TOUCH INTERNATIONAL

TOUCH INTERNATIONAL

DECODING TOUCH TECHNOLOGY:

An Insider's Guide to Choosing the Right Touch for Your Display

Gary L. Barrett, Chief Technology Officer at Touch International
Jamie Sewell, Touch International

Graphics By:
Kelly Leff, Touch International

DECIDING ON THE RIGHT TOUCH TECHNOLOGY CAN BE CHALLENGING FOR EVEN THE SEASONED TECHNOLOGY GURU.

With over 1,200 touch-related patents in existence, it is easy to become confused about which touch technology to choose to integrate into a new product.

When choosing a touch screen, it is important to first carefully evaluate the needs of your product and the environment of the display. Once your key requirements have been identified, it becomes much easier to weigh the advantages and disadvantages of each technology to find the touch screen that is right for your application.

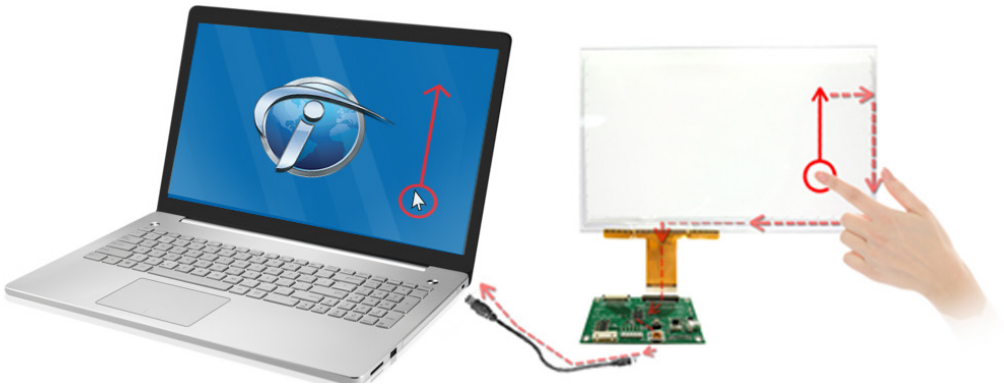
In this guide, we will cover some of the basic characteristics of touch, and then examine the ten most popular technologies to help shed light on why there is a need for so many types of touch.

WHAT IS TOUCH?

In the simplest of terms, touch is defined as "to come into or be in contact with something." An example of this is when a hand, finger, stylus, etc. comes in close proximity or contact with an add-on touch sensor (most common) or the display itself. Some "touch" technologies do not actually require the user to make contact with a surface, but are, nevertheless, still considered touch technology.

HOW IS A TOUCH RECOGNIZED?

When a touch is initiated, a Cartesian coordinate (X, Y and sometimes Z) is generated within the touch controller. When the touch system is married to a computer operating system, such as Windows or Linux, the X, Y coordinates are converted to mouse moves (up, down, right, and left "mickeys"). The difference between a mouse and a touch screen is the difference between relative and absolute. A mouse moves the cursor on the screen up and down, right and left, and it does not matter where the mouse is on the desk (or cursor control pad on the laptop). A touch screen moves the cursor to a place under the touch point - this the absolute mode. To move the cursor to the touch point, the software driver looks into the video RAM to see where the cursor is on the screen. It then looks at the coordinates from the touch point, and issues the number of mickeys needed to move the cursor from where it is on the screen to where it should be under the touch. For more on this process, please see Touch International's whitepaper **Putting the "Touch" in Multi-Touch.**



WHAT IS MULTI-TOUCH?

Exactly as the name implies, the term multi-touch refers to the ability to simultaneously register more than one touch at the same time. One of the most common multi-touch features is the ability to use gestures. The most common gestures are the same features that you'll find on your smart phone or tablet: pinch, expand and rotate. When using multi-touch, a driver is written to recognize specific gesturing functions and relay them to the software to act upon.

There is a bit of a debate within the touch community about redefining the term multi-touch. For a system to be classified as "multi-touch", the coordinates must be absolute, meaning there must be two or more specific coordinates. All of the technologies covered below, excluding surface capacitive and analog resistive, are capable of doing gestures (this is controller dependent); however gestures do not require true multi-touch capabilities, as it can rely on what we call "ghosting". For more on the topic of multi-touch and a better explanation of ghosting, please see Touch International's whitepaper Putting the "Touch" in Multi-Touch. The most commonly used multi-touch capable technologies are projected capacitive, multi-touch analog resistive and optical touch, all of which are discussed in more detail below.

WHERE CAN I FIND TOUCH?

Whether it is the credit card terminal at the grocery store, the ticket kiosk at the local movie theater or the mobile phone in your pocket, the use of touch is making its way into virtually every environment and is here to stay. It may be augmented by motion and voice, but until we develop a direct telepathic link to the machine, touch will be present.

Until the recent introduction of gestures, touch was introduced whenever it was found that it could complete a task three times faster than using a keyboard (point of sale terminal in a restaurant), or where the device could instruct the casual user on a complicated device (medical instrument), or where pen input for writing was needed (PDA). Gestures have added the first new use for touch in several years.

WHAT FACTORS AFFECT THE DISPLAY?

Once you begin taking steps to put a touch product into production, you must consider the factors below to identify which touch technologies will be good for your application, as well as the ones to avoid:

- ***Size*** *– What size does your application require?*
- ***Capabilities*** *– What type of functionality is needed?*
- ***Input Method*** *– Finger, Stylus, Glove?*
- ***Number of Points*** *– Single-Touch, Dual-Touch, Multi-Touch?*
- ***Environment*** *– What conditions will it be subjected to?*
- ***Durability*** *– How long does it need to last?*
- ***Complexity*** *– Does my project need a standard display or custom design?*
- ***Regulatory Restrictions*** *– Are there any industry regulations I need to consider?*
- ***Availability*** *– Will it be available in the future if I need replacements?*
- ***Cost*** *– What is my budget for adding touch to this product?*
- ***Power Consumption*** *- How critical is a few milli-watts of power?*

Once you've answered these questions, you will be better prepared to identify touch technologies that fit within your requirements. It is important to keep in mind that there is no such thing as a perfect touch solution. While the goal of every manufacturer is to produce indestructible touch screens that last forever, have perfect optical clarity, are immune to interference, and cost nothing, the reality is that each technology has strengths and weaknesses, so it is important to explore all options and make an educated choice based on your requirements.

