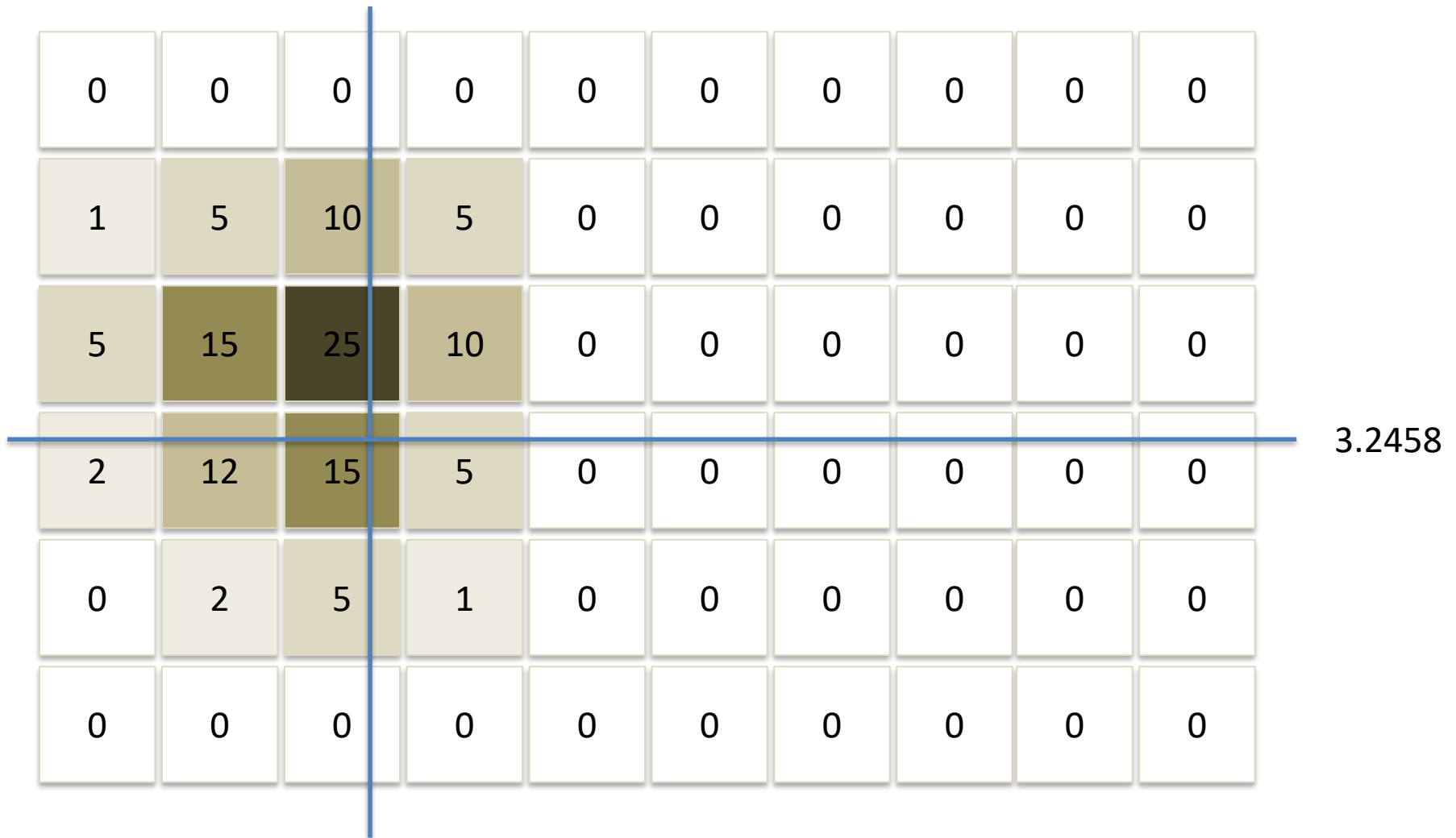
Projected (Mutual) Capacitance

- Conductive material is etched with rows / columns
- An electronic field is projected through the top layer of glass
- An electrostatic field is created
- Human acts as a conductor
- Decrease of capacitance between electrodes is detected during touch
- Measure capacitance at each electrode grid point
 - What resolution of touch should we have?
 - Original iPhone $10 \times 15 = 150$ “points”
 - 5mm x 5mm diamond grid

