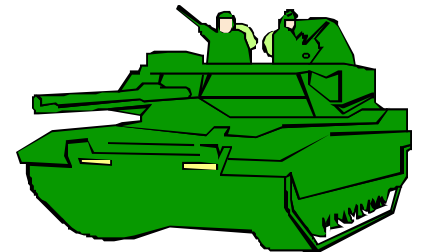
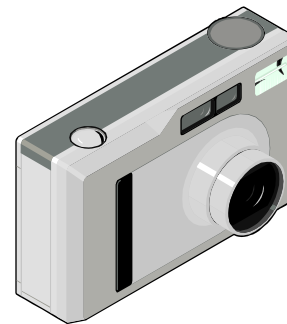
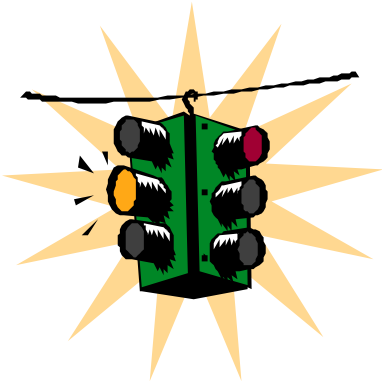
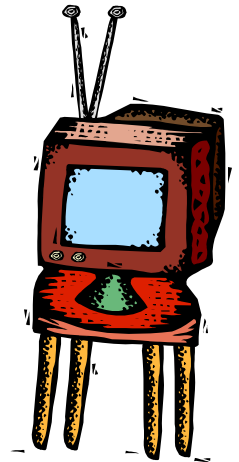




Embedded systems and Mobile devices

Embedded system definition: A computer that is not perceived as such



Real-time system - definitions

A definition: Real-time systems (RT-Systems)

are those computational systems that

- offer an assurance of timeliness of service provision

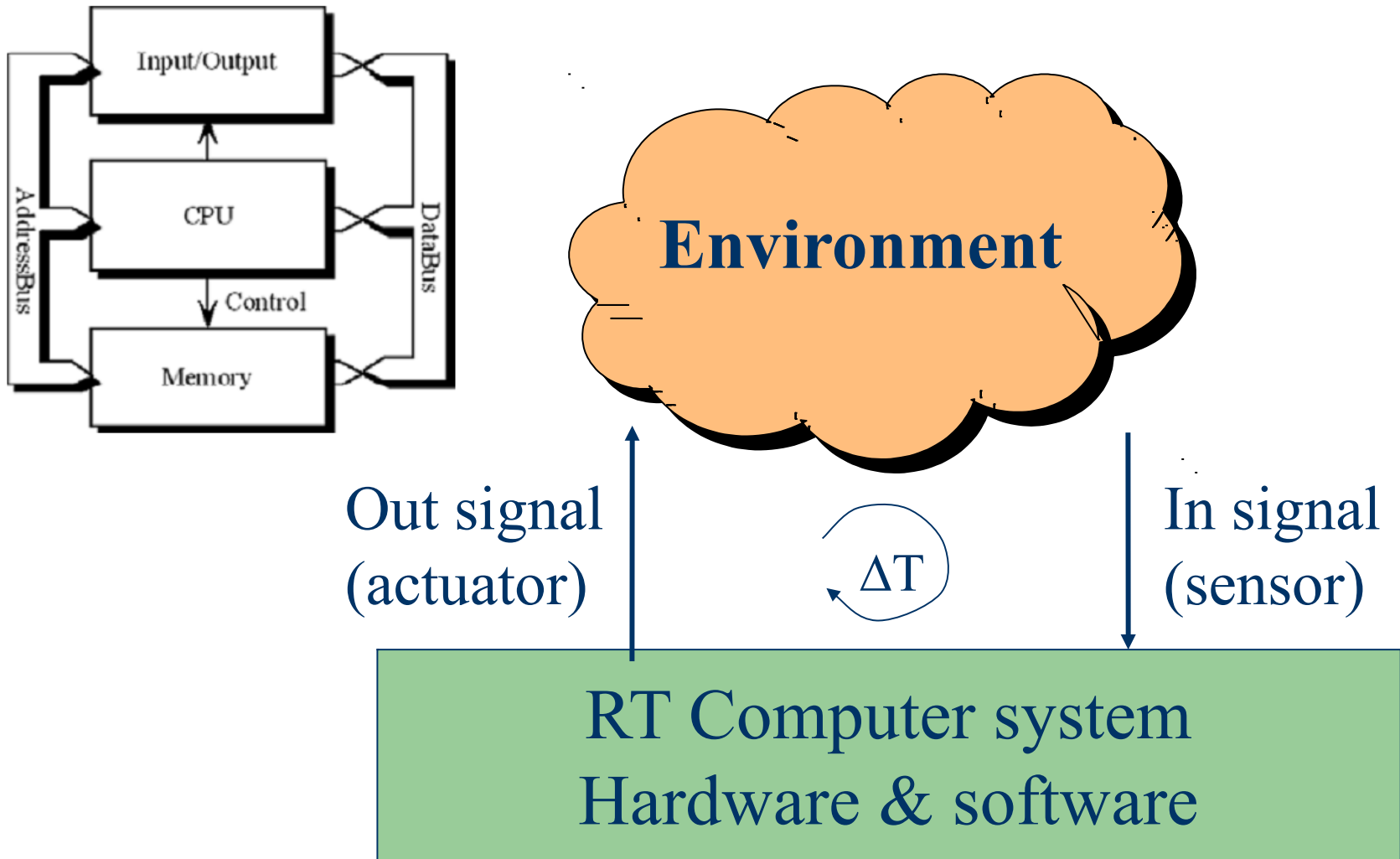
Another definition: RT-systems are those where the correctness of the system behaviour depends