WHAT ARE MY OPTIONS?

Before diving in head first, let's take a look at the market as a whole. What does the big picture look like? What technologies are mature and market-proven, and which ones are still emerging? There are many touch technologies in the market; however most have proven to be niche products, too expensive, not reliable or difficult to produce. Below is a summary of the top touch technologies, with projected capacitive and analog resistive making up 90% of the total market share.

TOP FIVE TOUCH TECHNOLOGIES IN THE MARKET TODAY

⬢ Projected Capacitive	▲ [Increasing Market Share]
⬢ Analog Resistive	— [Flat Market Share]
⬢ Surface Capacitive	▼ [Decreasing Market Share]
⬢ Infra-red (IR Touch)	— [Flat Market Share]
⬢ Surface Acoustic Wave (SAW)	▼ [Decreasing Market Share]

Additional Touch Technologies:

- *Optical Touch*
- *Multi-Touch Analog Resistive (AMR or MARS)*
- *Dispersive Signal (DST or Bending Wave)*
- *In-Cell/On-Cell Touch*
- *Acoustic Pulse Recognition (APR)*

Below is a breakdown each of these technologies. By analyzing the pros and cons of each, you will be able to narrow your options by matching up your requirements with the technologies' capabilities and limitations. An important caveat to the information below is that improvements in the touch field are happening very quickly and soon some of this will be inaccurate.

PROJECTED CAPACITIVE

Advantages	Limitations
Long Life Span	Doesn't Work with All Glove or Stylus Inputs
Excellent Optical Properties	Sizes Larger than 22" are Expensive to Build
Multi-Touch	Systems Must be Initially Tuned
Highly Reliable & Durable	Can be Affected by EMI & Emit EMI
Operates in Environmental Extremes	Can be Difficult to Integrate
No Recalibration Needed	
Low Power Consumption	

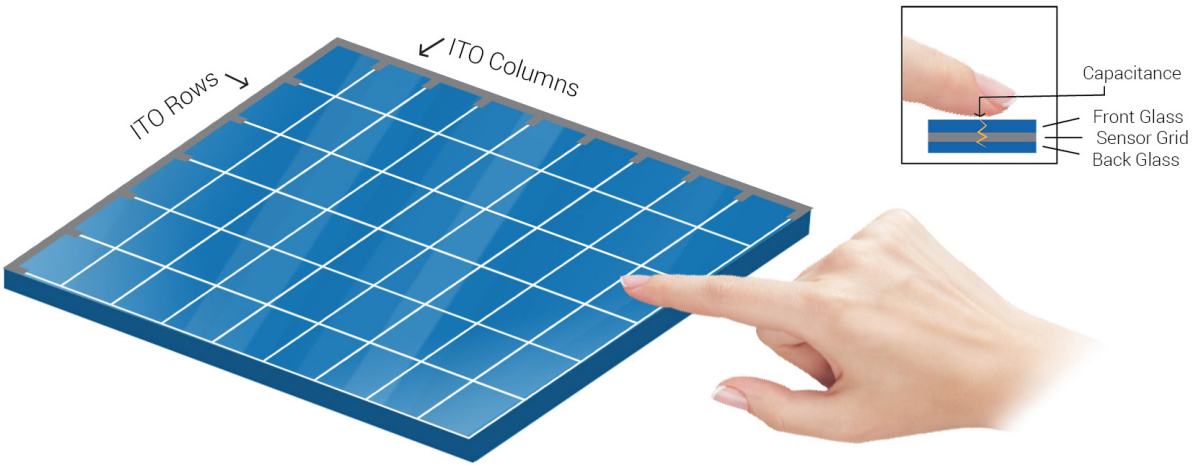
Since the release of the iPhone in 2007, the demand for projected capacitive (also called p-cap, pro cap, or PCT) has seen steady growth, especially in mobile devices, and is now the most popular technology for today's touch products.

Top 3 Reasons to Choose Projected Capacitive:

- ***It will never wear out (potentially) -*** *The ITO layer (conductive coating) of the sensor cannot move and is well protected, giving the sensor the potential to last forever. The display will likely wear out before the touch screen.*
- ***Superior image quality -*** *Second only to infra-red touch (which has nothing in front of the LCD), projected capacitive offers the best image clarity and light transmission.*
- ***Multi-Touch -*** *The number of input points the touch screen can recognize is potentially unlimited, but is dependent upon the controller to relay those points back to the computer; ten input points is typical.*

Additional Benefits & Capabilities

- *Ultimate design flexibility. Projected capacitive is typically available in a standard all-glass design, but film-glass and all-plastic configurations are also available.*
- *All-plastic versions can be made with a flexible construction to fit curved surfaces, and are virtually unbreakable and very light weight.*
- *Touch point accuracy is very high and drift free, with no recalibration needed.*
- *Proximity sensing is possible up to 6cm (typical) from the display.*
- *It can work with water spray and on-screen contaminants.*
- *Works with varying thicknesses of cover glass, allowing for a flush front (seamless) finish like one would see on the iPhone, or behind the very thick glass of a store front window.*
- *There are many vendors for reliable projected capacitive electronics.*



How it Works

In the short time since the introduction of projected capacitive touch screens in the iPhone, a myriad of construction methods have been developed. All projected capacitive touch screen designs have two key features in common - the sensing mechanism (ITO layer) that lies behind the touch surface and the use of no moving parts.

Mutual capacitance is now the more common projected capacitive approach and makes use of the fact that most conductive objects are able to hold a charge if they are very close together. If another conductive object, in this case a finger, bridges the gap, the charge field is interrupted and detected by the microcontroller.

Projected Capacitive touch screens are “scanned”, meaning that most of these touch screens are made up of a matrix of rows and columns that are “read” one by one to get a reading or count. To get an exact coordinate, the results from several row/column intersections are read and the counts used to triangulate the exact touch location. The illustration above shows the rows and columns made by the ITO and a very basic stack-up design with the ITO layer protected by glass on both sides.