Working Principle of Projected Capacitance

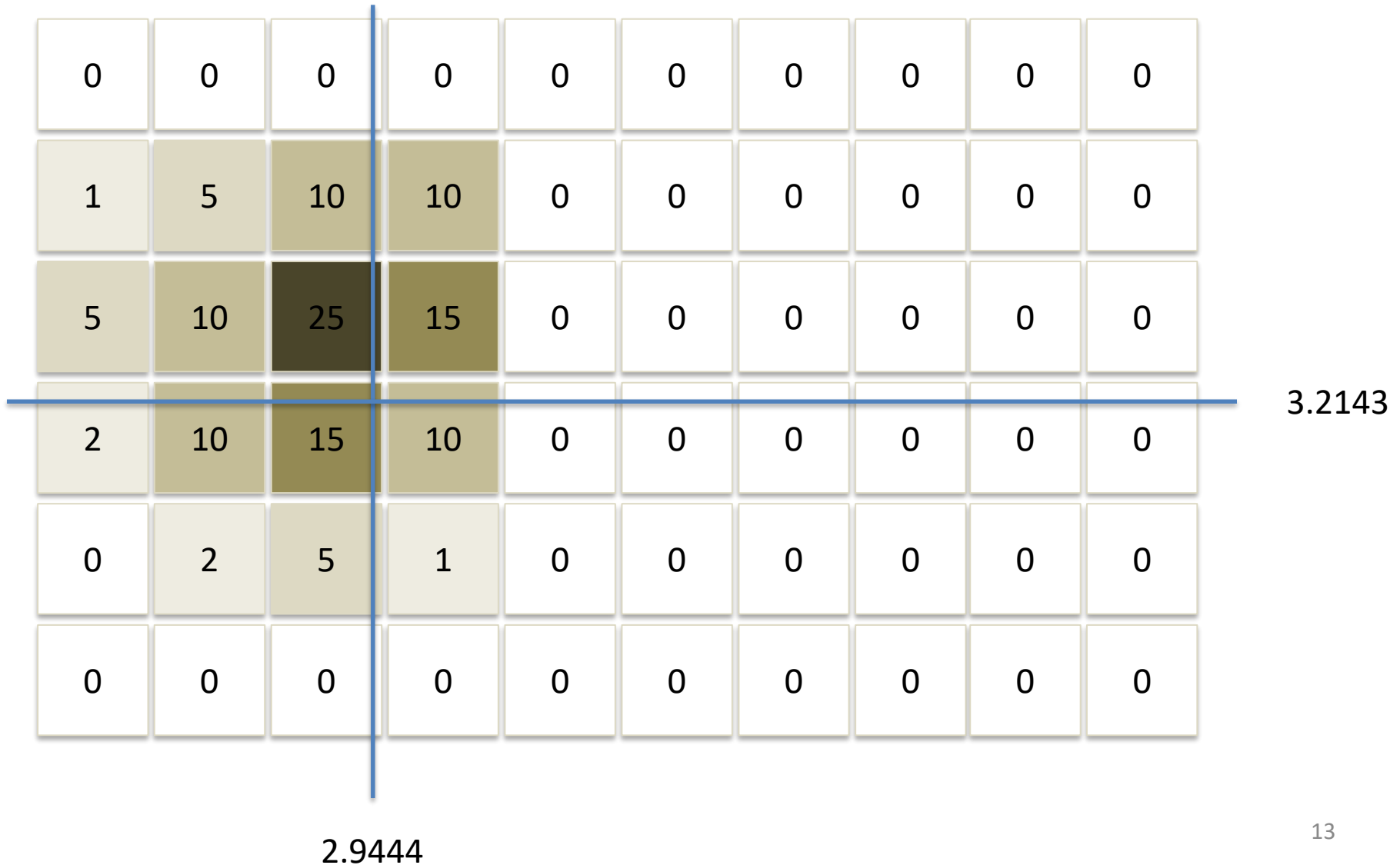


Higher Touch Resolution

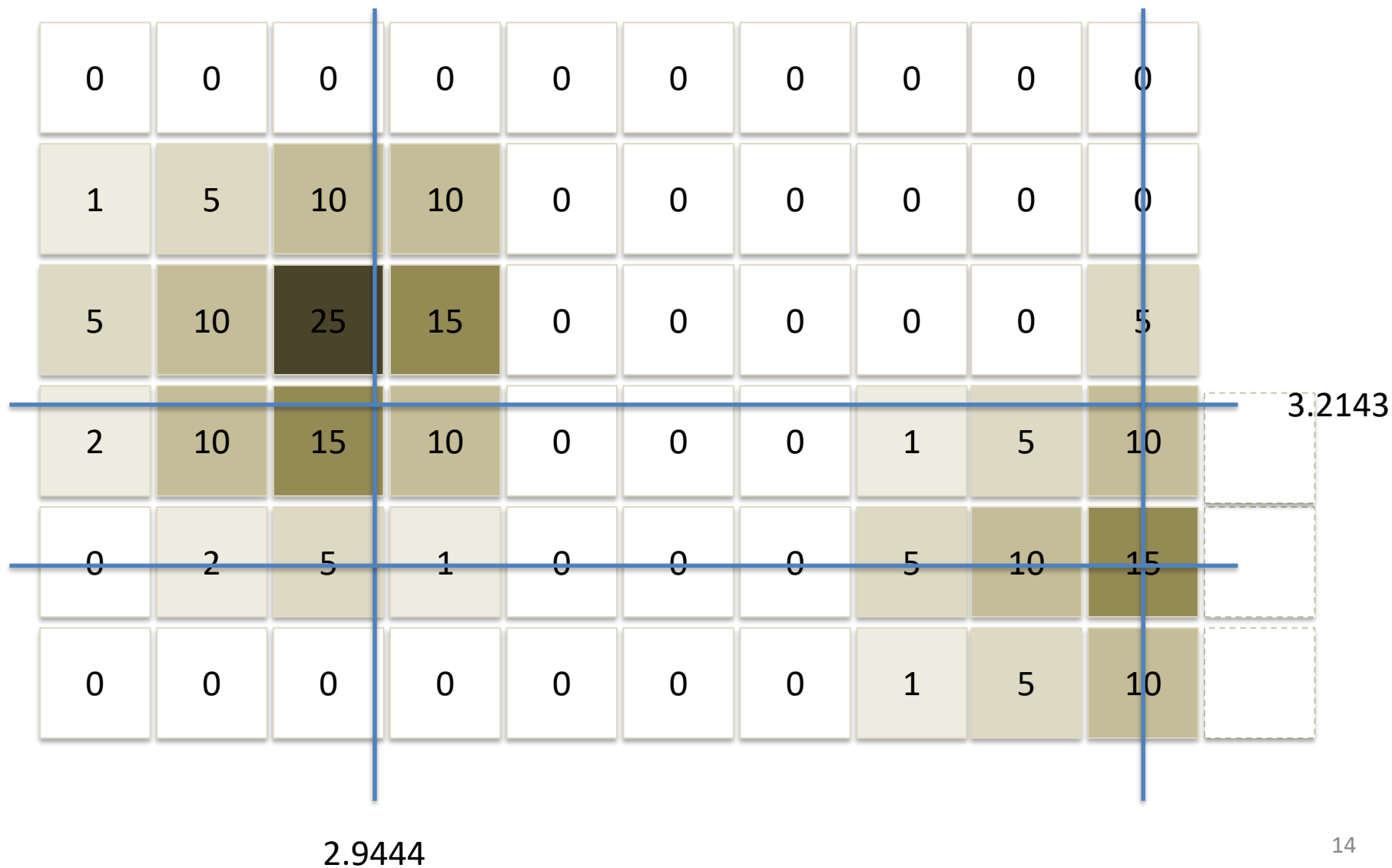


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Higher Touch Resolution



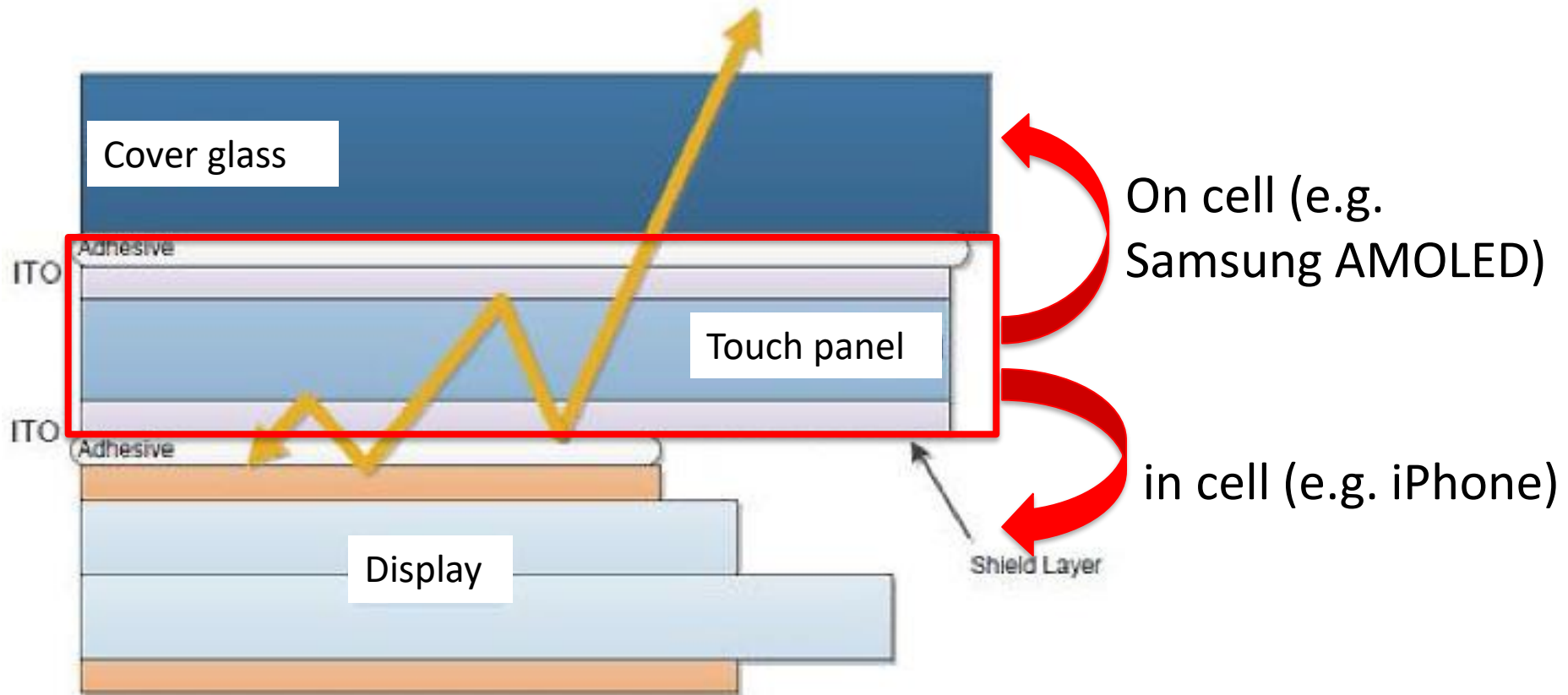