- on the logical results of the computations, ***and also***
- on the physical time when these results are produced

Yet another definition: RT-systems are those that

- have to be designed according to the dynamics of a physical process

A simple real-time system



Further RT System Classifications

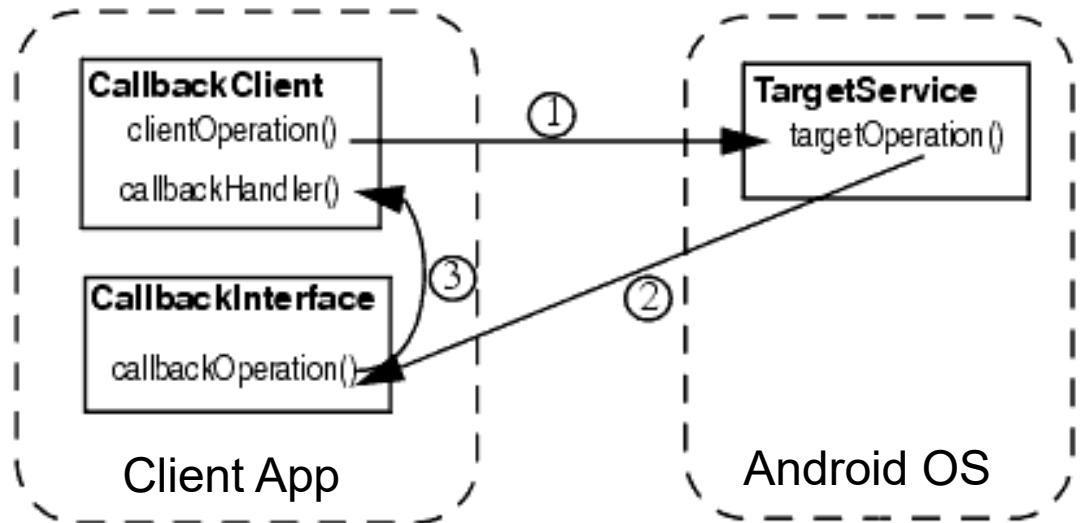
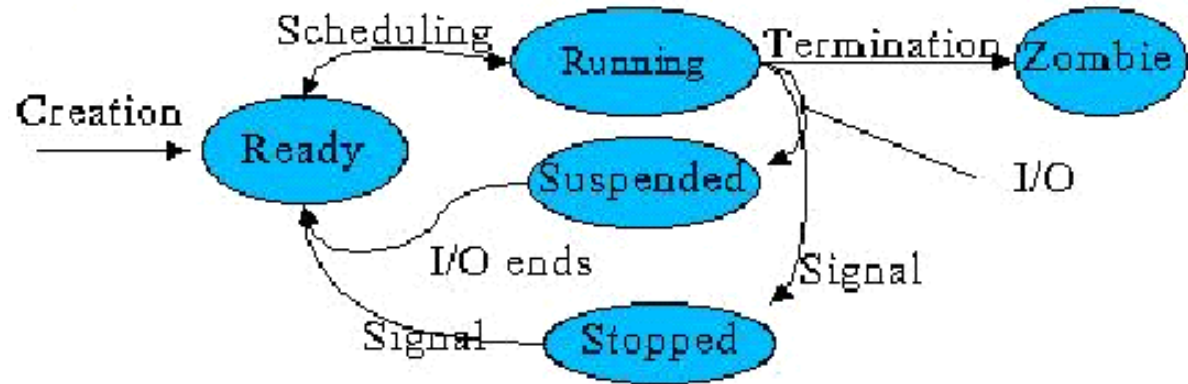
- ***Fail-Safe vs. Fail-Operational***
 - Error detection coverage critical
 - Often use watch dog, heart-beat signal
- ***Resource-Adequate vs. Resource-Inadequate***
- ***Event-Triggered vs. Time-Triggered***
 - Dynamic vs. static scheduling
 - Presence of global time base