ANALOG RESISTIVE

Advantages	Limitations
Low Cost Solution	Not as Durable as Other Technologies
Lowest Power Consumption	Requires Periodic Recalibration
Unaffected by Dirt, Water, Light & Most EMI Noise	Lower Transmittance & Optical Quality
Works with Finger, Glove & Any Pointing Device	Not True Multi-Touch Capable
Easy to Integrate	

For twenty years, analog resistive reigned supreme, but fell to the #2 spot in 2010 when it was unseated by projected capacitive. At one point in time it could even be said that there were more analog resistive touch screens manufactured in one day, than all other touch technologies combined in one year.

Even though projected capacitive has replaced it as the most widely produced technology, resistive still has an important place in today's market and should not be overlooked.

Top 3 Reasons to Choose Analog Resistive

- ***Pressure Sensitive -*** *Virtually any object can be used to activate the sensor, including a finger, pencil, tool, or glove, making it ideal for applications requiring full input flexibility.*
- ***Low Cost -*** *Overall system prices for resistive are traditionally inexpensive because materials and equipment costs are low and there are many suppliers.*
- ***Lowest Power Consumption -*** *Resistive systems consume a very small amount of electricity because power is only consumed when the sensor is actually being touched, making it a good choice for battery powered units.*

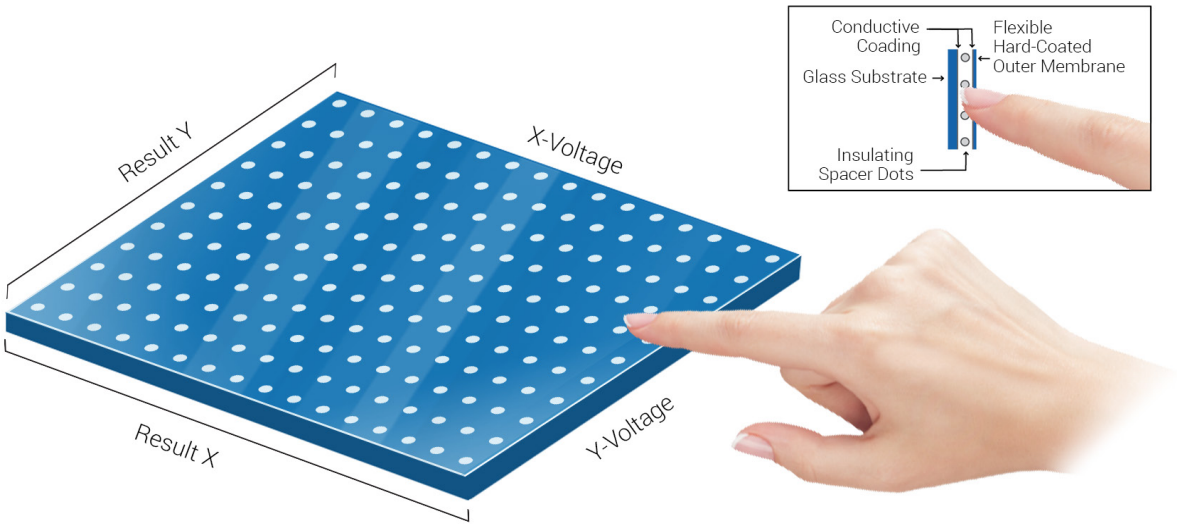
Additional Benefits & Capabilities

- *In some applications, the purchase of additional electronic components may not be needed because many ASICS (application-specific integrated circuit), including LCD ASICS, often include a touch screen controller as part of its circuitry.*
- *The resolution of the sensor is very good so it can adapt well to written input, making it a logical choice for many writing or character recognition applications.*
- *Highest coordinate (touch) output of any technology, which can exceed 300 frames a second.*

How it Works

There are five types of resistive technology defined by the signal lines and include 3-wire, 4-wire, 5-wire, 6-wire and 8-wire touch screens. Today we most commonly build 4-wire (lowest cost) and 5-wire (most durable). Generally, all resistive touch screens consist of a glass layer with an ITO conductive coating on top and a polyester top sheet with a conductive coating on the bottom. The conductive surfaces are held apart by “spacer dots” - usually glass beads that are silk-screened onto the coated glass. In the case of 5-wire, a toggled voltage is applied to the 4 corners of the glass layer, and when a person presses on the top sheet, its conductive side comes in contact with the conductive side of the glass, effectively closing a circuit (this is called pressure sensing). The voltage at the point of contact is read from a wire connected to the top sheet, which is the fifth-wire.

The image below represents a basic illustration of how this technology works.



Reference: *http://www.cnintech.com/blog/Interactive-Whiteboard_2015072401.html*

For 4-wire, the glass layer has two conducive buss bars on either side of glass layers, and on the top, two conductive traces perpendicular to the two on the below. A plus voltage, and opposite side ground are put first on the ITO glass layer, which has a uniform resistance between the buss bars. The voltage is read at the point where the top layer pushes to the bottom, passed through an analog-to-digital converter to get the X coordinate. Then the voltage is applied to the top layer and read back by the bottom layer to get the Y coordinate. This toggling is repeated more than 100 times a second to get very fast, high resolution coordinates.

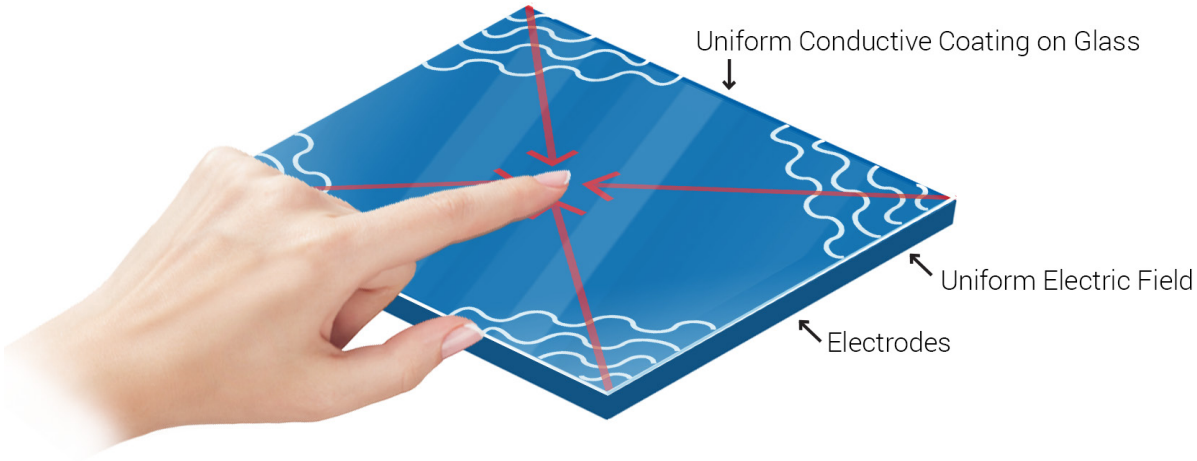
The durability issue comes from the flexing and rubbing of the ITO which breaks or wears out the ITO, which is only a few angstroms thick. In addition, the multiple air gaps are reflective which reduces the light transmission and degrades the image.