Multi-Touch



Projected Capacitance

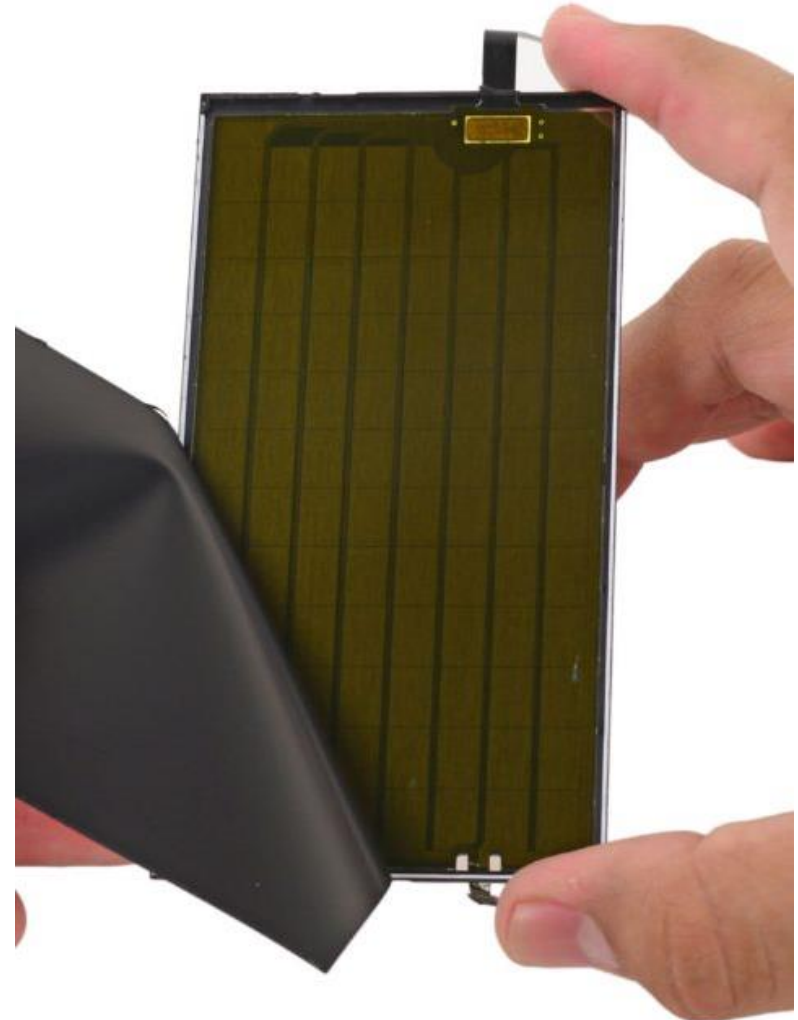
- More accurate / multi-touch
- Sensing requires an “active” touch
 - Non-conductive materials will not change the electrostatic field
 - Fingers / capacitive glove / capacitive stylus
- State-of-art technique for smart phone, tablets.
- Can be manufactured to the top glass layer (on-cell) or the display layer (in-cell)

In-cell vs. on-cell



iPhone 6s with “3d touch”

- Pressure sensitive touch
 - i.e. light press vs hard press
- Layers
 - A flat parallel plate capacitor
 - Backlight
 - Display
 - Touch screen “digitizer”
 - Flexible glass
- Pressing forces the finger closer to the rear capacitor
 - Measures depth, not location
 - Responds with a haptic event