Summary

- ***Real-Time Systems:***
 - Focus is predictability – not performance per second
 - Correct behaviour = correctness + timeliness of results
 - Must consider dynamics of physical process
- ***Real-Time Systems is usually used in Safety-critical systems***
 - Humans, environment or property can be damaged
 - Safety vs. Security
 - Two types
 - Safe state exists – if everything goes wrong, the system can transition to a safe state
 - Safe state is the working state – high availability
 - Safety critical software – **Dependable** (reliable and safe)

OS concepts

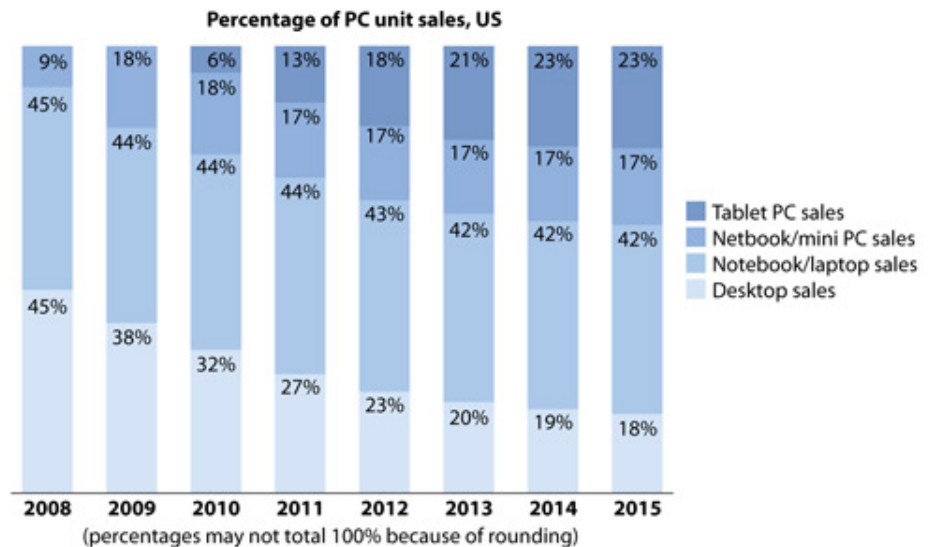
- Threads/tasks
- Priorities
- Scheduling
- IPC and signals
- Locks
 - Semaphores
 - Mutexes
- Callbacks
- Asynchronos
- Synchronos



Flight of the desktops – the future is mobile!

- Tablets are more or less a smart phone with a large screen
- x86 CPU:s are declining – portable needs energy efficiency!
- Systems as Motorola ATRIX and Asus Padfone etc.
- The laptop functions as the screen and keyboard or just a bigger screen for tablets

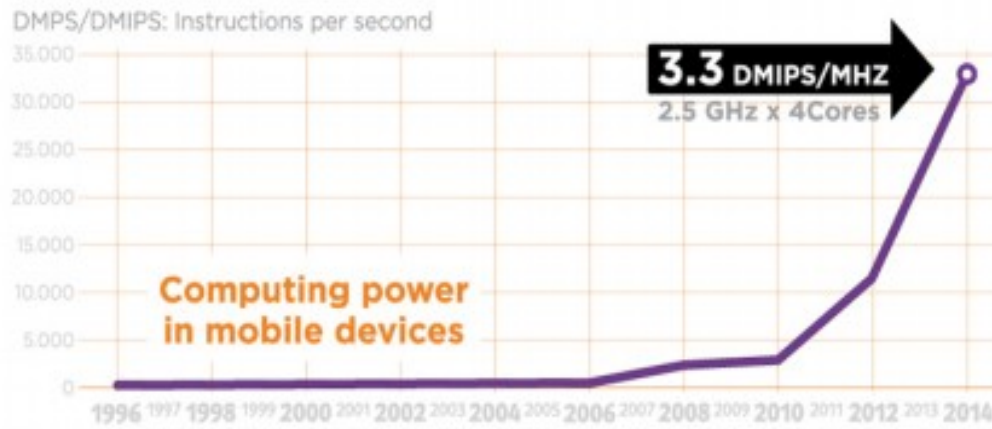
Forecast: Share Of US Consumer PC Sales By Form Factor, 2008 To 2015



Source: Forrester Research eReader Forecast, 2010 To 2015 (US)

Flight of the desktops – the future is mobile!