SURFACE CAPACITIVE TOUCH TECHNOLOGY

Advantages	Limitations
Low Cost	Limited to Finger Input Only
Replacement for Legacy Applications (Primarily Gaming)	Wears Out with Heavy Use
Unaffected by Many Environmental Factors	Single Touch, No Gesturing
	Requires Periodic Recalibration

Surface Capacitive (s-cap, surface cap) is a declining technology and is now mostly used in legacy gaming and amusement machines. One thing that surface capacitive still has going for it is that its optics are just as good as projected capacitive and the sensor dimensions can be larger. For example, Touch International offers a 42 inch surface capacitive sensor for a gaming table application. The information kiosk business, including ticketing systems, is shared equally with infra-red touch.

Unfortunately for this technology, the drawbacks outweigh the benefits. This is mainly due to its inability to take heavy use, lack of true multi-touch capability, limited suppliers, and design flexibility limitations due to manufacturing methods used.



How it Works

The surface capacitive touch screen has a conductive coating on the front surface with wires connected to each corner. A small voltage is applied to each of these 4 corners. The operation relies on the capacitance of the human body. When the screen is touched, a small current flows to the point of input, causing a voltage drop which is sensed at the 4 corners. The reason this technology wears out with heavy use is because the conductive coating is on the outer area of the glass; as the screen is continually touched, this coating will eventually wear off, causing the screen to no longer work.

INFRA-RED TOUCH TECHNOLOGY (IR)

Advantages	Limitations
Long Life	Limitations on Integration with the Display
Stable Drift-Free Operation	Vulnerable to Surface Contaminants & Water
Works with Finger, Glove & Any Pointing Device	High Cost
High Transmission & Optical Clarity	Low Resolution
Adapted to Large Format LCD's	

Infra-red touch is one of the oldest touch technologies and remains a survivor. Today it can be found in public access kiosks, point-of-sale terminals, and big displays. Here are the advantages:

Top 4 Reasons to Choose IR

- ***Best Optics -*** *With nothing needed in front of the display, there is nothing to degrade the optics. Keep in mind, however, a transparent window is typically put in front of the display to protect it from damage.*
- ***Large Format Available -*** *It has been adapted to very large (62 inch) displays and has found its current niche in this domain.*
- ***Input Options -*** *It will respond to any probe… pencil, glove or tool; however very thin input devices may not work because it needs to have a large enough point to interrupt the light signal.*
- ***Muti-Touch -*** *Recent improvements to IR sensing technology have introduced true multi-touch to this technology; however this application requires a lot of computing power and sophisticated software.*

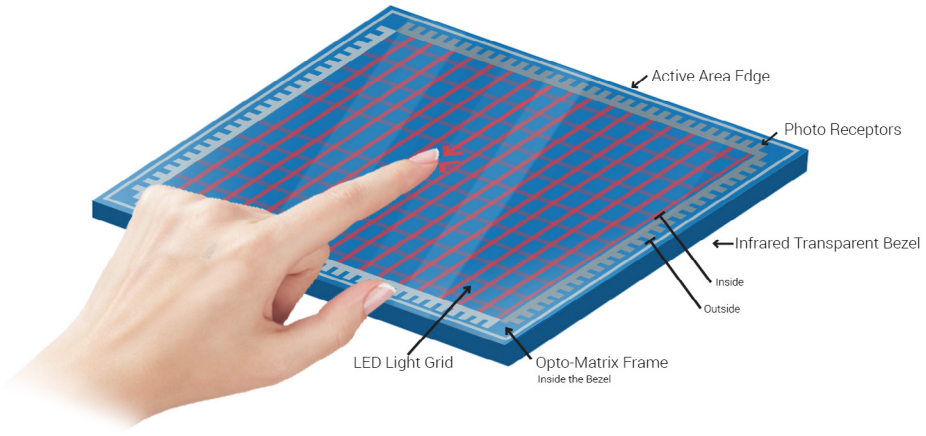
Additional Benefits & Capabilities

- *Until the advent of projected capacitive touch, IR was the longest lasting of the touch technologies and is also chosen for its durability.*
- *Although costly, it may be one of the best technologies for night-vision applications.*

How it Works

IR uses a Printed Circuit Board (PCB) “frame” around the perimeter of the display. On two sides there are closely spaced IR LEDs - the opposing two sides have matching photo transistors. The LEDs are turned on in sequence and the signal is read from the photo transistor to the matching transistor. If no signal is read, then that indicates a blocked IR beam, meaning a touch. No actual touch “screen” is required for operation; however a plate of glass is generally used to protect the underlying display from damage and to provide anti-glare properties.

Problems, mostly solved, include sunlight making the IR pulse unreadable, objects such as gum, water, bugs and accumulated dust blocking the beams.



