



Windows® Phone

The Windows Phone hardware

Session 1.1



Topics

- Windows Phone hardware examined
 - Processor and operating system
 - Graphical Display
 - Touch input
 - Location sensors
 - Camera
 - Memory
 - Network



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Processor and OS

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The Windows Phone Device

- The Windows Phone is a pretty powerful device
- Best regarded as a computer that can make phone calls
- Runs an operating system specially optimised for mobile devices



Windows Phone processor speed

- The Windows phone hardware standard requires that a Windows Phone device will have a processor “clock speed” of at least 1 GHz
- This means that something will go “tick” inside the phone 1,000,000,000 times a second
 - A tick lasts a nanosecond, the time it takes light to travel around 30 cm

Processors and Clocks

- Each time the clock in a Central Processor Unit (CPU) goes “tick” a particular low-level operation will be performed
 - Perform part of a hardware instruction
 - Load data from memory
 - Store data into memory
- The faster the clock ticks, the faster the processor is running

Clocks and speeds

- A Windows PC processor runs at 2-4 GHz, a
- A Windows Phone processors start at 1 GHz
 - This does not mean a phone is around half the speed of a desktop PC
- The clock speed is just one factor that determines computer speed
 - A bit like engine size in a car

Speed and processors

- Some processors need more “ticks” to perform the same action
 - Phones use “Reduced Instruction Set Computing” designs which reduce the amount they can do per clock tick
- The desktop PC may contain multiple processors
- The Windows Phone cannot run at full speed all the time as this would flatten the battery

Performance and programs

- When you write a Windows Phone application you have to worry about performance
 - There is not the spare processing power available to compensate for poor programming techniques
- Performance must be considered at all times
 - This will turn us into better programmers
 - The techniques we are going to learn will improve all the programs we write

Windows Phone Operating System

- Windows Phone 7 is not based on the Windows 7 operating system
 - The numbering is coincidental
- Windows Phone is actually based on Windows Compact Edition (Windows CE)
 - This is an operating system specially built for use in battery operated devices with low power processors

Operating Systems and Programs

- From the point of view of a programmer the operating system is becoming less important
- We are going to write Silverlight and XNA applications that make method calls to use the underlying system
- How that underlying system works does not affect the programs we write
 - They can run on any platform



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Windows Phone Graphical Display

- The Windows Phone has a high resolution display with at least 800x480 pixel resolution
- This makes a lot of work for the hardware
 - The higher the resolution of the display the more work needed to keep it up to date
- The display can be used in landscape and portrait mode
 - The phone will detect how it is being held and a program can change the display to match

Graphics Hardware Acceleration

- Desktop PCs have used graphical acceleration for a long time
 - The Graphical Processing Unit (GPU) draws the display and performs image processing on it
- GPUs are now appearing in mobile phones
- The Windows Phone contains a GPU
 - Used to render user Silverlight user interfaces
 - Also used to create 3D games in XNA



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Touch Input

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Touch Input

- Modern mobile devices are making increasing use of touch screens
- These are now provided in addition to a keyboard
- The Windows Phone user interface is entirely touch based, using a capacitive multi-touch input device

Resistive Touch Input Screens

- Early mobile devices used resistive touch screens
 - Touching the screen connects two plastic membranes to form a circuit
 - The resistance across this circuit is used to work out the location of the touch
- This technology is very precise (particularly if a stylus is used)
 - But it cannot easily detect more than one touch

Capacitive Touch Input

- Capacitive touch sensors detect the change in capacitance caused by touch event
 - There is no physical movement
 - The touch sensor can be printed on a glass screen
- The resolution of a capacitive screen is not as great as a resistive one
 - This is not a problem as the user will be touching with a finger, not a stylus
- A capacitive screen can track multiple touches

The Windows Phone touch screen

- The Windows Phone touch screen can track up to 4 simultaneous touches
- Each individual touch event is uniquely identified by the phone so your software can easily track it
- The phone software can also track “gestures” from the user

Touch and Gestures

- Gestures are particular movements made with one or more finger
 - Dragging an item on the screen
 - Pinching movements to zoom in and out
- The Windows Phone operating system has built in support for gesture input
 - A program can be sent a message when a user has performed a particular gesture



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Gadgets and Gizmos

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Location Support

- A Windows Phone contains a Global Positioning System (GPS) receiver
 - Works well when outdoors with a view of the sky
- The phone will also use other location information
 - Location of cellphone towers in use
 - Location of WiFi access point
- This “assisted” positioning makes it possible to determine position when inside buildings

Accelerometer

- The accelerometer can measure acceleration in three directions (X, Y and Z)
- This can be used to detect movement of the phone
- It can also be used to determine how the phone is being held
 - This orientation information can be used to control games by tipping the phone

Compass

- The compass can be used to determine the direction the phone is pointing
- This can be useful for orienting map displays and creating “augmented reality” applications
- The compass has a calibration behaviour which may be invoked automatically when it is used in an application

Gyroscope

- A gyroscope can be used to detect when the phone is twisted or moved in a particular axis
 - The gyroscope always points the same way, and can detect when the phone is moved in relation to this
- Programs can use this to detect how the phone is being twisted and moved
 - This can add extra precision to programs that re controlled by moving the phone around

Sensor Integration

- Having all these movement detection methods is great, but it might make a program very complex if it tries to use more than one of them
- The Windows Phone operating system provides a class called **Motion** that integrates the readings for us
- This will make best use of all the sensors available

Camera

- The camera has at least 5Megapixels
 - This makes for good quality pictures
- The pictures which are taken are stored within the phone and transferred to the Windows PC using the Zune software
- Programs can load these pictures, and other pictures from the media in the phone
 - Your programs can also initiate a photograph and capture a video stream from the camera