- Last 3-4 years not so much exiting stuff have happened
- Ultrabook spec. 2013, 10/15W - <http://en.wikipedia.org/wiki/Ultrabook>
- Year 2000 – 1 TeraFlop in computing power needed a super computer with 10 000 CPUs consuming 1 MW
- Year 2015 – 1 TeraFlop needed about 10 Watts



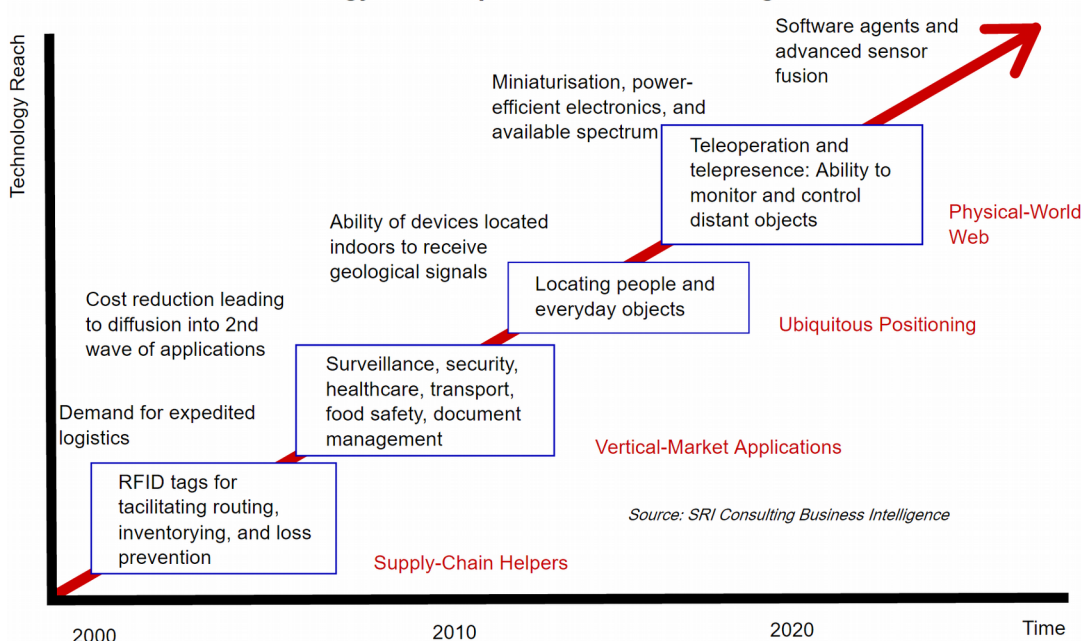
 First microprocessor in 1971 had a core speed under 10 MHz.



M2M the cloud, IoT and IoE

- Machine-to-machine refers to technologies that allow both wireless and wired systems to communicate with other devices of the same ability
- M2M uses sensors/actuators to capture an event which is relayed through a network to a software which translate it into meaningful information
- M2M birthed < IoT (Internet of Things) which birthed < IoE (Internet of Everything)
- https://en.wikipedia.org/wiki/Internet_of_things

Technology roadmap: The Internet of Things



Autonomous systems (robotics)

- We are just now benefitting from many technological increments in various segments that makes it possible to build very advanced embedded systems
 - Machine learning
 - Sensors for positioning and obstacle detection
 - Hardware have reached a level in performance and low cost which makes it mass market possible
- Example - self driving Uber taxi car is available now!