Reference: *http://informationdisplay.org/id-archive/2009/december/frontline-technology-high-volume-manufacturing-of*

SURFACE ACOUSTIC WAVE (SAW)

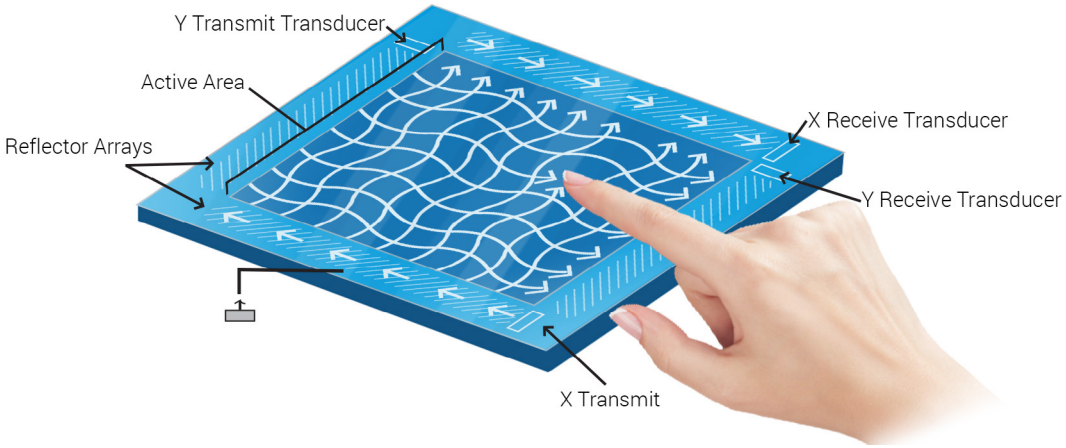
Advantages	Limitations
High Transmission & Optical Clarity	Will not Work with Hard or Rigid Probe, Fingernails, Pens
Durable Glass Construction	Vulnerable to Surface Contaminants & Water
Activated by Finger, Glove or Soft Stylus	Requires Periodic Recalibration
Stable Drift-Free Operation	Sizes Larger than 30" are Expensive to Build
Pressure Sensitive Touch	Doesn't Support Draw or Draw Effectively
	Not True Multi-Touch Capable

The first to be able to compete with the original big three (analog resistive, infra-red and surface capacitive), surface acoustic wave offers superior optics and durability.

Top 3 Reasons to Choose SAW

- ***Durability -*** *Boasts a scratch-resistant glass construction and will continue to work if scratched. It will, however, wear out because of the life of the acoustic actuators.*
- ***Superior Optics -*** *Pure-glass constructions allows for a high image clarity, resolution and light transmission.*
- ***Pressure Sensitive -*** *Capable of recognizing the amount of pressure applied when touched.*

The demand for SAW technology is on the decline in today's market, mostly due to the fact that it offers few advantages over projected capacitive. The main reasons are that it does not "last forever" and is not multi-touch capable. It is also important to keep in mind that this technology is always sold as a kit (touch screen plus electronic controller) as there are very few vendors for this technology.



Reference: *http://www.accuview.com/cmspage.php?page_id=22*

How it Works

A SAW touch screen consists of a piece of glass with "sound wave reflectors" deposited along all four edges. Two emitting transducers are mounted in two corners and receivers are mounted in the opposing two corners. A sound wave travels parallel to the borders of the glass. As it encounters the sound wave reflectors, some of it is passed through to the next sound wave reflector, and some of it is reflected across the touch screen. On the opposite side, the wave is passed through the sound wave reflectors to the receivers. The receivers can detect a drop in amplitude of the sound wave when a sound absorbing material (such as a finger) is placed in contact with the glass. It is important to note that SAW will not work with a hard-tipped stylus – since it uses the absorption of sound waves to detect touch, SAW requires a soft-tipped stylus or finger input.

OPTICAL TOUCH

Advantages	Limitations
High Transmission & Optical Clarity	Susceptible to False Touches
High Transmission & Optical Clarity	Can be Affected by Direct Sunlight
Lower cost than IR	Primarily for Large Format (≥ 32")
High Accuracy	Not for Slim Designs
Works with Finger, Stylus or Light Pen	
Does Gesturing	

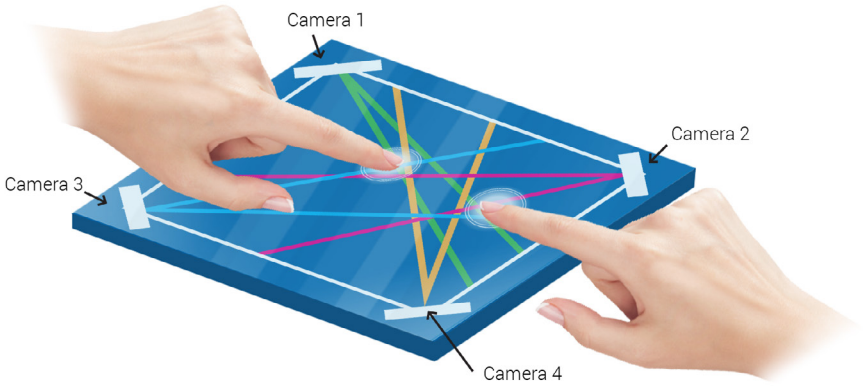
Optical touch is the name for the technology which uses two or more cameras mounted over the surface of the display, usually in the corners, and its sophisticated software performs the touch recognition. This technology is primarily used for displays 32 inches and larger, and especially for digital signage applications. Today, most large format displays use either IR or optical, which share most of the same advantages and disadvantages.

Optical touch had the potential to offer a lower cost than IR systems (which requires hundreds of pairs of IR emitters and IR receivers), but this was found to be true only if one could assume there would be enough ambient light to illuminate the probe so the cameras could "see" it. Whilst today most optical touch suppliers make this assumption, it means low light applications may not work. Also, difficulty in integrating the frame causes people to generally purchase an integrated display which will carry all of the overhead of a complete unit.

If your application requires a large display or something for digital signage, optical touch and IR are the most common choices. If your display is 32 inches or smaller, optical touch will likely not be the best option.

Top 3 Reasons to Choose Optical

- ***Highest Optical Clarity -*** *Without requiring any additional layers of glass on top of the LCD, optical touch (and IR) is able to provide the highest level of light transmission and optical clarity of all touch technologies. If every fraction of light transmission counts, optical might be a viable option. Generally, an unbreakable piece of glass is put in front of the LCD to protect it from damaging touches on the LCD surface.*
- ***Easily Scalable to Very Large Sizes -*** *Since optical works with cameras and is not constricted by layers of glass, the technology is easily scaled to very large displays (up to 120"), making it the best touch technology for digital signage.*
- ***Lowest Cost for Large Format***



How it Works

Optical touch makes use of optical sensors (usually two, but can be more) mounted in the bezel or on the surface of the glass and track the movement of objects close to the surface by detecting the interruption of infra-red light. The light is emitted in a plane across the surface of the screen and can be either active (infra-red LED) or passive (special reflective surfaces).