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Buttons and Keyboards

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Hardware Buttons

- All Windows Phones have a specific set of physical buttons
 - Start, Back, Lock, Search, Camera, Volume
- These will work in exactly the same way on every version of the phone
- Programs are required to use them in a particular way too

Start Button

- Starts a new program
- When the user presses Start they are always taken to the start menu to choose a program to run
- The application that was running when Start was pressed is paused
- This is part of the way that Windows Phone enforces the “one program at a time” rule

Back button

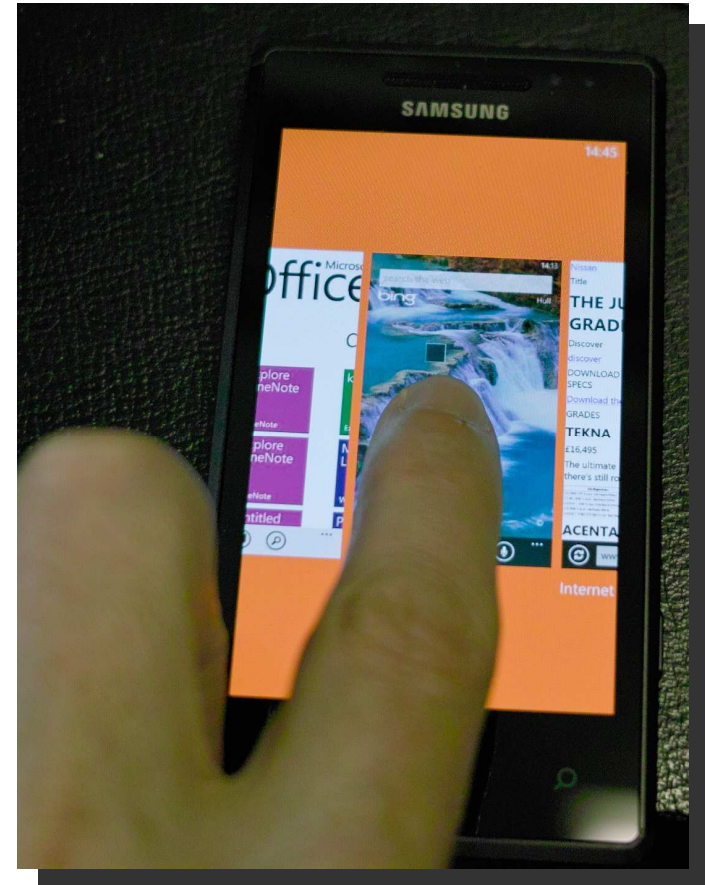
- This button has several uses
 - Within a particular program it moves you back to the previous menu
 - When at the top level menu of a program it is used to exit the program and return to the Start menu
 - At the Start menu the back button will return the user to the program they were running when they pressed Start to do something new
 - A “long press” displays the task switching screen

The Back button and the Phone UI

- Back is rather hard to explain
- But very easy for users to get to grips with
- It makes it easy to drop in and out of applications on the phone without having to keep finding them and restarting them
- For us developers it means that programs may be “woken up” from having been stopped

The Back Button “Long Press”

- If the back button is held down the “task switching” screen is displayed
- The user can pan between active applications and select the one they want



Other Buttons

- Lock Button
 - Stops the currently running program and locks the phone
- Search
 - Starts a search operation. Your program should respond to search appropriately
- Camera
 - Stop the current program to take a picture

Phone Keyboard

- Some Windows Phone devices will be fitted with hardware keyboards
- The system provides a “software” keyboard that uses the touch screen
- When we design our programs we need to make sure that they can be used with or without a physical keyboard



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Phone Memory

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Phone Memory

- There are two flavours of memory
- Main memory
 - This is where programs are loaded and executed
 - Fast memory chips connected directly to the processor
- Mass storage memory
 - This is where program, data and media are stored
 - Slower storage that holds its data when the power is turned off

Main Memory

- A Windows Phone will have at least 256Mbytes of main memory
 - A few years ago this was a huge amount, but these days it is not quite as impressive
 - It can soon get eaten up by programs that use a lot of graphics in their user interfaces
- In contrast a desktop PC will have around 8 times that memory space, with at least 2Gbytes of RAM

Mass Storage

- A Windows Phone will have at least 8Gbytes of mass storage
- In program terms this is a lot, but most of it will be used store media
 - A single music track is around 8 Mbytes
 - A high quality picture is around 2 Mbytes
 - An hour of good quality video is around 1Gbyte



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Connectivity

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Network

- Windows Phones have lots of connectivity options:
 - WiFi wireless network (high speed)
 - 3G phone network (high to media speed)
 - GPRS phone network (low speed)
 - Out of coverage (no speed)
- Software on a mobile device must deal with all these types of network



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Programming Considerations

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Programming Considerations

- A Windows Phone is an amazing device
 - But it is limited by size and battery power
- Users will expect a high quality experience
 - This will be based on their experience on much more powerful devices which are not mobile
- Our job as developers is to make the most of what the platform gives us
 - This gives us more to think about when we write our programs

The Good News

- Programming for a phone is fun!
- The range of features a device has, and the fact it is mobile makes it possible to invent completely new applications
- The development environment is really powerful and easy to use
- You get a lot of help from the system in creating great user interfaces

Review

- Windows Phone is a computer, but one working specifically in the mobile environment
- All Windows Phone devices are built to a particular standard with standard features
- Performance and storage is restricted and our program design must reflect this
- Network connectivity is variable on a phone
- Programming a phone is harder than a desktop, but still fun