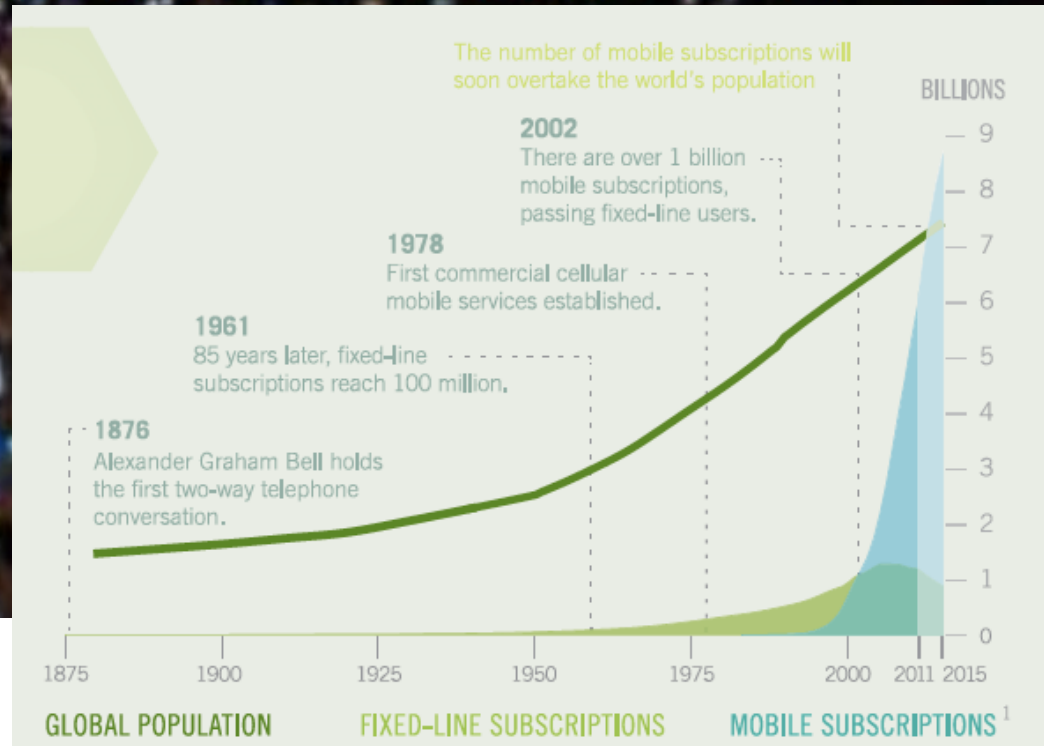
Honk If You Love Robots

The National Highway Traffic Safety Administration has defined five levels of autonomy based on how many car functions are computer-controlled

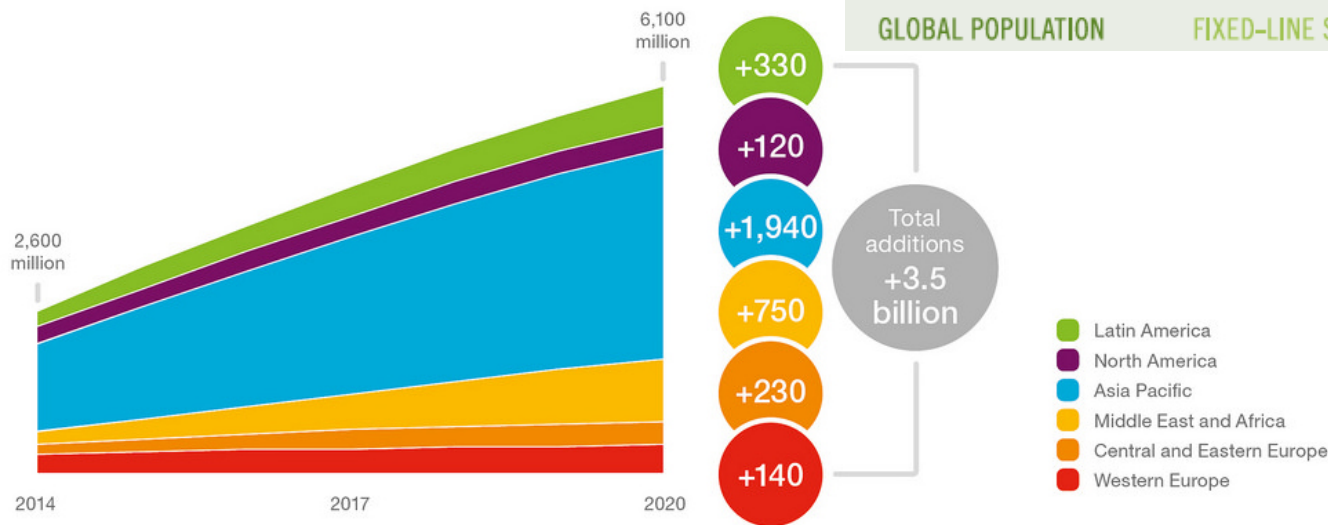
	Level 0 1972 Chevrolet Vega	Level 1 1998 Mercedes S500	Level 2 2016 Tesla Model S	Level 3 Uber, Google	Level 4 JohnnyCab from Total Recall
Driver	Life is a highway—the driver is in complete control of the car at all times	Driver can regain control or stop the car more quickly than when driving without the automated function or functions	Driver shares control as an intermittent operator; you'll want to take your hands off the wheel, but you shouldn't	Professionally trained operator for ride-hailing service cedes full control during certain conditions	Driver selects destination, doesn't control car functions
Vehicle	Automatic transmission optional	Automation of one or more specific control functions, such as assisted braking	Partial automation of at least two primary control functions working together (e.g., adaptive cruise control with lane centering) to relieve driver of the tasks	Steering, throttle, braking, and other critical functions are automated; the car can monitor changes in road conditions (e.g., construction) that might require the human to retake control	Fully automated; designed to perform all safety-critical functions and monitor road conditions for an entire trip; responsibility for safe operation rests solely with the vehicle