At the heart of the system is a printed circuit controller board that receives signals from the sensors. Its software then compensates for optical distortions and triangulates the position of the touching object.

MULTI-TOUCH ANALOG RESISTIVE

Advantages	Limitations
Multi-Touch (Up to 10 Input Points)	Not as Durable as Other Technologies
Low Power Consumption	Lower Transmittance & Optical Quality
Unaffected by Dirt, Water, Light & Most EMI Noise	Cost is Higher than Typical Resistive
Works with Finger, Glove & Any Pointing Device	Requires Large Connecting Tail
Easy to Integrate	

Multi-touch analog resistive, also called MARS, MAR or AMR, is the new way to achieve true multitouch for applications that need the ability to use any probe, glove, or non-body activation. This technology can be thought of as replacing one standard analog resistive touch surface with a multitude of tiny, finger-tip size, touch panels on a single touch surface. Each of these tiny touch panels will report analog output, so writing on the touch surface will result in the same high-resolution “ink” you would expect from a single touch analog resistive touch surface. Because this technology is a cross between a digital and analog sensor, the result is more accurate over time than a traditional analog resistive system which can suffer from “drift” in the touch coordinate. In addition, this technology allows you to solve the “palm rejection” problem by only looking at input from the area where writing is involved.

There are many applications that can benefit from a multi-touch pressure sensitive solution. For example, two pilots with flight gloves entering information on the same display at the same time. Traditional applications that use writing or typing as opposed to graphic user input (GUI) will benefit from this technology.

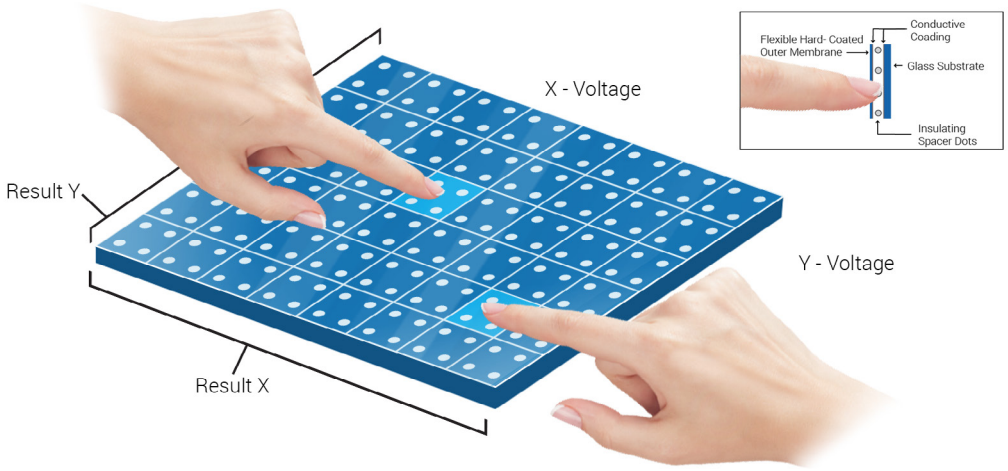
However, compared to projected capacitive, the display image is not as nice and the sensor will not have the same life expectancy.

Top 3 Reasons to Choose MARS

- ***Input Options -*** *The touch sensor can be activated by virtually any input device including bare fingers, gloved fingers, and any pointing device, including a stylus, scalpel or pencil.*
- ***High Resolution & Palm Rejection -*** *The technology's high-resolution screen and palm rejection allow for easy note-taking, making it ideal for tablet pc applications.*
- ***Multi-User Input -*** *With its multi-touch capabilities and flexible input options, MARS is an alternative to PCAP, and is ideal for multi-user input in industrial applications or even two-player bar top games.*

Other Reasons to Choose MARS

- *MARS is not affected by surface contaminants, making it a viable option for marine applications where water, dirt and other contaminants may be on the screen. Unlike some other technologies, MARS is not activated by water or other on-screen contaminants.*
- *Areas of the sensor can be deactivated to solve for the "palm rejection" problem.*
- *A "z" component, or pressure measurement, is possible. Some signature capture software requires pen pressure as a component of the recognition algorithm.*



How it Works

The construction of MARS is similar to that of regular resistive, and is essentially a 4-wire resistive sensor cut up into many small 4-wire touch screens. Unlike traditional resistive, however, MARS is made up of an X-Y grid which is scanned. The advantage of this technology is that it provides multitouch abilities, while still allowing for input from any pointing device because it is pressure sensitive.

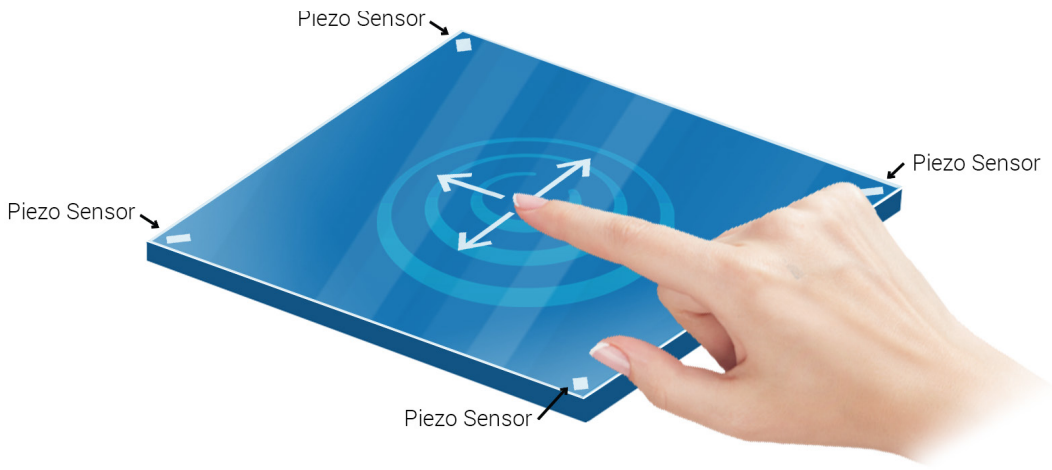
DISPERSIVE SIGNAL (DST OR BENDING WAVE)

Advantages	Limitations
Very Good Optics	No “Touch and Hold”
Good Durability	Not True Multi-Touch Capable
Simple Technology to Build	Touch Screen Mounting is Critical
Works with Finger, Stylus or Any Touch Object	3M is Only Supplier
Operates with Static Objects or Scratches on Surface	

Introduced by 3M a few years ago, dispersive signal technology (DST) is used in large format displays for digital signage. While overall performance is good, DST will stay in the shadows of optical and IR because it does not scale to sizes over 50 inches, is difficult to integrate and does not detect input if the finger or probe is not continuously moving.