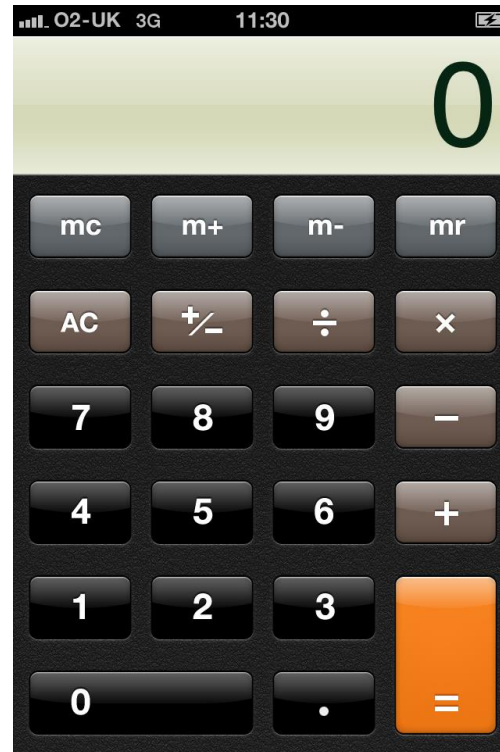


Touch and the UI

- Touch relies on finger contact with the display
 - This has to alter the way we design our displays
- Size of the finger sets the properties of the UI, not the size of a display
 - The size of 'buttons' must be big enough that the user can touch them
 - Ditto the spacing between them
 - Average index finger width is 16-20 mm, thumb is 25mm. 47- 57 pixels on an average device.

Tips for UI Design

- Make the button bigger
- Haptic or lasting visual feedback
- Best use of space (e.g. full screen width button)
- Break tasks into small & discrete Activities



UI Compatibility for Different Devices

- Things are slightly more complicated on Android
 - Display size, shape and resolution varies from device to device
 - Best use of portrait and landscape
 - A button that is the right size on one device would be too small/large on another

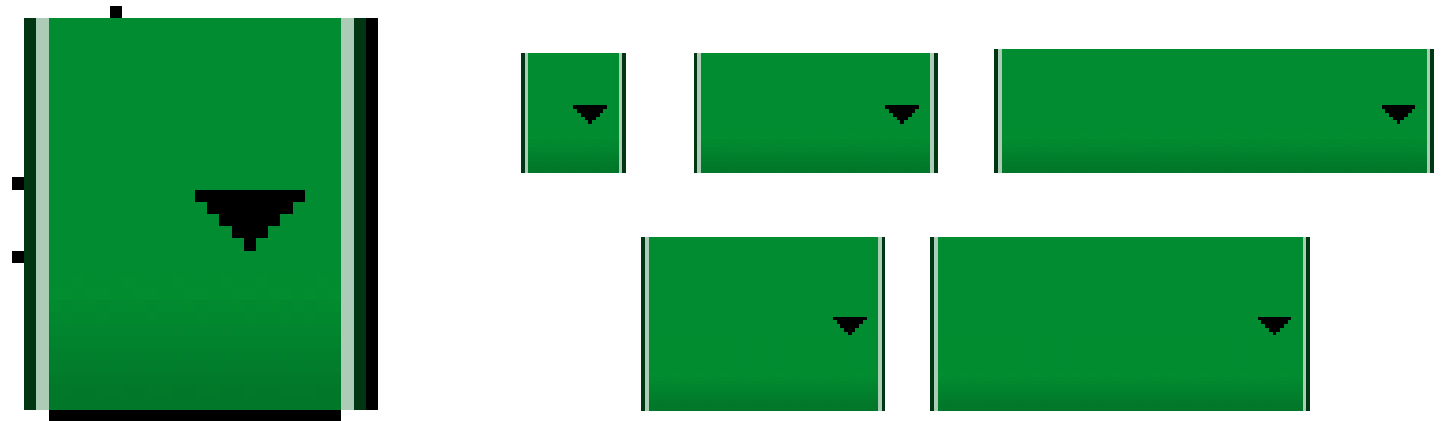
Designing for Multiple Screens

- Use "wrap_content" and "match_parent"
- Use RelativeLayout



Designing for Multiple Screens

- Use Layout Aliases (different layout for different screen size)
- Use Orientation Qualifiers (different layout for portrait & landscape)
- Use Nine-patch Bitmaps



Supporting Different Screen Densities

- Use density-independent pixels (DP), never use pixels for layout
- Use scale-independent pixels (SP) for texts
- Provide alternative bitmaps for different screen resolutions (put in res/drawable-xhdpi; drawable-hdpi; drawable-mdpi; drawable-ldpi)

References

- <https://developer.android.com/training/permissions/requesting.html>
- <https://www.ifixit.com/Teardown/iPhone+6s+Display+Teardown/49951>
- <https://developer.android.com/training/best-ui.html>