Globally by the end of 2010 there will be 5.1 billion mobile subscriptions

That represents about 2 mobile subscriptions for every 3 people in the world



Smartphone subscriptions per region 2014–2020



Worldwide Smartphone Sales to End Users by Vendor in 2Q16 (Thousands of Units)

Company	2Q16 Units	2Q16 Market Share (%)	2Q15 Units	2Q15 Market Share (%)
Samsung	76,743.5	22.3	72,072.5	21.8
Apple	44,395.0	12.9	48,085.5	14.6
Huawei	30,670.7	8.9	26,454.4	8.0
Oppo	18,489.6	5.4	8,073.8	2.4
Xiaomi	15,530.7	4.5	15,464.5	4.7
Others	158,530.3	46.0	160,162.1	48.5
Total	344,359.7	100.0	330,312.9	100.0

Source: www.gartner.com

Worldwide Smartphone Sales to End Users by Operating System in 2Q16 (Thousands of Units)

Operating System	2Q16 Units	2Q16 Market Share (%)	2Q15 Units	2Q15 Market Share (%)
Android	296,912.8	86.2	271,647.0	82.2
iOS	44,395.0	12.9	48,085.5	14.6
Windows	1,971.0	0.6	8,198.2	2.5
Blackberry	400.4	0.1	1,153.2	0.3
Others	680.6	0.2	1,229.0	0.4
Total	344,359.7	100.0	330,312.9	100.0

6 runner ups



Linux for Human Beings
ubuntu Phone

Install thousands of Apps and Games from the **Ubuntu Software Centre**.

Featuring the beautiful **Unity** interface.

Sync between your phone and desktop with **Ubuntu One**.

Swipe up or down to switch between homescreens

Regain **control** of your devices

The Power of **Open Source** within your hand

www.must1m.tumblr.com

The image shows a smartphone displaying the Ubuntu Phone interface. The screen is filled with various app icons like Firefox, Messages, Phone, Mail, Contacts, Music, Software Centre, Clock, Calendar, Camera, Calculator, Facebook, Videos, Spotify, YouTube, Gallery, Themes, Weather, To-do List, Dropbox, Voice Control, and Settings. The phone is shown from a slightly angled perspective, highlighting its white and orange design.

Challenges that developers may face 1

- Trade-off between distribution of users and features of your app due to...
 - Software fragmentation
 - Hardware fragmentation
- Security restrictions
 - User and manufacturer applied
- Multiple development language/environments
 - In this course we use the Java JDK, Android SDK and Android Studio IDE
 - Other than Java you can use C/C++ (NDK) or other various technologies as cross language compilation or hybrid web apps etc.
 - Kotlin is the latest official supported language addition, included as standard in AS 3.x
<https://developer.android.com/kotlin/index.html>



Challenges that developers may face 2

- Priority (dynamic) event driven OS
 - We got a “main thread” - the “UI thread”
- If we use the UI thread for intensive or longer background work in response to user interaction, performance will be poor (UI thread is blocked)
 - Users are prompted with an Application Not Responding (ANR) error
 - No response to an input event within 5 seconds
 - BroadcastReceiver hasn't finished executing within 10 seconds
- Solution is API supported asynchronous tasks or “background worker threads”
 - Networking, database operations
 - Heavy calculations, etc.
 - In short everything that do not modify the UI
- Follow two basic rules!
 - Do not block the UI thread
 - Do not access the UI toolkit from outside the UI thread