Top Reasons to Choose DST

- *Large format*
- *Good optics*



How it Works

DST is a very simple technology to build and consists of plain glass with one transducer in each corner. When a touch occurs, mechanical energy (bending waves) is radiated out from the touch location and detected by the sensors.

IN-CELL/ON-CELL TOUCH

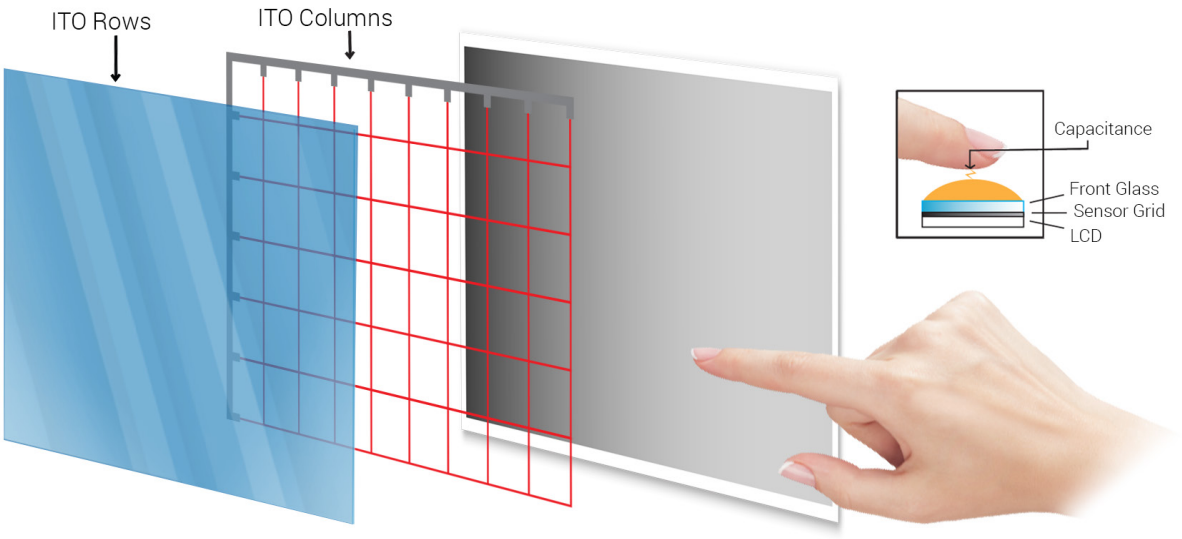
Advantages	Limitations
Very Accurate	High Power Consumption
No Drift and no Calibration Needed	Very Expensive
Unlimited Touch (Controller Dependent)	Low Durability
	Cover Glass not an Option
	Inflexible, Few Suppliers

Twenty-five years ago it was thought that spoken inputs would replace touch. Today, however, building touch into the LCD is thought to be the killer of touch screen companies.

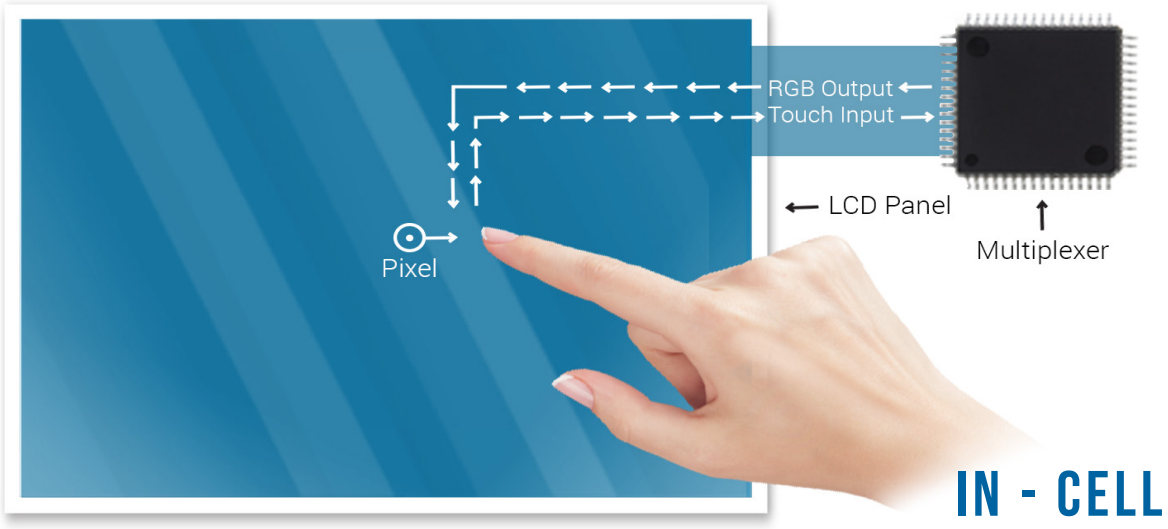
Although there are some on-cell LCD's which have been used in products, today, this is not a technology that you could choose. Samsung and Microsoft have jointly developed a new table size incell system and the new Apple TV is rumored to be incorporating this technology as well.

Top Reasons to Choose In-Cell/On-Cell

- *Elegant display of new technology*
- *Large formats available*
- *Up to 50 touch points*



ON - CELL



IN - CELL

How it Works

On-cell simply means that the transparent conductors used to make a separate projected capacitive touch panel are instead incorporated into the LCD layers, essentially adding a projected capacitive sensor to the layers of the LCD.

In-cell touch means that something in the LCD pixel is touch sensitive, usually photo-sensitive, though it could be self-capacitance type projected capacitive. This is done by scanning the pixels and reading the input back through the drive multiplexer. Thus, the multiplexer both changes (drives) the color pixel and then reads the touch input on the pixel (receives).

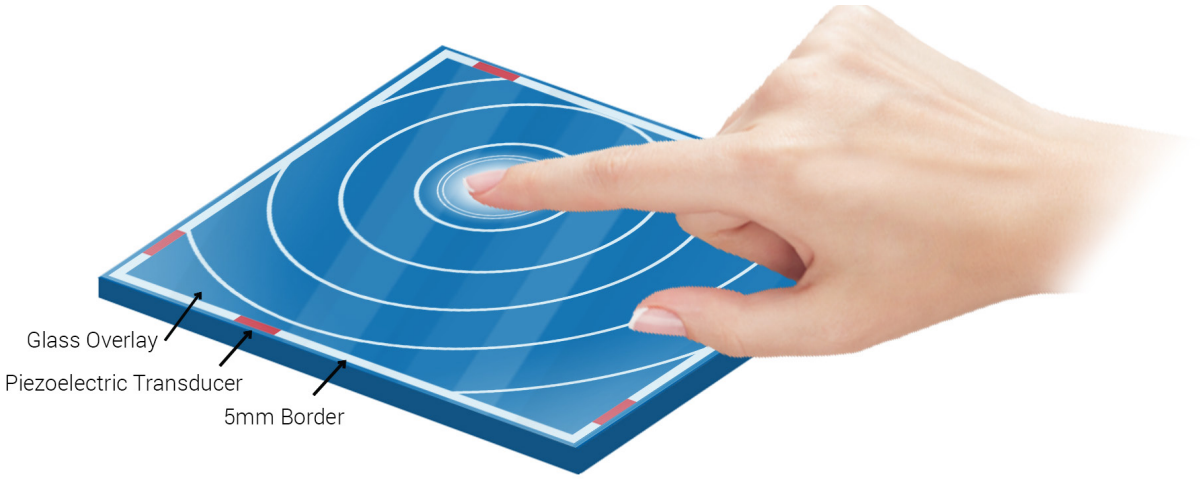
ACOUSTIC PULSE RECOGNITION (APR)

Advantages	Limitations
Simple Technology to Build	No “Touch and Hold”
Works with Finger, Stylus or Any Touch Object	Not True Multi-Touch Capable
Very Good Optics	Touch Screen Mounting is Critical
Good Durability	Elo is Only Supplier
Operates with Static Objects or Scratches on Surface	
Totally Flush Top Surface “Zero Bezel”	

Acoustic pulse recognition (APR) was introduced a few years ago by Tyco International’s Elo division. This technology is very similar to 3M’s DST technology and shares most of the same advantages and limitations. Unlike DST, APR comes in small sizes as well as large format.

Top 4 Reasons to Choose APR

- ***Performance -*** *The performance of APR is similar to SAW but at a lower price point and will likely replace SAW eventually.*
- ***Durability -*** *Boasts a scratch-resistant glass construction and will even continue to work if scratched.*
- ***Superior Optics -*** *Pure-glass constructions allows for a high image clarity, resolution and light transmission.*
- ***Pressure Sensitive***



Reference: *https://www.eeweb.com/profile/master-electronics/articles/acoustic-pulse-recognition-apr*

How it Works

Like DST, APR is a very simple technology to build and consists of plain glass with one transducer in each corner. When a touch occurs, mechanical energy (bending waves) is radiated out from the touch location and detected by the sensors. APR determines the exact touch coordinates by generating a unique sound for each position on the glass. Similar to DST, after the initial touch, a motionless finger cannot be detected. However, for the same reason, touch recognition is not disrupted by any resting objects, making it a good choice for palm rejection.

TOUCH TECHNOLOGIES NOT DESCRIBED

There are more than 1,200 patents for different types of touch technologies. The ones described here are the most common ones. There are a few others, including force sensing, banana bar, cyclops touch, fiber optic, water bottle, and GAW that have made appearances from time-to-time, but not had the staying power to compete with the more entrenched technologies.

SUMMARY

In 2012, the de facto standard of touch technology is projected capacitive; said differently, there must be something about your application that requires one of the other commercially available touch systems before you would choose it. With the exception of gesturing, it still can be said that 90% of all applications can successfully use any of the touch technologies, so there is probably no “wrong” system to use…. only a best one.

REFERENCE CHARTS

	Resistive	MAR	PCAP	SCAP	SAW	IR	Optical	DST	In/On Cell	APR
Power Consumption	Lowest	Low	Mid-Low	Middle	Mid-High	Highest	High	High	High	Middle
Preserve Image Quality	–	–	✓	✓	✓	✓	✓	✓	✓	✓
Cost	Lowest	Mid-Low	Middle	Low	Mid-High	High	High	Middle	High	Middle
Scratch Resistant	–	–	✓	–	–	✓	✓	✓	–	✓
Flexible	✓	✓	✓	–	–	–	–	–	–	–
Contoured (Curved Glass)	✓	✓	✓	✓	✓	–	–	–	–	–
Long Life	–	–	✓	–	–	✓	✓	✓	✓	✓

	Resistive	MAR	PCAP	SCAP	SAW	IR	Optical	DST	In/On Cell	APR
Pen Input	✓	✓	✓	–	–	✓	–	✓	–	✓
Single Touch	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Dual Touch	✓	✓	✓	–	✓	✓	✓	✓ Emerging	✓	✓ Emerging
Multi-Touch (3 or more)	–	✓	✓	–	–	✓ Emerging	✓ Emerging	–	✓	–
Proximity Sensing	✓ Emerging	–	✓	✓	–	–	–	–	–	–
Z-Component	✓	✓	✓	–	–	–	–	–	–	–

	Resistive	MAR	PCAP	SCAP	SAW	IR	Optical	DST	In/On Cell	APR
2" – 10"	✓	✓	✓	–	–	–	–	–	✓	✓
10" – 17"	✓	✓	✓	✓	✓	✓	–	–	✓	✓
17" – 32"	✓	–	✓	✓	✓	✓	✓	–	–	–
Large Format (32" & Up)	–	–	✓ Emerging	✓	✓	✓	✓	✓	–	✓

** Based on research done by Touch International, these categories represent the findings of our sales and engineering teams. We recognize that there may be variations within the technologies and the suppliers.